haustion, whispers low or talks confusedly to himself or tosses restlessly on the bed with loud delirious ravings, or, if he is not prevented by the attendant or fastened to the bed, gets up and wanders restlessly about in a wild frenzy, and makes efforts to escape. With careful scrutiny it is possible to detect the local disease focus even in the first hours, and thus approach the correct diagnosis. A freshly swollen gland and a pustule on the skin are the indications of commencing inflammation of the lungs, and belong to the developed clinical picture of the plague, which can thus appear as gland plague, skin plague, or lung plague. Plague of the alimentary canal has hitherto been established only in animals. The gland plague or bubo usually appears in the inguinal region, but also frequently in the axilla and in the neck, especially with children. In a few cases it has been noted on the back of the head, on the elbow, the popliteal space, the anterior or posterior ear glands, the hyoid glands, etc. Frequently the superficial glands are only slightly inflamed; the disease process seems to have jumped them and affected the deeper glands, the second or third class glands, which develop into buboes. For instance, the femoral glands may be unaffected, while a large iliac or lumbar bubo may be palpated like an appendicular tumor through the abdominal wall; or a cervical gland may be only slightly swollen, while an area of dulness in the clavicular region and symptoms of compression in the cervical organs may reveal the formation of a bubo in the upper portion of the thoracic cavity. The separate enlarged glands can be distinctly palpated in the bubo, or the inflammation of the interstitial tissue may have bound them into a thick bunch which can only be vaguely distinguished from the surrounding tissues, and is frequently surrounded by doughy œdema extending far around and involving the skin. The sensibility of the bubo to pressure is usually much more than the spontaneous pain, so that the patient, by favoring the bubo by the position of the limb, experiences no pain. A small bubo is frequently not even noticed by the patient and his attendants, so that every gland that can be reached should be carefully and repeatedly investigated by the physician. Plague pustule and carbuncle are rare in comparison to the bubo. They begin with a small spot like a flea's bite anywhere on the body. The spot smarts sharply and soon develops into a larger or smaller blister with a cloudy fluid. The pustule either stops at this stage, or the subjacent tissues harden and soon become transformed into a deep carbuncle, progressing to a gangrenous ulcer. Inflamed lymph vessels frequently lead from the pustule to the nearest cluster of glands, and a bubo may then develop in them. A bubo may also develop in the vicinity of a carbuncle. Buboes, pustules, and pneumonia may appear from the first, at the commencement of the disease, sometimes before the fever, or they may become evident a few hours or days afterward, seldom later than the third day. In all forms of the plague the early weakness of the heart is noticeable. In all, symptoms of irritation in the alimentary canal are evident at first, with sensitiveness to pressure in the upper abdomen and cæcal region, violent vomiting, later also the passage of black fæcal masses. With considerable regularity there have also been observed a slight degree of tympanites; a soft, palpable, or percussionable swelling of the spleen, and traces of nucleo-albumin and serum-albumin in the urine. Vomiting of blood or blood in the urine is rarer. A diphtheritic affection of the tonsils is frequently noted early. There is almost constantly more or less conjunctivitis, which is frequently and rapidly complicated with keratitis and may lead to the complete suppuration of the eye. Punctated or striped hemorrhages in the skin and mucous membranes have been noted with varying frequency in different epidemics. In the course of the disease the lymph vessels beneath the buboes may become involved in the inflammation, and new buboes may develop elsewhere in the body.

Mortality and Prognosis.—There is no other epidemic disease which owns a mortality rate so high as this. It has been already intimated that the virulence and prognosis of the plague are influenced by social and especially sanitary conditions in the community visited, and are also affected by the season of the year. As in other infectious diseases, cases exceptionally occur of very mild form, and in which the incubation stage may be unduly prolonged, these cases being important factors in disseminating the epidemic, although scarcely sick themselves. Others occur which are overwhelmed with the poison and die in a few hours. The mortality of the recent epidemic in China has been stated to be as high as 98 per cent.; that in India is 75 per cent. among natives; among Europeans it is said by Arnold to have never exceeded 60 per cent., and is usually much less. The Marine Hospital Service's issue for December 22d of its Public Health Reports gives some startling figures of the mortality of the present outbreak up to August 11th, 1899; namely, to mention only a few, that there had been in the Belgaum district 29,300 cases, with 22,042 deaths; in the Dharwar district 38,754 cases, with 31,307 deaths; and in the Nassik district 20,162 cases, with 15,480 deaths. The septicæmic and pneumonic forms are most fatal. If the necrotic material in the buboes makes its way through the overlying tissues and skin and evacuates itself, the patient's chances of recovery are generally admitted to be improved. If, on the other hand, the material in the buboes becomes diffused into the tissues, and is not evacuated, death from septicæmia quickly follows. The prognosis is greatly improved if modern sanitary and therapeutic measures are available and are early instituted.

Diagnosis.—The clinical features which distinguish the plague have just been considered. Although typical, fully developed cases could scarcely escape recognition, it is important for the protection of the community that the diagnosis should be made at the earliest possible moment. Suspicion of impending danger may be aroused by the occurrence of a great mortality among rats and mice; it has been observed that rats sometimes leave a locality in great numbers before the plague manifests itself in man. There may also be unusual mortality among domestic animals. A bacteriologic examination of these animals might thus give early information of the presence of the plague bacillus and anticipate the outbreak in man. In the human subject errors may be made in the milder cases of the bubonic form and in the pulmonic and septicæmic forms, but a bacteriologic examination properly carried out will clear up the diagnosis. The method pursued by Harris and Arnold is, in the bubonic form, to open a gland involved, under due antiseptic precautions, and plant some of the contents on any ordinary culture medium. Cover-slip preparations are also at once made, stained, and subjected to microscopic examination. In most cases, the latter procedure will at once determine the true nature of the case, as in addition to the morphologic characters of the bacilli their very number serves to distinguish them, for in no other disease are so many bacteria present. In the septicæmic form the blood should be examined in the same manner, and, if the bacilli are not found in the cover-slip preparations, they will develop in the culture. An examination of the sputum in plague pneumonia is at once sufficient to place the diagnosis beyond all doubt, as this material always contains the bacilli in great numbers—oftentimes in pure culture.

Morbid Anatomy and Histology. — Post-mortem rigidity and lividity appear early. The temperature often increases after death (108° F. in some instances). Petechiæ usually, and carbuncles occasionally, are observed. In about half the cases, the *lymph nodes* of the groin first show the disease: in the remaining half, the axilla is affected in about fifty per cent. The superficial nodes appear to be first affected, but the disease quickly extends to the entire chain of glands to which the one first affected belongs. All the other lymph nodes of the body may be invaded, but especially those of the mouth, throat, intestines, and mesentery. The tissues around the nodes are softer and may show hemorrhagic foci. The nodes, or lymph glands, are very much increased in size. On section, the node substance is quite firm if the process is recent, or the contents may be semi-fluid and mucilaginous, the material resembling lard. The cut surfaces often present a grayish, red color, with darker areas of hemorrhage, or the entire contents are of a dark red color. Other glands in distant portions of the body are enlarged, but do not present any hemorrhagic foci, except in cases of relapse. Around the nodes the tissues are swollen, the blood-vessels are engorged and contain pest bacilli; these are not found, however, in the tissues or lymphatics, although the latter are distended with lymphoid cells. Unless the necrotic process extends through the capsule, the tissues show no other change. Harris and Arnold found that in those instances in which the node has just been attacked, or in which the disease is of a mild character, there is evident increase in the number of cells within them, the vessels are dilated, and the lymphatic channels contain many bacilli. In advanced cases, no differentiation is possible; all the gland contents now consist of a finely granular material, which is colored pink when stained by hæmatin and eosin, or by the method of Van Gieson. Intermingled with this granular material there are quite a number of cells and some cellular débris. If the section be stained by the toluidin blue and glycerin-ether method, or by toluidin blue followed by eosin, this granular material is found to consist of countless myriads of pest bacilli, they constituting, in many instances, more than one-half of the entire contents of the node. The same authors insist upon the importance of the presence of mast cells, as they have never seen them in any other lesions of the lymph nodes. It is suggested that their function is to elaborate an antitoxin, as they never appear to be phagocytic, like the hyaline cells, but it was observed that around many of the mast cells there is a zone in which no bacilli are seen. There are also a few plasma cells and a few polymorphonuclear leucocytes. When the gland softens and breaks down, it is due to a process analogous to cheesy degeneration of tubercles; therefore it is obviously wrong to speak of the process as a primarily suppurative one. If, however, any of the organisms of suppuration subsequently reach the diseased area, or a mixed infection occurs, a true suppuration will ensue. Lymph nodes, in parts of the body at a distance from the original foci of the disease, show only macroscopic swelling and a somewhat darker color than is normal. On microscopic examination, the cells of which the nodes are composed are found to be apparently somewhat increased and the blood-vessels dilated. In severer cases, and in relapses, these vessels usually contain bacilli, but they are not found in the gland substance ordinarily.

Lungs.—The plague causes broncho-pneumonia, but more of the lung tissue is involved than is commonly the case in the ordinary forms of this disease. There is occasionally observed a fibrinous pleuritis with the pneumonia.

Spleen.—The spleen is large, dark colored, and soft. There are numerous hemorrhagic areas in its substance. Its vessels are greatly dilated. Many of the cells show degenerative changes. This organ always contains the bacilli, often in great numbers.

The *Kidneys* may be either somewhat enlarged or normal in size. There is hyperæmia, with areas of hemorrhage; especially between the Malpighian pyramids. The capsule is easily removed and the cortex is thickened and quite friable. The cortical cells are granular and many have degenerated and lost their nuclei. Hyaline substance resembling that found in the normal thyroid tubules is found in the uriniferous tubules. Areas of hemorrhage are occasionally seen between the collecting tubules, but there is no evidence of nephritis. In all the blood-vessels (which are enormously dilated), both in the Malpighian bodies and elsewhere, are found numerous pest bacilli.

The *Liver* is somewhat darker in color than normal, owing to hyperæmia and dilatation of capillaries. The liver cells show signs of degeneration and are irregular in form and swollen, with disappearance of the nuclei in many.

Intestines and Stomach show hemorrhagic foci and the lymph nodes are enlarged.

The *Brain and its membranes* are congested, and, rarely, fibrinous meningitis, or meningo-encephalitis, is met with. This condition of the brain is more often found in cases of the fulminant form in which death occurs within a few hours after inoculation.

The *hemorrhages* found in the various organs, according to the same authorities, are not caused by the mere presence of the bacilli, but they are the effects of a poison or poisons produced by bacilli. The instance is given, which was reported by the German Pest Commission, of a woman suffering with the pest who gave birth to a dead child, and although its body was entirely free of the bacilli, the hemorrhages were very numerous in its organs. The leucocytosis, which is so constant in the plague, may be frequently made out by sections of the tissues—the white cells being evidently increased in the blood that is present in the blood-vessels. A mixed infection frequently occurs: streptococci, diplococci, and different varieties of staphylococci may be found in various lesions or structures; generally, however, they appear late, or in the agonal period, and in such cases do not influence the result to any material extent. It is probable, however, that when recovery takes place they are active in causing eruptive diseases of the skin and prolonged suppurations of glands and carbuncles. Paralyses of certain muscles result from the occurrence of hemorrhages into the meninges and spinal cord.

Treatment.—At the present day attention is particularly concentrated upon the use of Haffkine's prophylactic and Yersin's anti-pest serums. The best recent authorities appear to be agreed as to the great value of these agents. It is understood that, as Wyman insists, it is necessary to draw a sharply defined line between the serum therapy and serum prophylaxis of a disease. In the case of plague the difference is not merely one of degree but of kind. The serum which may be successful in protecting against the plague may be powerless to cure it when once the disease has manifested itself. For the cure of plague, according to Wyman, there is at present but one accredited remedy, viz.: the curative or antitoxic "anti-pest" serum of Yersin and Roux.

The preparation of the Yersin serum is, in brief, as follows: Horses are treated with progressively increasing doses of the toxins of plague, prepared by subjecting virulent bouillon cultures of the B. pestis to a degree of heat which insures their sterilization. These injections at first have a very profound effect upon the horse, but in time a certain immunity is conferred, and his blood serum is found to have a very decided effect in preventing the infection of animals when these are subjected to inoculations of cultures of the organism after the usual laboratory methods. Usually the process does not stop here, but is carried on to the production of true anti-pest serum, preventive and curative, whose further preparation is as follows: When reaction to the increasing doses of toxin has practically ceased, toxins of the same nature are administered intraperitoneally and intravenously, and these are supplemented by the intravenous injection of toxins prepared with a special view to rendering soluble the toxin which is enveloped in the dead bacterial body. If necessary, this is supplemented by the intravenous injection of live bouillon cultures, and bleedings are practised and experiments made with the serum both against living, virulent cultures and against the precipitated toxins of the organism. When the serum has reached a point of strength when a dose of $\frac{1}{10}$ c.c. will protect a mouse of 25 gm. weight against living cultures and a three times mortal dose of toxin, the serum is considered to have acquired full antitoxic power, and is not only protective or prophylactic, but also antitoxic or curative.

A French commission, after an investigation made upon mice, monkeys, and human beings, during the epidemic in Oporto, reported that the value of the anti-pest serum is incontestable. In cases treated with it the mortality was only fourteen per cent., while in those not so treated it was at least seventy per cent. These cases were of the pneumonic form. When exposure to the plague infection continues, it is recommended by Roux

that these inoculations should be repeated every thirty-five to forty days, but the reports of Simond show that they should be practised more frequently, viz., every fourteen or twenty-one days. It should always be borne in mind that these inoculations do not in any way take the place of general hygienic measures. The technique is thus given by Wyman:

General Technique.—The injection should be administered in the subcutaneous connective tissue of the flank, the abdomen, or the back, and should be practised under the usual antiseptic precautions. The region where the remedy is to be injected should be washed with a solution of carbolic acid (five per cent.) or solution of mercuric chloride (1 to 1,000). A large antitoxin syringe should, if possible, be employed, and before use it should be nearly filled with cold water and then submerged in water which should be brought to a full boil and maintained at that temperature for fifteen minutes. Having been emptied, it should be allowed to cool before being filled with the serum, as heat has an injurious action on the remedy, and the syringe may be clogged by the coagulation of albumen. In the absence of an antitoxin syringe, an ordinary hypodermic syringe may be employed in its stead, care being taken as to the sterilization as above, and, the syringe having been filled and emptied, the remainder of the dose determined upon may be administered without removing the needle by detaching the syringe and filling its barrel the requisite number of times, the syringe being screwed or otherwise joined to the needle *in situ*. This obviates the necessity for multiple punctures, always disagreeable, and is an important point in the treatment of children.

(*a*) *Administration for Prophylactic Purposes.*—When a case of plague manifests itself in a house or on board ship, 10 c.c. of the serum may be administered to all persons exposed to the contagion. The injection is not accompanied by any inconvenient or disagreeable after-effects. It should be repeated in ten days in order to prolong the immunity, and in a badly infected locality the injections should be repeated several times.

(*b*) *Administration for Curative Purposes.*—The curative action of the serum is the more efficient the earlier in the disease the injection is practised. Large doses should be administered, 30 to 50 c.c., rather than smaller doses successively administered. Under the influence of the serum the fever decreases and the swelling of the glands (the buboes) rapidly diminishes. If this amelioration is not produced promptly, a second and even a third dose should be administered until the fever and the general and local symptoms disappear. This is important, for so long as the bubo remains, especially if suppuration supervenes, the patient is liable to secondary infections.

The Haffkine prophylactic is intended solely for prophylactic purposes, and is not to be used after a person has already been exposed to the infection. Under antiseptic measures, the dose of 1 c.c. is administered hypodermically, and, when the constitutional reaction has subsided, the dose may be repeated. A slight fever for two days with temporary enlargement of neighboring glands is observed following the inoculation. The immunity does not continue long over thirty days and inoculations may be repeated.

The inoculations made by Haffkine in Bombay were quite successful. In the first experiment 8,142 persons were inoculated. Of these only 18 subsequently contracted the disease and 2 died. Among 4,926 persons inoculated a single time at Dharwar 45 were subsequently attacked and 15 died, while among 3,387 persons in whom a second inoculation was made only 2 were attacked. At the same period, the rate of mortality among those who held back from the inoculation rose to an unparalleled height, the deaths being 657 to 1,000 per week. The results elsewhere were equally good. The following table is excerpted from Surgeon-Captain Leumann's report. The conclusions to be drawn from it are self-evident.

Dates.	Census of Hubli.	Number of non-inoculated inhabitants.	Number of inoculated inhabitants.	Plague deaths among the non-inoculated.	Plague deaths among the inoculated.
Five weeks, from May 11th to June 14th, 1898	Fell from 50,000–47,427	44,573	2,854	47	1
Week ending (1898):					
June 21st	47,082	41,494	5,588	22	3
June 28th	47,485	39,042	8,443	29	1
July 5th	46,537	36,020	10,517	55	6
July 12th	46,518	33,255	13,263	34	6
July 19th	45,240	29,716	15,524	82	7
July 26th	43,809	24,112	19,697	100	15
August 2d	43,707	21,031	22,676	140	16
August 9th	42,768	15,584	27,184	272	19
August 16th	40,441	10,685	29,756	386	61
August 23d	39,400	6,367	33,033	371	41
August 30th	38,210	4,094	34,116	328	28
September 6th	38,382	2,731	35,469	227	34
September 13th	38,408	1,116	37,292	138	47
September 20th	39,142	937	38,205	106	55
September 27th	39,315	603	38,712	58	20

The government of India is now making a prophylactic from a vegetable culture medium which appears to be equally successful. The *Lancet's* Calcutta correspondent wrote (January 27th, 1900):

"In order to meet the religious scruples of a large section of the natives, experiments have for some time past been conducted in order to ascertain whether or not the plague prophylactic obtained by growing the bacilli of plague in a medium manufactured from wheat was as effective as that made in the ordinary manner from meat. For rabbits at least, the wheat-peptone vaccine is as effective as that prepared from meat peptone. Only one experiment has been made, but there is no reason to suppose that human beings will react differently. It is suggested that publicity be given to this experiment, so that those communities which have religious scruples against the use of vaccine prepared from goats' flesh may be made aware that they can now be protected by the use of the wheat-peptone prophylactic. The new material is ready for distribution."

In some experiments made to determine the efficacy of the different constituents of Haffkine's prophylactic, C. Balfour Stewart found that the sediment contains bactericidal properties, and that the filtrate alone is capable of conferring immunity or of modifying the attack.

Prevention of Epidemics.—The observations of sanitary authorities all over the world agree in one respect, and that is that the plague is a thoroughly preventable disease under conditions imposed by modern medical science, and that if these precautions can be freely carried out an epidemic will be impossible. As recommended by Roux, the attention of the sanitary authorities is devoted at the outset to the lower animals, the entire destruction of rats and mice being advised, and the cremation of their bodies. It is suggested that since the discharges from the nasal chambers of infected rats contain the plague bacilli in nearly pure culture, this may be one method of the extension of the disease. Since dogs and cats eat rats and mice, the propriety or necessity of quarantining or destroying these also must be considered. In the human subject, besides attention to ordinary hygiene, the use of Haffkine's prophylactic on a large scale is advised.

Lord Curzon, the Viceroy of India, recently before starting for a thorough inspection of the sanitary arrangements of the infected districts, took the precaution of having himself and entire party inoculated with the prophylactic serum. "A measure," he said, "which changes the death rate of from 70 to 80 per cent. into one of from 15 to 20, even in those who are attacked after submitting to it, to say nothing of the large proportion who are completely protected by it, is one which no sensible man can afford to neglect."

The value of the anti-plague inoculation has just been investigated by a government commission in India,

which has carefully reviewed the entire subject and has reported that under the safeguards and conditions of accurate standardization and sterilization of the vaccine, together with the precaution of sterilizing the syringe in each case, the inoculations should be encouraged wherever possible and in particular among disinfecting staffs and the attendants of plague hospitals.* Lustig and Galeotti have used a nucleo-proteid as an immunizing substance, which they claim has marked advantages over Haffkine's prophylactic serum. Its efficacy has been proved by experiments upon animals. It is innocuous as regards man, being free from the toxic substances found in all cultural liquids used in their entirety. They make the specific charge against Haffkine's liquid that it easily becomes contaminated and there is no guaranty of the sterility of each separate bottle.†

Experience has shown that the doses laid down in the instructions for the use of the plague prophylactic by M. Haffkine require revision. This fact has been taken account of by the sanitary authorities in India, and an official order has been made in relation thereto. *The Lancet's* special correspondent says (February 3d, 1900, p. 345): "It has been found that children are less affected by inoculation than adults and can be given proportionately larger doses. Accordingly new rules have been promulgated and official instructions for the use of the plague prophylactic have been sent out. Considerable improvement has been effected in the matter of packing and fitting up the bottles. At one time this appears to have been carried out very insecurely and many bottles of the fluid were found to have undergone decomposition. The following dosage is now ordered:

	If the Dose Marked on the Bottle is—	
	2.5 c.c. then give—	5.0 c.c. then give—
Below 2 years	0.5 c.c.	1 c.c.
From 2–5 years	1 "	2 "
" 6–11 "	1.5 "	3 "
" 12–15 "	2 "	4 "
" 16–50 "	2.5 "	5 "

It is thought that persons over fifty years of age should get 0.25 c.c. less for each decade above that age.

"The official instructions contain the following paragraph indicating the usual symptoms of plague inoculation: 'The symptoms commence, as a rule, three to five hours after inoculation and consist chiefly of swelling and pain at the seat of inoculation and of a rise of temperature. The pain is felt particularly on movement of the part. The fever is accompanied by general discomfort usual to this condition. No treatment of the symptoms is required beyond applying ice for the relief of headache, if any is felt, and enjoining some rest. General symptoms subside after twenty-four to thirty-six hours; the pain at the seat of inoculation lasts for three or four days, disappearing gradually; a painless induration remains for some time longer. It is desirable to produce a rise of temperature to at least 102° F. If the reaction is less marked the operation may be repeated three or four days later with the same or an increased dose, according to the result of the first inoculation. There is no harm in leaving a longer interval between the two inoculations. No changes in diet or occupation are necessary, beyond if possible insuring some rest. Bathing in the open air should be avoided for some days. A simple purgative may be given twenty-four hours after the inoculation.'"

Both the anti-pest serum of Yersin and Roux and the Haffkine prophylactic are now prepared in the hygienic laboratory of the United States Marine Hospital service at Washington, D. C.

In India investigations have also been made in the treatment of plague with the poison of the cobra, administered hypodermically, and diluted with glycerin. A dose of 1 mgm. was given, afterward increased to 2 mgm. Experiments upon monkeys were said to have given good results. Deane reports a mortality of 54 per cent. in 500 cases treated in this manner as compared with the average mortality of 70 to 80 per cent. (*Lancet*, July 8th, 1899, p. 121).

Turning now to the materia medica, the drugs to which we naturally look for assistance in treating such a typically infectious disease are the antiseptic and bactericidal agents. In fact J. M. Alkinson reported (in the *Lancet*, December 9th, 1899) a case of bubonic plague treated with large doses of carbolic acid with the recovery of the patient. Dr. Alkinson was induced to use carbolic acid in plague by the successful employment of large doses in the treatment of influenza and tetanus. The patient, a man of thirty-eight years, was admitted to the Government Civil Hospital, Hong-Kong, June 9th, 1899. Three days previously he had been exposed to contagion and the fever appeared two days later, or the evening before admission. After a preliminary calomel purge, gr. iij. (0.2 gm.) of carbolic acid were given every few hours, but this not being sufficient he was given a mixture of pure carbolic acid gr. xij. (0.75 gm.), syrup of ginger ʒ i. (or 4 c.c.), and chloroform water ℥ vi. (180 c.c.). Of this one ounce (30 c.c.) was given four times the same evening. On the following day the headache was much better, there was no evidence of toxic action, the urine was not blackened by the acid. A bubo was now found in the groin. The medicine was continued every two hours during the day. The patient's pulse and temperature had fallen on the 13th to 72 and 99.8° respectively. On the 15th the dose was reduced to gr. ij. (0.13 gm.) twice daily, and on the appearance of urinary symptoms was finally discontinued June 26th. During the acute stage, six ounces of brandy were given in twenty-four hours and the diet was liquid. The patient in three days, from June 10th to 12th, took over two hundred grains (13.33 gm.) with the result of lowering temperature, allaying vomiting, and relieving nervous symptoms.

There are other antiseptics less toxic than phenol to the human system, which can be given in larger doses, such as creosote, creosotal, guaiacol (and its benzoate or carbonate), betanaphtol, iodoform, resorcin, sodium hyposulphite, etc. The affected glands may be painted with pure guaiacol, or anointed with iodoform ointment or iodol dissolved in oil (gr. xx. to cod-liver oil, ʒ i.). If the glands are accessible, they may be extirpated or destroyed with the galvano-cautery.*

The imperative necessity of scrupulous antisepsis should be impressed upon the patient and all his attendants; the sputum, the œdema fluids, the urine, and all other discharges should be promptly mixed with chloride of lime solution, and, with all dressings, clothing, etc., destroyed by fire with the least possible handling or delay.

In order to guard a community against the introduction of an epidemic it was well said by Prof. Max von Pettenkofer that three things are essential to success. 1. A rigidly enforced quarantine to exclude the *fomites* or *materies morbi*. 2. By means of improved hygiene, personal cleanliness, diet, and other precautions, the individual should so far as possible be rendered immune from or less liable to the infection. 3. The locality should be purified from sewage and all filth that may form disease-

* Brit. Med. Journ., February 24th, 1900, p. 461.
† Brit. Med. Journ., No. 2041, p. 311.

* "Encouraging results have followed surgical treatment in cases of bubonic plague. In a report to the Surgeon-General of the Marine Hospital service, Acting Assistant Surgeon W. Havelburg states that the clinical registry of the Panlo Candido Hospital, Rio Janeiro, Brazil, during the period from June 1st to August 31st, 1900, shows that there were 221 plague patients treated by extirpation of the infected glands, of whom 45 died, giving a death rate of about 20.8 per cent. And of 143 patients with solitary infected buboes, treated in the same manner, 23 died, showing a death rate of about 16 per cent. The diagnosis in all the above cases was confirmed by two bacteriological examinations, one before removal to the hospital, and the other after admission to the wards. Sero-therapeutic treatment was instituted in a number of other cases, but the effect of operating displayed such favorable results that injection of serum in the others was deemed unnecessary. The necropsy reports in the cases that died showed buboes that were inaccessible to operations, being scattered in the mesentery, or deeply situated in other tissues."—Journ. Am. Med. Assn., January 19th, 1901, p. 185.

breeding centres, pure water only should be used for drinking by the community and various similar precautions should be taken. Not only should the sick-room be disinfected, but the house should be similarly cleansed and the whole neighborhood made as clean as possible by the sanitary authorities. The free use of disinfectants to the discharges from the patient and to the surroundings is now regarded as an imperative duty and the directions given by the sanitary authorities are most explicit and comprehensive. The methods followed by the United States Marine Hospital service, and by the French and German governments are summarized in the report of General Wyman, already freely quoted from.

A few words may be permitted to correct a popular error to which attention has been called by Dr. James Edmunds* of London. The impression prevails among a rather large proportion of the profession and the community that alcohol has a certain antidotal power against infection, and that, if when epidemic disease prevails, it will act as a prophylactic and confer a certain degree of immunity upon those who are under its influence. Alcoholic drinks, therefore, are often publicly recommended, when a community is threatened with an epidemic.

Whatever may be the result of such a course in other infectious diseases, experience does not warrant the view that it would be of any avail when plague is imminent. On the contrary, intemperance is now generally recognized as constituting or favoring a predisposition to the disease. Sydenham's observation is here very much to the point. "Certain it is," he says, "that the free use of wine, and other strong preservatives, taken at stated hours and in the way of regimen, has brought the disease upon many persons who in all probability would have remained safe and sound otherwise."

As the therapeutic and prophylactic problems relating to the plague are at the present day taken out of the province of the private medical practitioner, on account of the very important interests that are involved, and as the problems are now being studied seriously by the sanitary authorities of the various governments of the civilized world, they can have only an academic interest to the members of the profession in general and need not be dwelt upon further. The reader is referred to the publications of the national departments, and particularly to those of the United States Marine Hospital service, for detailed information on these topics.

John V. Shoemaker.

BUCHU.—*Short Buchu.* "The leaves of *Barosma betulina* (Thunberg) Bartling et Wendland, and *Barosma crenulata* (L.) Hooker (fam. *Rutaceæ*)" (U. S. P.). A third species, B. *serratifolia* Willd., "Long Buchu," was also once official, but was dropped because of its inferiority. The British Pharmacopœia rejects also the second-named species, which is greatly lacking in uniformity and which is now but little collected. There are about fifteen species of this genus, all natives of South Africa. The drug was in use by the Hottentots at the time of settlement by the whites. Its introduction to America was in the form of a notorious quack medicine, and was afterward adopted upon its merits by the profession.

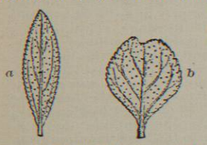

FIG. 1055.—Buchu Leaves. *a*, *B. crenulata*; *b*, *B. betulina*. (After Baillon.)

The leaves of *B. betulina*, the best variety, are mostly one-half to three-quarters of an inch long and two-thirds as broad or more, occasionally broader than long. They are abruptly contracted into a short, narrow basal portion, the broad upper portion being irregularly sub-rotund, the apex blunt, often recurved, the margin sharply and finely dentate. They are very thick, brittle when dry, smooth and somewhat shining, slightly papillose, and of a yellowish-green color. Against the light they are pellucid-glandular-dotted, with larger marginal glands. They have a strong mint-like odor and a warm, aromatic, and mucilaginous taste.

B. crenulata varies from oblong to oval or obovate, usually a little broader than our figure, and is often twice as long as the other, and less blunt. The margin is crenulate. It is also thick and greenish-yellow, and has similar pellucid glands.

B. serratifolia is markedly different from the others, being of a bright green color, thin, sub-three-nerved by the elongated basal pair of veins, narrowly oblong or lance-linear, sharply serrate, the teeth and sinuses curved. The leaf is about as long as the *B. crenulata*. There is a very large gland at the obtuse apex.

There is no adulterant of the official buchu, but when long buchu was official, the leaves of *Empleurum serculatum* Ait. were used for that purpose. They are distinguished by the very acute apex and the straight, incised, salient, longer toothing.

COMPOSITION.—Official buchu contains 1 to 1.5 per cent. of volatile oil, long buchu half as much. There are also resin, gum, and a little of the bitter glucoside *barosmin*, believed to be the same as *hesperidin*. The oil contains a camphor-like body, often called buchu camphor (diosphenin $C_{10}H_{16}O_2$). There is but little of this in oil of long buchu, but that contains much of a body to which the peppermint-like odor is due.

ACTION AND USES.—Buchu acts locally as a mild stomachic. Absorbed, it possesses the ordinary diffusive stimulant properties of volatile oils, its special point of action being the kidneys, by which it is excreted. Its diuretic properties are mild, but it is distinctly sedative and astringent to the urinary organs, as well as slightly antiseptic. Henbane is often combined to increase the sedative effect. It is a mild expectorant. The fluid extract is official, and the dose is 1 to 2 c.c. (fl. ʒ ¼ to ½).

Henry H. Rusby.

BUCKBEAN.—*Bogbean. Menyanthes.* The herb of *Menyanthes trifoliata* L. (fam. *Gentianaceæ*). A widely distributed bog herb, with a creeping perennial rhizome, and thickish bright-green leaves, but which become very thin in drying. They arise from long, sheathing petioles. These leaflets are nearly entire, oblong or ovate, blunt, about 8 cm. long and half as wide (one and one-half by three inches). They have a disagreeable odor when fresh, which disappears upon drying; the taste is bitter and nauseous. The white or pinkish flowers are borne in an upright, spike-like raceme at the end of the rhizome, and are very beautiful.

Buckbean grows in cold swamps and moist places in Europe, Asia, and America, and has naturally been long known and used in medicine, but is now very little called for. Its bitter principle, *menyanthin*, was separated in 1860 by Kromayer as a white, amorphous, bitter powder, and shown to be a glucoside—sugar and a liquid oil, "menyanthol," being the result of its decomposition.

In moderate doses it is a simple bitter tonic, similar to, but less agreeable than, the other Gentianaceæ. In large doses it is cathartic, and sometimes emetic. Dose, as a tonic, 1 or 2 gm. (15 to 30 grains).

W. P. Bolles.

BUCKEYE. ÆSCULUS.—*Horsechestnut* (fam. *Hippocastanaceæ*). A genus of about a dozen species, of America and Asia, growing mostly north of the Equator. The bark and seeds of *Æ. Hippocastanum* L., native of Asia, but largely cultivated for ornament in all temperate countries, have been much used in domestic practice in the treatment of malaria and rheumatism. Both contain considerable tannin, but the activity appears to reside in the bitter glucoside esculin ($C_{15}H_{16}O_9+1.5\ H_2O$) which is crystalline, white, soluble in water and alcohol, and antiperiodic in fifteen-grain doses.

The seeds of the red buckeye, *Æ. Pavia* L., of the southern United States, are reported to have caused fatal

* "Alcohol and the Plague." The Indian Lancet, December 1st, 1899, p. 472.

cases of poisoning in children, the symptoms being those of poisoning by saponin. It is even said that the former species has acted similarly.

H. H. Rusby.

BUCKTHORN.—*Frangula.* "The bark of *Rhamnus Frangula* L. (fam. *Rhamnaceæ*), collected at least one year before being used" (U. S. P.). This is a very large shrub or small tree, growing throughout Europe and in adjacent Asia and Africa, and sparingly naturalized near New York City. The wood is very fine-grained, and its charcoal is largely utilized for powder-making, for which the bark must be first removed. The latter thus results as a by-product. It is largely employed in domestic veterinary practice, in the fresh or recently dried condition. It is then a sharply irritating cathartic or even emetic, but its griping properties are greatly mitigated by being kept. It occurs in strongly curved quills, which are commonly more or less flattened by pressure. The bark is very thin for the size of the quill (about 1 mm. = 1/25 inch). The outer surface presents two forms, the one nearly black, the other dark-gray. Both are commonly marked by numerous transversely elongated white dots, and are somewhat warty-roughened, but never fissured or scaly. The inner surface, bright yellow when first collected, becomes successively dark yellow, brown, reddish, and nearly black with keeping, this being a fairly good way of recognizing its age. Its fracture is weak but not brittle, and is slightly fibrous. It has a slight characteristic odor and a bitter taste.

Composition.—With resin and a small amount of tannin, the important constituent of frangula is the yellow glucoside *frangulin*, or rhamnoxanthin ($C_{21}H_{20}O_9$) and its products *emodin* ($C_{15}H_{10}O_5$) and *isoemodin* ($C_{15}H_8O_4$). The development of all three of these substances proceeds as the dried bark ages, and coincidently the drug becomes a milder cathartic or laxative. Emodin and Isoemodin belong to the class of *Anthraquinones*, some one of which appears to give the properties to one large class of laxative drugs. Emodin, derived both from rhubarb and from frangula, is on the market. It is insoluble in water, little soluble in alcohol, but dissolves readily in alkaline solutions. It is not used medicinally in its own form.

Properties and Uses.—Frangula can be used as a cathartic in doses of 4 to 8 gm. (ʒ i.–ij.), but, like cascara sagrada, it acts much better as a laxative in doses of one-fourth or one-third these amounts. The fluid extract is official. Owing to its less mild and uniform action, frangula has almost entirely given way to cascara sagrada as a laxative.

The genus contains some seventy-five species, mostly in the north temperate zone, and gradually decreasing southward, in the mountains, a few in the south temperate zone. Many of them have a similar composition and action to that here described. *R. Cathartica* L. has especially been so used, both the bark and the fruits (buckthorn berries) having been used as cathartics from ancient times. The bark of at least one species, R. Wightii, of India, is a strong astringent.

Henry H. Rusby.

BUDDING.—One of the methods of asexual reproduction in the animal kingdom as well as in the vegetable world.

It differs from fission (*q. v.*) in that the offspring produced from the bud has never formed an integral part of the parent organism, but arises as an outgrowth of some part of the parent.

In its simplest form, as in the case of the fresh-water hydra (Fig. 1056), the process is as follows: Certain cells of the wall of the hydra grow and multiply, forming a hollow outgrowth on the side of the parent (*a*). As this enlarges and develops, tentacles appear at the outer end, and a mouth is formed (*a'*). Later, communication with the digestive cavity of the parent is cut off, and the young hydra feeds itself, and at a still later stage becomes separate from the parent.

In other cases the buds remain permanently attached, and thus are formed colonies, or stocks of greater or smaller size and complexity, often supported by a skeleton. Such are the coral stocks and many others. One example from the protozoa is shown in Fig. 1057, and one from the polyzoa in Fig. 1058.

FIG. 1056.—Hydra (enlarged). Showing buds, *a*, *a'*.

Buds may be formed at various places on the parent or colony. Very frequently they grow from the side of the parent—lateral budding, as in hydra and most corals; or on the top—apical budding (Fig. 1057). Sometimes buds are formed from stolons developed from the cœnosarc of the colony (Fig. 1058, *b*) or from the cœnosarc directly.

FIG. 1057.—Dinobryon, an Infusorian (greatly enlarged). Showing apical budding.

A variety of apical budding, called axial, consists in the production of new segments, which may remain permanently united, as in most worms, or become detached, as in the tape-worm.

In some cases internal buds are produced, as in echinococcus (*q. v.*), and in the redia of the fluke-worms.

Closely united with this last method is the formation of germs, or unfertilized eggs, from organs corresponding to the ovary (parthenogenesis, *q. v.*), which develop into animals like the parent, as in the production of drone bees, plant lice, etc.

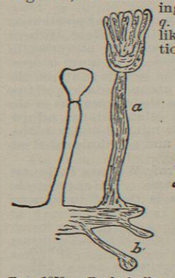

FIG. 1058.—Fredericella, a Polyzoan (much enlarged). Showing adult bud, *a*, and stolon, *b*.

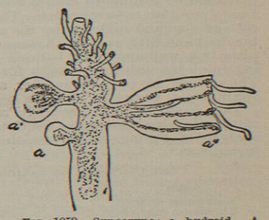

FIG. 1059.—Syncoryne, a hydroid. A nutritive zoöid with medusa (reproductive) buds (*a*, *a'*, *a''*) in various stages of development.

A variety of this method, pædogenesis, consisting of the production of germs from animals still in the larval form, is exemplified in certain flies, as Cecidomyia, Miastor.

In some cases the buds of a colony are of different forms and functions. This is best seen in the hydroids, in which the feeding zoöids are of a different form from the reproductive zoöids (Fig. 1059, *a*, *a'*, *a''*). This method of budding leads to colonial division of labor.

E. A. Birge.

BUENA VISTA SPRINGS.—Logan County, Kentucky.

POST-OFFICE.—Russellville. Springs Hotel. Accessible viâ Louisville and Nashville Railroad (Memphis branch) and Owensboro and Nashville branch to Russellville, thence by stage six miles to springs. The stage meets the train which leaves Russellville for the springs at 8 A.M.

This resort is located in a beautiful and picturesque region, interspersed with lofty hills, deep gorges, beautiful dells, and majestic native forests. The hotel has been rebuilt, and the guests will now find a large and