cysticerci occur as small bladder-like bodies in the muscles. Such meats ought to be rejected but may be rendered innocuous by efficient cooking. If not properly cooked and the cyst is ingested, it undergoes certain changes and developes into a tape worm in the small intestines. A few years ago tape worm was very common in Bombay, especially among the poorer Mahomedans, as these indulged in contraband meat (buffalo and ox) brought stealthily into the City; much has been done by the Health Department and the Market Department of this City to prevent the importation and the sale of such flesh, and large quantities of such meat are seized and destroyed and the offenders prosecuted from time to time under section 412 of the City of Bombay Municipal Act. The tape worm now is not probably so prevalent as it used to be, as only a few cases come to the notice of the Health Department.

Pig or pork meat is prohibited to Hindus, Jews and Mahomedans. They hold the pig in abhorrence not only because it is so ordained by religion but because of its foul habits as it supplants the scavenger. Christians and the Chinese indulge in fresh pork meat and are liable to suffer from Tenia Solium, if these victuals are not rendered innocuous by efficient cooking.

Trichiniasis is a disease occurring in colder climates and is due to tiny cysts enclosing Trichina spiralis; this disease must be rare in this Presidency, as no cases are reported. Flesh of animals suffering from the following diseases must be condemned :—(1) Variolous Diseases, (2) Rabies, (3) Glanders, (4) Foot and Mouth Disease, (5) Anthrax, (6) Tuberculosis.

Another tenia which occurs in man is Tenia Ecchinococcus hominis. It is really the cysticercus stage of the adult tenia, which lives in the small intestines of the domestic dog and the wild jackal and wolf. The cysticercus stage lives chiefly in the liver and lungs of sheep, ox, pig and buffalo. It is not uncommon in man in this stage, though the adult tenia

has never been found in man. The only source of infection in man is the ingestion of the oncospheres (eggs) of the dog-worm. Dogs disseminate the oncospheres wherever they go, and the dog being in close association with man, this can be the only source of human Ecchinococcus disease. It will also be easily understood how cattle become infected; the eggs voided by the dog find access to hay, grass and straw and water which are consumed by cattle; so also they may gain access directly to man by means of uncooked vegetables, lettuces, etc. But the most frequent source of infection is the caressing of dogs. Ecchinococcus is very frequent in slaughtered animals, especially sheep, oxen and buffaloes. It occurs chiefly in livers and lungs, and it is best to condemn such flesh. When it occurs in man, it is called the hydatid cyst; it is a spherical bladder containing greenish yellow liquid and other smaller cysts known as daughter cysts containing one or more Ecchinococcæ scolices, the predecessors of the adult tenia. The hydatid is rare in children up to 10 years of age, but it is most frequent in women.

FISH.

Fish is extensively eaten in the tropical climates, and along the coast, where fish abounds, it forms one of the chief ingredients in the dietaries of the people. Fish must be fresh and must be eaten as early as possible after being caught. In hot climates fish rapidly loses its freshness. Stale or partly decomposing fish is poisonous. It produces symptoms of Gastro-Enteritis. Fresh fish is always firm and stiff: any drooping of the tail indicates staleness. Fresh fish has the slime clear and not discoloured, the scales are full and not dull or damaged, the eyes bright and not sunken and dull, the gills bright and red. If old, stale or starting to decompose, pressure between the finger and thumb produces an indentation and may separate the skin from the fish. Fish is in perfect condition just before spawning and is then said to be

" in season; " during the process of spawning it becomes poor and thin and is " out of season." The flavour of fish depends upon the quantity of fat it contains and is also influenced by the food it takes ; carnivorous fish have a finer flavour than those which feed on vegetable food ; the former generally dwell in the sea and running streams, while the latter in muddy and stagnant waters.

All stale or decomposing fish must be forthwith condemned.

Fish is " cured " by salting and drying or by smoking. The entrails are always removed. The amount of nourishment in any given fish is not perceptibly affected by these processes ; and cured fish may be reckoned as simply equivalent to fresh fish. The industry of salting and drying fish is lucrative, and the fisherfolk of coasting towns are engaged extensively in this trade. Unless fish is properly salted and dried by exposure to the sun, it is liable to decompose. Dried fish, with rice, forms the staple diet of the poorer classes in India. The " Bombay duck," commonly called " bombla " or " bombil," requires special mention. It abounds along the Bombay and Gujerat coasts. It is eaten fresh, but more frequently salted and dried. The fresh fish is sometimes poisonous and produces symptoms of acute Gastro-Enteritis but the cured is extensively eaten ; both the rich and poor indulge in it. If not properly cured, it is liable to decompose and produce Gastro-Enteritis. If fish is caught in spawning season, the roe is taken out and salted and dried ; for domestic use it is pickled and used as a dainty.

Fish is also preserved in oil in tins in India. On the Malabar coast sardines abound and European companies have established factories for the tinning and exportation of sardine. The Indian mackerel is salted and smoked and exported to other countries. The fish is said to be poisonous during spawning season. The popular belief is that stale or decomposing fish, or dry fish in a decomposing state, produces Cholera.

SHELL FISH.

Shell fish, scientifically speaking, are not fish at all ; they belong to the order of molluscs and crustaceans. Molluscs include oysters, mussels, clams, cockles, whelks ; and the crustaceans include crabs, lobsters, prawns, shrimps, etc. Of the first group, oysters and mussels are in great demand ; of the second group, all the four mentioned are sought for.

Oysters and mussels are generally eaten raw. Oysters, when fresh and coming from a reliable bed, are easily digestible and are reckoned a dainty, but when they are collected from a bed to which sewage gains access, they are apt to be actively poisonous, producing symptoms of severe Gastro-Enteritis. Oysters may contain specific pathogenic germs gaining access to them from sewage contamination. They have been known to contain Eberth's (Typhoid) bacillus, and to occasion local outbreaks of Enteric when they happen to come from contaminated beds, and the causation has been conclusively traced to this infection. Besides Eberth's, Bacillus Coli and Bacillus Enteridis Sporogenes have been found in oysters from polluted beds. Deep sea-water oysters are free from these germs and, therefore, perfectly harmless. Under certain circumstances, oysters are able to transmit the infection of Cholera. If there be any suspicion that an oyster was grown in a contaminated bed, it is best to discard it ; the bacillus lives both in sea-water and within the shell of the oyster. It has, however, been recently shown by scientists that oysters, mussels and cockles have the power of clearing themselves of infected germs partly by discharging them and partly by directly devitalising the microbe. Therefore, oysters coming from suspected waters should be deposited in pure water for a time before consumption, but it is best to eschew them altogether, unless eaten properly cooked. The above remarks also apply to mussels and cockles. Experiments have shown that Bacillus Coli and Bacillus Enteridis

Sporogenes are invariably found in these fish, especially in those coming from contaminated waters. These should be eaten properly cooked. The crustaceans, crabs, lobsters, prawns and shrimps should always be purchased alive and kept alive until the time of cooking, because their flesh decomposes very rapidly and, when only slightly tainted, may produce disastrous results. Even when perfectly fresh, they are found to disagree with many people and give rise to minor disorders. Shell fish is generally said to produce "Urticaria." Mussels are particularly liable to be toxic. They suffer from enlargement of liver, wherein is produced an alkaloid (mitilotoxin) which produces in man symptoms like those of curara poisoning. Mussels in this condition are, even if stewed, poisonous.

Mussels should be tested by shaking them up in a bag; if they rattle and the shells open up, they should be condemned. Cockles when bad are found on opening the shell to be thin and when squeezed no liquid squirts from them. Crabs and lobsters should be examined under the apron and tail to see if they are discoloured. Crabs which after boiling are wet and sticky under the large claws are unfit for food.

VEGETABLE FOODS (CEREALS).

Cereals are the complete fruits (grain or caryopsis) of the plants of the natural order "Graminacæ." Speaking generally, rice and maize are the produce of hot climates, barley and rye of cold climates, while wheat is extensively grown in both climates. Cereals contain a very large proportion of starch, above 70 per cent. of the grain, while the albuminoid or proteid material differs in different cereals, ranging for 6·5 to 18 per cent. Vegetable oil or fat exists to a very small amount, and salts represented by alkaline and earthy phosphates, although very small, are relatively large and important as nutritive substances; it has also been observed that the larger the percentage of proteid matter, the larger is the proportion of these phosphates.

Wheat is the richest in nitrogenous material, maize and barley rich in fats, while rice containing most starch is the poorest in nitrogen and fat. In the process of decortication and milling, wheat loses a large percentage of oil and mineral matter.

Wheat is the fruit-grain (seed) of the plant Triticum Sativa, sub-order Hordeæ of the Graminacæ. It is grown all over the world. In India it thrives best where rice does not grow ; it does not grow in districts along the coast where rice abounds.

Indian wheat grain is not uniform in consistence and size but the variations are in the relative proportions of starch and nitrogenous substances and the change in mineral salts and oils is very infinitesimal. The albuminoid material rises or decreases according to the seed from 12 to 18 per cent., and there is correlative reduction in starch, about 6 per cent., which is not striking, as the reduction is small having regard to the large percentage of starch in wheat grain (about 70 per cent.)

Indian wheat is of two varieties, the white and the red ; the former is rather soft and has an opaque kernel or endosperm and the latter a red and translucent, which indicates a large percentage of nitrogenous matter or albuminoid, while the former has a higher percentage of starch. The average composition of Indian grown wheat is—

Water	12·5 per cent.
Albuminoids	13·5 ,,
Starch	68·4 ,,
Oil	1·2 ,,
Fibre	2·7 ,,
Ash	1·7 ,,

The nitrogenous matter or albuminoid in wheat consists of different substances : first, gladin, mucin and fibrin constitute the crude 'gluten.' This substance may be readily obtained by kneading the floor with water and subsequently washing away the starch and soluble matters, which are two : albumin and cerealin. Gladin renders the gluten tena-

cious, stringy and elastic, and this cohesive property renders wheat flour so adapted for making bread. Cerealin has properties akin to diastase, converting starch into dextrin and maltose. The carbo-hydrates are chiefly starch with a very small amount of dextrin and cellulose. The salts are principally phosphates of potash and magnesia ; the nutrient ratio of wheat is 1 : 5, and nutrient value 84.

Wheat flour is extensively used in Indian dietaries. The old process, which even to-day obtains in mofussil towns and villages where there are no flour mills, is to grind the wheat grain between mill stones into meal (flour). In Presidency towns, even the very poor have their wheat ground at the flour mills which are established and worked by electric motors or small oil engines. In the City of Bombay such mills are dotted all over the place. The home-(hand) ground flour is classified into three portions :—(1) *Sooji* is the coarse flour derived from the outer coat of wheat; (2) *Atta* is the finer flour from the middle portion; and (3) *maida* is the flour of the innermost layer. *Atta* is used for making *Chappatis* or *rotis*, unleavened bread. Flour is kneaded with water into dough, which is spread over on smooth surface to the required thickness, and baked over a fire or on a hot earthern platter. *Chappatis* are generally eaten with other vegetable foods or with milk or ghee. They are always eaten freshly prepared, as stale *chappatis* are dry and hard and consequently difficult of digestion. *Chappatis* prepared with ghee are more agreeable to the taste and keep longer. They form a part of every day meal among all well-to-do Indians.

Sooji and *maida* are used in the preparation of Indian confectionery. "*Halva*," so extensively sold in Indian bazaars, is prepared by boiling *sooji* well mixed with ghee, sugar and water to the required consistence. It is a dear and a heavy food.

Wheat or its flour may be rendered unwholesome by being kept in a damp place or being attacked by certain fungi, the

most common being Puccinia graminis which produces the "smut" of the wheat. Vibrions may be present in damp fermenting flour. Acari farinæ are also common in damp or inferior flour which is beginning to change.

Bread is also largely eaten in India. It is prepared in the same manner as in Europe, by addition of yeast to the dough or by addition of baking powders (alkaline carbonates with an admixture of tartaric acid), or by charging the dough with CO_2. Ordinary white bread is made from flour; brown bread is made from whole meal, and "whole meal" bread is made by addition of finely ground bran. This last variety is much used by persons suffering from chronic constipation because of its laxative properties.

Biscuits are prepared from flour either plain with water or with addition of butter and sugar. They are baked until all the water is driven off and without the use of yeast or any other means of raising the flour. Biscuits contain a large amount of nutrient material, and are also easy of digestion, and being dry keep a considerable time.

Rice constitutes the main food of the people of tropical countries. Rice is the produce of a grass plant "Oryza Sativa," sub-order Oryzæ Graminacæ. It is extensively grown all over India and Burma; in some places so many as four crops are obtained annually. According to Prof. Church: "The analyses of a large number of samples of "cleaned" rice give figures which are wonderfully accordant, considering the difference in appearance of the specimens and the very diverse conditions under which they are grown." The following is the composition of rice:—

Water	12·8 per cent.
Albuminoids	7·3 ,,
Starch	78·3 ,,
Oil	·6 ,,
Fibre	·4 ,,
Ash	·6 ,,

The nutrient ratio is 1 : 10·8 and the nutrient value is 86·5. The mineral matter consists of the phosphates of potash.

Rice is the staple food of the natives of India. It is obtained from *dhan* or paddy or unhusked rice by pounding. In many districts *dhan* is boiled and dried by being exposed to the air and then unhusked by pounding. Hulled or husked rice is called *chaul*. *Chaul* boiled and cooked is called *bhat*. In this process only so much water should be taken as can be absorbed by it ; if boiled in a large quantity of water, the mineral salts are dissolved out and lost as the excess of water is thrown away. Rice parched is known as *kurmurah*, and is used by labourers at midday meals and by travellers. In Indian dietaries, rice is prepared in many ways with milk, sugar, mollasses, cocoanut juice, etc.,

Newly gathered rice is said to be unwholesome, as it is not easily digestible. It produces disorders of the alimentary canal, such as Diarrhœa and Dysentery. Rice is deficient in mineral salts and also nitrogenous matter ; long continued use of this food alone deteriorates health, as the nutrient ratio is insufficient being 1 to 10 of albumen, while the standard ratio of perfect food is 1 to 5, a ratio which is present in wheat. It is, perhaps, because of this that the wheat-eater of the North of India speaks deprecatingly and disparagingly of the rice-eater of the South.

Maize or Indian corn is largely grown in India, and is commonly called *macchai* in the North and as *butta* in the Bombay Presidency. The original home of maize or Zea Mays is South America. The seeds are large and yellow. Maize is rich in fatty oils amounting to as much as 5 to 8 per cent., proteids 9 to 12, carbo-hydrates 65, salts 1 to 2 and water 14. It is, therefore, very nutritious ; but because of the large quantities of fat, it is liable to become rancid and mouldy, and because of the deficiency in gluten it is not adapted for making bread. It has also a peculiar " harsh " flavour. Although not a very popular food, it is largely con-

sumed by the peasant. The dry seed is ground into flour and prepared into a porridge or with milk into a pudding, or the whole seed is parched in hot sand and sold as "pop-corn." "Corn flour," extensively sold in Indian bazaars, consists of maize flour deprived of its "harsh" flavour by treatment with a weak solution of caustic soda; in this process it loses a considerable portion of proteids and fats, leaving only pure starch.

Barley is the grain of Hordeum Distichon. It is grown largely in cold climates and also in tropical countries. In commerce it is found with husk and when ground with it forms *barley meal*. This is largely used as horse-food. When deprived of the husk, it is called *pot-barley* and, when further rounded, it is called *pearl-barley*. Fresh barley ground into flour is called *patent* barley. *Malt* is the product of barley, yielded when it is allowed to germinate and germination stopped at a certain point by dry heat. Barley is not much eaten as food, but used in the preparation of malt and in the manufacture of beers and spirits. Barley flour is inferior to wheat flour as it contains very little gluten, and therefore unsuitable for making bread. Pearl barley is used for making "barley water," a pleasant and demulcent drink for the sick.

Oats are the product of Avena Sativa. In commerce it occurs in husk, but when unhusked it forms *groats*, the flour of which is *oatmeal*. In Scotland and the north of England it is largely used as food: (1) *oat-gruel*, (2) *porridge* and (3) *brose*. Gruel is made by boiling the groats with water or milk, and porridge by stirring the meal in boiling water until it comes to the consistency of pudding. Brose is prepared by treating the oatmeal in meat or cabbage soup. Oats are largely used as horse-food. It is a highly nutritious food, as it is very rich in fat (10 per cent.) and nitrogenous matter (16 per cent.), and that it is so is proved by the exceptionally good physical condition of the Highlanders. Others, however, do not appear to flourish on it, as porridge is apt to have

an irritating effect on the intestines, causing Diarrhœa. The nitrogenous matter is chiefly legumin with little or no gluten.

Rye (Secale Cereale) is largely cultivated in the colder climates, especially in Russia and Germany. Rye-seed is not unlike wheat, but is darker and smaller. Rye is subject to a peculiar fungus disease due to a mycelium of Secale Cornutum, which grows at the expense and in place of the grain, producing what is known as *ergot of rye*, and which attains to about 3 times the size of the normal grain. It is black in colour and gives off a sickly odour and is of nauseous taste. If ergot-rye is allowed to germinate, it produces on its surface several club-shaped growths termed Claviceps Purpurea, which contain the spores ; when these ripen they are liberated into the air, and find attachment to the pistil of a flower of rye and impregnate it, and thus the ergots of rye are developed. Pure rye is very nutritious, as the percentage of proteids is about 10 and of fat 2. The proteids consist largely of gluten ; hence rye flour can be made into bread ; the bread is however dark, unpleasant to the taste and indigestible.

Ergots, because of their size, are easily sifted from the normal grain and collected and sold. Their active principle 'ergotine' and the extract and tincture are valuable drugs ; their therapeutic action is well-known.

Millets are other cereals largely grown in India and consumed as food. They are the (1) great millet or *joar*, the products of Sorghum Vulgare, (2) *bajra* or bulrush millet, the produce of Pennisetum Typhoideum, (3) *ragi natchni* of Eleusine Coracana, (4) *chena* or Indian millet of Panicum Meliaceum. As a rule, millets are the produce of an autumnal harvest. All these millets are smaller in size than the cereals (wheat, etc.) previously described, with the exception of Panicum Meliaceum or Indian millet, which has a high nutrient ratio (1 : 6) ; all the rest have very deficient ratios not unlike rice. These minor cereals form the staple diet of the hill tribes, and are also consumed by Indian

peasantry during time of scarcity and famine. They are eaten as gruel (*conjee*) or made into cakes or scones.

Pulses are the seeds of leguminous plants. As compared with the cereals, they are richer in albuminous matter, vegetable fats and mineral salts.

Some pulses and beans contain as much as 18 per cent. or even more of vegetable fat and about 4 per cent. of mineral salts. The salts are richer than those of the cereals in potash and lime, but poorer in phosphoric acid and magnesia. The nitrogenous matter they contain varies from 17 per cent. to as much as 35 per cent. and consists of legumin or vegetable casein. The legumin is generally combined with sulphur and phosphorus, which naturally add to its nutritive value, but render it somewhat difficult of digestion and apt to produce flatus. The starch (or carbo-hydrates) is comparatively less than in cereals, averaging about 56 per cent. In India these pulses are generally eaten with rice and form the staple diet of Hindus. The pulses are first denuded of their seed coats or skins, and prepared in various ways; either parched and ground into meal and prepared into curries or split and boiled with condiments, or ground into flour and made into confectionery.

A few of the important pulses used as food in India will now be briefly described.

(1) The groundnut or peanut; the seed of Arachis Hypogaea, sub-order Papilionaceæ. The seeds grow in pods partially buried in the ground, hence called ground-nuts. Each pod is about 1 to 1½ inches long and may contain 2 or 3 seeds. Its nutrient ratio is 1 : 5·4 and it contains 25 per cent. of albuminoids and as much as 50 per cent. of vegetable oil. The nutrient value is 151. Oil pressed from the seed is *bhoiseng* oil. It is used for culinary purposes instead of ghee and is used also as an adulterant of ghee. The split seeds are fried and mixed with molasses or *ghur* or jaggery, pressed into small squares and eaten. The cake, after the oil is expressed, is used as cattle food.

(2) Gram or chick-pea, the seed of Cicer Arietinum, sub-order Papilionaceæ. Common gram is cultivated almost all over India, but chiefly in the North. The seed is collected and dried in the sun. The unhusked seed is used as horse and cattle food. Gram parched and unhusked is largely

consumed by the labouring classes. The nutrient ratio is 1 : 3·3. The percentage of albuminoids is about 19, starch 53 and oil 4·5. The nutrient value is 84.

(3) *Kesari* or *Teora* or *Tuwar Dhal* is a vetch, the seed of Lathyrus Sativa, sub-order Papilionaceæ. *Kesari Dhal* is consumed by all classes but especially by the agricultural classes. The nutrient ratio of the *dhal* is 1 : 1·75. It contains albuminoids 32 and starch 54 per cent, and a very small percentage of vegetable oil. The nutrient value is 87. Occasionally a bitter poisonous principle is present rendering it unwholesome and is said to be the cause of the disease known as Lathyrism. The *dhal* is boiled with spices and condiments and prepared into a thickish paste or curry and is consumed with *chappaties* or rice.

(4) The garden pea of Pisum Sativum and (5) the lentil of Lens Esculenta (Indian *Mussoor*) may be treated together. The pea is consumed as food when it is green—not ripened, and the lentil, which is regarded as a pulse of inferior quality, is eaten after the husk is removed. The lentils contain a bitter principle which is removed by soaking them in cold water, to which some soda carbonate is added. The nutrient ratio of each is about 1 to 2·5 and albuminoids 25 per cent., starch about 58 per cent. and oil 1·5. The nutrient value is about 85.

(6) The soy or soja bean is the seed of Glycine Soja, sub-order Papilionaceæ. This bean is largely consumed in China and Japan ; of all the pulses or beans, the composition of soja bean is the richest in albuminoids and vegetable oils, the percentage being 35 and 19 respectively. The nutrient ratio is 1 : 2. It is rich also in mineral salts, chiefly phosphates and potash. The nutrient value is 105.

(7) *Mung* bean is the seed of Phaseolus Mungo. There are three varieties : P. Manx producing the black, P. Aureus the yellow, P. Mungo the green. The pods of these plants are about 2 inches in length, containing about a dozen seeds. The nutrient ratio is 1 : 2·5, albuminoids 22 per cent. and fats 2 per cent. ; the nutrient value is 83. This bean is largely indulged in by the affluent classes and has the reputation among Indians of being easily digestible, and is therefore eaten during illness and convalescence. It is taken in the shape of *Mung khichri*, a dish prepared by boiling *mung*, rice, ghee and condiments in water to a certain consistency.

(8) The lab-lab bean ; this lentil is the produce of Dolichos Lab-lab, sub-order Phaseolæ. The plant is a native of India and cultivated all over the land ; the pod is about 2 inches long and contains about 4 seeds. Both the green pods and the ripe seeds are largely used by all vegetarians. The nutrient ratio is 1 : 2·5. They contain a large percentage of albuminoids (20 per cent.) and of fat 2 per cent. The nutrient value is 80. There are many varieties of this plant, and the beans may be large or small according to the size of the pod. Of the numerous forms of lab-lab, almost all are eaten as green vegetables.

Cereals and pulses are collected in crops. They should, therefore, be carefully sifted, and stored in clean bags in properly paved and dry godowns or granaries. If not properly attended to, they are liable to be rendered unwholesome by damp. They may become mouldy, and ferment and decompose. Grain in this condition is positively dangerous, and, if consumed, produces symptoms of severe gastro-intestinal irritation, causing violent vomiting and purging and even death. All such grain, therefore, should be condemned. Large consignments of damaged, mouldy, wet and fermenting Rangoon rice have been, on several occasions, seized by the Health Department of Bombay under Section 415 of the City of Bombay Municipal Act. The object was to prevent its entrance and sale in local bazaars, so that the same may not be used for human consumption.

Certain cereals are affected by specific fungi. Rye is ergotised by the mycelium of the fungus (Claviceps Purpuræ) Secale Cornutum. The ergots if not carefully sifted and removed, but ground into flour with rye and made into bread and eaten, give rise to a disease called "Ergotism." The initial symptoms generally are vomiting and Diarrhœa, followed by either gangrene of the extremities or convulsive fits.

Wheat is liable to be attacked by a parasitic fungus, the Ustilago Carbo, producing "caries" or "smut" of the wheat. When wheat is ground into flour with smut, it gives a disagreeable odour and the bread becomes of bluish colour; if eaten, it causes Diarrhœa. The presence of acarus farina indicates the flour is about to change, and if vibrions are discovered the flour is fermenting and therefore unwholesome.

Occasionally wheat flour is adulterated by an admixture of rye flour and, as rye grain is often ergotised, the use of such flour in bread may cause symptoms of Ergotism. Wheat flour may also be adulterated by the addition of the flour of darnel seeds or Lolium Temulentum and of the flour of purple

cow-wheat or Melampyram Arvense. The latter gives bread a bluish, violet tint but causes no poisonous or injurious symptoms. The addition of the flour of darnel seeds does not impart any colour to the bread but is decidedly poisonous, producing Vertigo, hallucinations, delirium and other narcotic symptoms. The Lolium flour is readily detected by the addition of alcohol, which gives it a greenish hue with a bitterish repulsive taste and, on evaporation, leaves a resinoid extract of a very unpleasant taste ; with pure wheat flour, alcohol gives a straw-coloured solution with agreeable taste. Two alkaloids have been isolated from the darnel seeds : loliine and temuline produced by a parasitic fungus. Loliine is a digestive irritant, while temuline is toxic—a nerve poison.

PARASITES.

There are certain parasites which affect grain, flour, peas, etc. ; these parasites may be divided into two classes, animal and vegetable.

I. ANIMAL PARASITES.

The *Calandra Granaria*, or the corn weevil, is much larger than the flour mite. The insect perforates the shell and abstracts the contents leaving only the outer shell. It attacks the grain while standing. It is chestnut-brown in colour, and unlike the rice weevil has no power of flight, the elytra being firmly cemented together.

The *Acarus Farinæ* is found in flour which is beginning to change. It can be distinguished from the Acarus Scabei which it somewhat resembles, by the fact that its legs are thick right up to the end, while those of the Acarus Scabei taper to a thin end.

The *Bruchus Pisi* attacks peas. It is closely allied to the Br. Rufimanus which attacks beans. It is the larval forms of these insects which cause the damage. The grubs live

in the seeds, and as a result the latter may not germinate, or if they do, the resulting plants are weakly. The adult Br. Pisi is oval, and dark in colour. The four basal joints at the antennæ are red, as are also the shanks and tarsi of the two front pairs of legs. Theadult beetles lay their eggs on the pea-pods when they are very young. The larva or grub, on hatching, bores into the pea and finding nourishment develops to its full growth. It then pupates in the pea, having first eaten its way to the outer coat, so that, when the beetle is mature, it has only to break through the thin outer skin.

The *Bruchus Rufimanus*, or bean weevil, lays its eggs on the very young pods in the fields. The grub bores its way into the bean and there develops. Two, three or more may be found in the same bean. The full-grown grub pupates in the bean and then, in the spring or earlier, the adult beetle emerges. A round hole shows the place of emergence. In beans still containing the beetle, a little round patch on the outer skin marks the place where the beetle lies.

The *Calandra Oryzae* or rice weevil is dark,reddish-brown in colour, with four dull reddish spots on the elytra. Its length is about 4 m.m. It attacks all kinds of stored grain, *e.g.*, maize, rice, buckwheat, and it also attacks peas and beans. The female pierces a hole and then lays an egg. There are upwards of four broods in a year. The larvæ hatched from the eggs, consume the contents of the grain and then enter into the pupa stage for a few days and finally develop into the insect which leaves the grain. The metamorphosis occupies about one month to six weeks. This weevil is a most destructive insect.

Tylenchus Tritici.—Grain becomes infected by a worm which is really the larval form of a nematode. It is usually seen in grain kept in damp places. The worm causes the grain to become small, short, thick and blackish, and on examination one finds a thick shell filled with a blackish substance.

PREVENTIVE AND REMEDIAL MEASURES AGAINST INSECT PESTS IN GRAIN.

(1) The godowns used must be free from these pests before the grain is introduced and all doors and windows should, as far as possible, be made insect-proof. If the godown is already infected, it should be thoroughly fumigated with sulphur dioxide by means of a Clayton apparatus.

(2) No infected grain should be knowingly admitted into a store.

(3) If infected, the grain should be fumigated before introduction. This can be done by using the Clayton apparatus or by using an air-tight bin of known dimensions. Place carbon bisulphide in a shallow dish and lay the whole on the surface of the grain in the bin and close the lid and leave for 24 to 36 hours. The quantity necessary is about 1 to 1½ lbs. for every 1,000 cubic feet capacity of the bin. It must be remembered that carbon bisulphide is inflammable.

(4) The gunny bags in which the grain is packed should, from time to time, be fumigated to free them from any insects that may exist in them.

II. VEGETABLE PARASITES.

(1) *Puccinia Graminis* is a fungus which attacks many varieties of grain causing a condition known as rust. A spore becomes attached to the grain and sends small filaments into the interior. These increase and form a dense network and later, small cellules develop which enlarge and become coloured. These cause the cuticle to distend and finally rupture. The fine powder which then appears on the surface gives rise to the name of rust.

Ustilago Segetum or *Smut* is a common parasite of corn. It attacks all cereals and is characterised by the grains being filled and destroyed by black dusty spores which, unlike bunt, are quite conspicuous in the undisturbed plant. Fur-

ther, it is more common in barley and oats. The spores of smut are smaller than those of bunt, and their surface is smooth. In the case both of smut and bunt, infection takes place when the plant is quite young, the fungus pushing up inside the plant as it grows, until ultimately the immature seeds are attacked. Among standing corn which is infected, withered heads can be seen, from which, if rubbed or even touched, a fine powder consisting of the spores of the parasite falls off.

The smut fungus in its resting stage is usually sown with the seed and both germinate at the same time. The mycelium of the fungus spreads throughout the tissues of the host but does not produce any malformation until the head begins to form. The best method of prevention is to sterilise the seed before sowing by soaking it in a solution of copper sulphate (one pound in 20 gallons of water) for 12 to 16 hours and then place in a solution of milk of lime (14 pounds of quicklime in 20 gallons of water) for five minutes. Then dry and sow.

Telletia Caries or *Uredo Fœtida* or *Bunt* chiefly attacks wheat and is characterised by the grains being filled by a black mass of spores. The external appearance is not altered, or, if at all, only to the extent of a slight darkening. If the affected grain be cut or crushed, a black powder is seen which, when rubbed, has a greasy feel and emits a fetid smell. Ears that are attacked are lighter than sound ones and therefore stand more erect than the sound ones, and they also remain green longer as the harvest approaches. Frequently, so long as the ears remain undisturbed, the black spore masses remain unseen.

Penicillium Glaucum is a common mould of the air. It consists of long threads interlaced to produce a network. The threads branch and some produce spores. This mould produces a greenish growth on damp flour bread and on cheese and damp grain.

Claviceps Purpurea.—Rye is subject to a disease produced by this fungus, the growth of which causes the grain to enarge and become black on the surface, but in the interior the grain is somewhat cream-coloured. Ergot may be detected in the flour by the microscope, by which the mycelium and spores of the fungus are laid bare, and also by chemical means.

Sporisorium Maidis causes a disease in maize which has been alleged to be the active agent in the causation of the disease in man known as Pellagra, but there is reason now to seriously doubt the truth of this assertion.

Aspergillus Glaucus and Mucor are species of other mould to be found in damp grain.

In India, green vegetables are consumed largely. Some green vegetables are eaten raw, unboiled. The chief of these are salads, water cresses, spring onions, celery, lettuce, small white radishes, red table radishes, tomatoes, cucumbers, etc. They are of special value in diets, because of their antiscorbutic properties, as they contain alkaline salts combined with organic acids, tartaric, malic, etc. Green vegetables must, before eating, be carefully selected and washed. This is very essential, as most vegetables are raised by the *malee*, or vegetable farmer, on soils which may have been contaminated with sewage or on soil recently reclaimed by city refuse, or they may have been raised on land by the side of drains, or again, may have been watered by drain water, or water otherwise contaminated with fæcal or other matters. Therefore, they may have been contaminated with pathogenic bacteria and, if not properly washed, cleaned and dressed, are known to have caused cases of Cholera, Enteric Fever and Dysentery. Special attention should be paid to the roots and the outer foliage, as these may be impregnated with the ova of *ankylostoma, ascaris lumbricoides*, etc.

Green vegetables are eaten also after being boiled with condiments or prepared into dishes with addition of butter

etc. The vegetables most commonly eaten thus in this country are cabbage, cauliflower, spinach, lady's fingers (*abel moschos Esculentus*), brinjals, white and red gourd, and a variety of *bhajees* prepared from the young shoots and young stems and leaves of various edible plants. The nutritive value of all green vegetables is very low, but they are largely consumed as they are agreeable to the taste and possess anti-scorbutic properties.

FRUITS.

In India there are many fruit-bearing trees. They yield fruits in seasonal crops, or the fruit may be borne perennially. Fruits are relatively expensive, and therefore are consumed only in comparatively small quantities. They are rarely included in the dietary of the poor man, except the mango and jack fruit when there is a plentiful crop. They are valued rather on account of their pleasant flavour and agreeable taste and other properties than for the nourishment they contain. They contain very little protein, about 1 per cent., and fat 5 per cent., carbo-hydrates occur in variable but more considerable quantities and generally consist of saccharine matters (sugars).

Ripe tropical fruits are almost all luscious. When they are over-ripe, they begin to change, ferment and decay ; in this condition they are highly unwholesome and injurious to health ; large quantities of such fruit, especially mangoes, custard apples and plantains, are destroyed annually by the Health Department of Bombay.

CONDIMENTS, SPICES, ETC.

Indian dishes are generally prepared with condiments and spices. The chief object is to season the food and make it more appetising and to induce a greater flow of alimentary digestive juices in the food by exciting a turgescence of the

blood vessels of the stomach. They have no direct nutritive functions. The spices are all vegetable products derived from various species of tropical plants. They may consist of the fruit, bark, stem, roots and flowers and are conserved in the dry state. They contain volatile or essential oils and aromatic resinous matters. The oils consist of ethers, aldehydes or terpene hydro-carbons, which give the spices their aroma and pungency. The distinction made between spices and condiments is purely conventional; the following spices are generally used in this country: cloves, cinnamon, coriander, saffron, nutmeg, mace, chillies, ginger, pepper, mustard, turmeric, dill, cardamom, cummin (*zira*) and fenugreek (*meti*).

INSPECTION OF FOOD SUPPLIES.

One of the important duties of a Municipality is to provide for the efficient inspection of the public food supply. This can only be done by means of trained Inspectors, who are well acquainted with the appearance of animals and flesh, both normal and diseased, and who are well posted in the sophistries practised by the adulterator.

The Inspector may be called upon to examine a living animal. An animal intended for human consumption should be well nourished, free in its movements, its coat in good condition and free from sores and scabs. The eyes should be bright, the mouth and nostrils moist but yet free from discharge. The breathing should be quiet and regular and the breath without odour. The pulse should be regular, and there should be no shivering or indication of pain. When the animal is sick, the coat is rough, the nostrils are dry or covered with foam or discharging profusely, the eyes dull, the tongue protruding respirations laboured, and the animal's movements are sluggish. The weights of animals vary considerably, and

in general the Indian animal is lighter than the corresponding English animal.

	Indian.			*English.*		
	lbs.		lbs.	lbs.		lbs.
Ox	350	to	400	600	to	1,200
Cow	200	„	300	700	„	740
Bullock	150	„	225	300	„	450
Buffalo	500	„	700			
Sheep	20	„	35	60	„	90

The age of an animal is usually reckoned by the teeth mainly, but, just as in the human subject, there is considerable variation in the time of appearance of the permanent teeth. The range usually lies somewhere within the limits shown in the two tables appended :—

BOVINES.

Teeth	Age in years.
2	$1\frac{1}{2}$ to 2
4	$2\frac{1}{2}$ „ 3
6	$3\frac{1}{2}$ „ 4
8	$4\frac{1}{2}$ „ 5

SHEEP.

Teeth	Age in years.
2	1
4	2
6	3
8	4

In young animals, the cartilages covering the articular surfaces are blue or rosy ; as age advances, however, they become whiter. Up to three years of age, one can cut through the ischio-pubic symphysis, and up to four years through the costal cartilage of the ninth rib. At the age of six this is almost impossible. In young animals the bones are small,

soft and porous and have a pinkish colour ; in older animals they become larger, harder and less porous, and of a whiter colour. The beef is light-red in young animals, firm and elastic in consistency, and marbled with fat.

In order to distinguish the sex of an animal the following points may be noted. Owing to greater muscular development, the flesh of the bull has less fat than that of the cow. There is great development of the neck, shoulder and hind quarters. The flesh is coarser in fibre and there is an absence of that marbling seen in cow's flesh. The flesh is dark-red in colour, the muscles tough and cross-grained and the carcass is generally poor in fat. Situated at the root of the penis, which in dressed meat is usually found on the left hand side of the hind quarter, is a muscle, the erector penis ; this muscle is much more developed in the bull than in the bullock, as is also the case with the penis itself. In the bullock the quarters are less developed, the penis and retractor penis are less prominent, and the erector penis is almost atrophied. The scrotal fat is prominent. The anterior part of the ischio-pubic symphysis is very well developed. If the penis has been removed, a furrow corresponding to its position will be found. The joints of a bull are larger than those of a cow, and the neck is very thick compared with that of a cow, ox or heifer. In the cow the quarters are less rounded, the angles of the haunch are prominent, the anterior part of the ischio-pubic symphysis is ill-developed. The udder is present, or if not, then marks of it are left. The fat at the base of the udder is fairly well developed and the supermammary lymph glands are large. In the heifer the mammary gland is poorly developed and is surrounded by fatty tissue.

How to distinguish flesh of one animal from that of another. A meat Inspector must be prepared to detect the substitution of the flesh of one animal for that of another. Horse flesh is frequently substituted for that of the cow, and a

knowledge of the following points may assist in the detection of the fraud. Horse flesh is much darker and coarser in fibre, and it is without the small layers of fat seen in the muscles (marbling). It has a disagreeable odour, the fat is oily, yellow and soft due to the large quantity of olein in it. The horse's liver has three lobes and no gall bladder; that of the cow consists of one large lobe plus a small supernumerary one. The kidney of the cow is lobulated on the surface, whereas the horse's is smooth and not lobulated. Two kidneys of the horse differ in shape, however, that on the right being somewhat heart-shaped, whereas the left one is ordinarily reniform in appearance. The heart of the horse has two grooves on the surface, the fat is yellow and oily, and is but little seen on the surface. The heart of the cow has three grooves, and at its base has a bone not seen in the heart of the horse. The horse's tongue is much smoother than that of the cow. It is spatula-shaped, and the circumvallate papillæ at the base are situated centrally, whereas in the ox the tongue is comparatively pointed with many papillæ at the tip, causing a sensation of roughness when the hand is passed over it, and the circumvallate papillæ are situated at the edges, and not centrally. The horse has a longer neck, the bones of the cervical region being elongated, so also the bones of the limbs. The epiglottis of the horse is smaller and more pointed. The horse's sternum is carinaform in shape. The horse has 18 pairs of ribs, the ox only 13 pairs. Moreover, the ribs of the former are much narrower. In general, the bones of the horse are much heavier.

Substitution of the flesh of the goat for that of the sheep sometimes occurs. Both animals have 13 pairs of ribs. The flesh of the sheep is paler and finer, the fat is firm, white and evenly distributed over the back and sides, and the flesh is rarely marbled. The flesh of the goat is dark and possesses a peculiar smell, especially if old. In the

sheep the external covering of fat is well developed, in the goat it is practically absent. The neck, body and quarter of the goat are longer. The sheep's liver, like that of the ox, consists of one large lobe plus a small supernumerary one situated on its superior and posterior surface. The normal liver of the goat weighs 8 to 10 ounces. It is divided into two lobes, the larger of which is again divided interiorly by a cleft. The breadth varies from 6 inches to 7 inches and the length from base to apex is 7 inches to 8 inches. The small lobe measures about 2 inches in length by 1½ inches in breadth.

The flesh of the pig is paler than that of either the ox or the goat, and is less firm to the touch. The subcutaneous fat is very white and soft. The pig has 14 pairs of ribs. Its liver has five lobes and the kidney is smooth, elongated and flattened so as to somewhat resemble a broad ribbon.

The flesh of the calf is pale-red in colour and not of a firm consistence, and the fat resembles tallow. Slink veal has a gelatinous watery appearance.

Buffalo meat.—The flesh is pale-red in colour, the muscle fibres are coarser and looser than in the ox, and the muscular parts are larger. The fat is pure white. The flesh, when cooked, assumes a darker colour and increases in bulk.

The dog's liver is two-lobed and its kidneys are smooth and oblong.

In examining any carcass, the Inspector must pay attention to the following points :—

(1) The colour and transparency of the meat, the smell, consistency and chemical reaction, and the presence or absence of any moisture ;

(2) the amount, character and distribution of the fat, the appearance of the lymphatic glands, serous membranes, articulations and bones ; and

(3) the presence or absence of any signs of lesions or parasites.

Good meat should have the following characteristics.—The carcass should be well set as soon as it is cold ; the flesh firm but not tough. It should be well bled and no part of it purple or speckled. When pressed with the finger, the flesh should not pit, as pitting would indicate the presence of watery fluid, nor should it crackle, thereby indicating the presence of air. No pus should exist in the intra-muscular tissue. The flesh should be fairly dry after exposure to the air. The meat should have a pleasant odour and be bright-red in colour (except in the case of pork, veal and lamb) and should have an acid reaction. The fat should be free from watery juice and blood stains. An excellent test of meat is to insert a clean, long, thin-bladed knife deep into the flesh : in good meat the resistence is equal, and in putrefying meat variable ; on withdrawal, the knife should possess no unpleasant smell. There should be no smell of physic about the flesh. In temperate climates, the marrow of the hind legs is solid ; about 24 hours after slaughter, it is of a light-red colour : if it is brownish or soft, or has black points in it, then the animal has probably been sick or putrefaction is commencing. The quantity of fat varies very much ; in an ox it constitutes about one-third, and in a fat pig about half the total. The fat usually solidifies after death. In horses the fat is yellow and oily, and has an unpleasant taste. In oxen it varies from yellow to pale, straw colour. In beef the fat consists mainly of palmitates, in mutton of stearates, and in pigs of oleates.

The Inspector should have a good knowledge of the various glands to be examined and their situation. Normally, all the glands are bluish-grey in colour, of firm consistency and moist on the surface.

The following are some of the more important glands :—

The supra-sternal : are found on each side of the upper surface of the sternum.

The pre-pectoral : are situated at the entrance to the chest beneath the

great vessels. One of them is always left just beneath the small muscle, which will be found in front of and attached to the edge of the first rib.

The pre-scapular : are found beneath some muscle and in front of and close to the shoulder joint.

The cervical : lie on each side of the trachea or wind-pipe.

The brachial : are found under the shoulder blade.

The mediastinal : lie between the two lungs.

The bronchial : lie on each side of the trachea just at its point of bifurcation.

The superficial inguinal (known as the supra-mammary in the cow) : in male animals are usually found buried in the cod fat ; in female animals they are readily seen when the udder has been removed. It may be here noted that these glands are much larger in the cow than in males.

The deep inguinal or pre-pubic : is lower down on the brim of the pelvis, 4 or 5 inches removed from the spinal column. It is always embedded in fat. Close to this and under the spinal column is a large collection of glands, the external and internal iliacs and some of the sacral.

The renal : are situated behind the kidney.

The sub-dorsal : are found in the fat just beneath and attached to the spinal column.

The hepatic : are found between the portal vein and the pancreas ; in very fat animals they may be completely buried in adipose tissue.

The popliteal : is found deeply buried in the muscles at the back of the stifle or knee-joint.

The pre-crural : is found on the outside of the hind quarter buried in fat and beneath the muscle in front of and above the stifle.

It is of the utmost importance that the meat Inspector should examine the glands, especially if the organs have been disposed of. Occasionally, however, the more easily accessible glands have also been removed, leaving only the deeper seated ones, as their removal would necessitate some degree of mutilation of the carcass, thereby lessening its market value. Three sets of glands, however, are practically always overlooked by the butcher, and they afford valuable information to the Inspector. They are (1) the sub-maxillary, which is found on the inner side of the jaw-bone just about its middle. A small tag of muscle which is almost invariably left in this situation, affords a guide in locating this gland; (2) the pre-auricular which, as its name indicates is situated in front of the auricle ; and (3) the post-

pharyngeal in the posterior wall of the pharynx. The principal disease for which the Inspector should be on the lookout in glands is Tuberculosis, of which the most usual indication is the presence of soft yellow nodules or areas in the glands.

In cows, usually, the first organ to be removed is the mammary gland. Both sides of this organ should be of the same size, shape and colour and of the same consistency. The spleen is a solid organ; it should be smooth on the surface and on first being removed bluish-grey in colour. It varies from 14 to 18 inches long by 4 inches wide and $\frac{1}{2}$ inch thick normally.

The stomach has four compartments; the first and largest is known as the rumen, the second as the reticulum or honeycomb from its appearance, the third as the manyplus or emasum and the fourth as the obomasum. The external covering of the stomach should be smooth, glistening and bluish-grey in colour. The contents should be examined for any sign of drugs.

The covering of the intestines should be smooth and of uniform grey colour. They lie coiled in a mass of fat—the mesentery. The liver is of a reddish-brown colour and of moderately firm consistence and the borders somewhat sharp. In the thicker portions of the liver, the borders are more rounded. The organ should contain no lighter coloured or yellow area. The diaphragm forms a strong musculo-fibrous partition separating the thorax from the abdomen. In its centre it is fibrous and in the periphery muscular. Both surfaces should be quite smooth and glistening and in no part adherent to any organ. The kidneys are solid organs with a lobulated surface and of a uniform brown colour. They are generally concealed from sight in fat. The surface should be quite smooth and glistening. The lungs are soft, elastic and of uniform consistency. They should be of a uniform pink colour, and perfectly smooth on the sur-

face; there should be no yellowish, whitish areas in the interior. The tongue has already been described. It should be examined for marks of erosions, and the large glands situated at its base examined for signs of Tuberculosis.

SOME SOURCES OF ALTERATION IN THE QUALITY OF THE FLESH.

Initial or essential defects including (*a*) *Age*: Very old or very young animals are not so nutritious as the average adult. An old animal is occasionally very deficient in nutritive value; the fat almost disappears and the muscular tissue is in part replaced by fibrous tissue. The flesh of young animals is deficient in salts and fat. (*b*) *Overwork and exhaustion*:—The meat loses value as a food and is often unpleasant to the taste; no animal should be slaughtered when in a tired or frightened condition. The flesh is liable to rapid decomposition. (*c*) *Unsuitable feeding*: Certain medicines given to an animal may produce symptoms in the consumer, *e.g.*, antimony, arsenic, lead, strychnine and phosphorus. Occasionally the smell of the medicine can be detected, and this should lead the Inspector to institute inquiries as to the nature of the illness which necessitated the administration of medicine. Ether, turpentine, creosote, carbolic acid and hydrocyanic acid are examples of drugs which may impart an odour to the flesh. If an animal has been poisoned by unsuitable food, *e.g.*, yew leaves, bryony, meadow saffron, or by mineral poisons purposely given, there will usually be some indication to be found in the stomach, more marked in the case of mineral poisons, and certain changes may be found in the liver, *e.g.*, fatty degeneration in the case of arsenic and phosphorus. Animals fed on red cabbage and beet leaves may produce a poisonous milk, which in certain individuals may cause acute Enteritis. (*d*) *Starvation* acts much like old age; the meat wastes considerably in cooking owing to the deficiency of fat. (*e*)

The flesh of animals killed by *lightning and apoplexy* rapidly decomposes. The organs and flesh are dark in colour, the meat is full of blood, and badly set, as is the case also in animals which have been smothered or drowned. If the flesh is full of blood, the carcass should be condemned. In regard to animals injured by accidents, much depends on the nature and extent of the injuries. If the accident is such as to result in purely localised bruising, this portion of the meat only need be condemned and the rest passed, provided that the bruising is not too extensive and the animal is slaughtered at once. If, however, the accident results in much bruising and injury to the animal and it is not slaughtered early, the flesh is apt to be dark and ill-bled and should be condemned. The flesh of animals dead from accident is usually dark and the serous membranes stained, owing to the animal not having been bled or only imperfectly so. The flesh of animals slaughtered just before, during or after parturition need not necessarily be condemned, unless there is evidence of extravasations of blood or of pyœmia and of inflammation of the pelvic organs, and membranes. (*f*) The *diseases*, both infectious and non-infectious, which either on the whole or in part render meat unfit for human consumption, or which depreciate its quality and therefore its market-value, ordinarily met with include Tuberculosis, Pseudo-Tuberculosis, Actinomycosis, Dysco-mycosis, Anthrax, Rinderpest, Pleuro-Pneumonia, Swine Fever, Sheep-pox, Erysipelas, and worms of various kinds, etc., etc.

TUBERCULOSIS.

Tuberculosis is a very wide-spread disease in man and animals. It is very common in cattle and poultry and occurs also in dogs, cats and the larger carnivora. In sheep and goats it is comparatively rare, especially in the former. Comparative statistics show that the disease occurs in cattle

16·25 per cent., swine 2·3 per cent. and sheep ·2 to ·3. The horse is also liable. Birds are specially susceptible, the disease causing great mortality in hens, geese, turkeys and pheasants. Most wild animals are susceptible. The disease also occurs in monkeys in confinement and the nodules have a special tendency to break down into a pus-like fluid.

The disease may be either local or general. Small oval or spherical nodules form, and these may soften and become caseous or contain pus, while others become fibrous or even calcareous.

Tuberculosis is due to a bacillus discovered by Koch. It belongs to the acid-fast group, which also includes the smegma bacillus. The bacilli are straight or curved, non-motile rods from 2 to 4 m.m. in length. They are very difficult to cultivate in the absence of glycerine. They occur scattered in the tissues, or in little round masses. They are usually single, but may sometimes be found lying end to end forming an obtuse angle : true chains are not found. Their resistance is considerable and they can retain their vitality outside the body for a considerable time. Salting and smoking do not kill them. They resist the gastric juice for 6 hours, and a temperature of 3°C. for 3 hours and drying and putrefaction for a very long time, even months.

In *cattle*, generally the lungs are affected, nodules appear in them and these may be firm, caseous or calcified. In addition, one may find caseous Pneumonia and small Tubercular granulations. Along with these changes in the lungs, there may be nodules on the pleura and peritoneum, some of which may be pedunculated. In other cases, however, the abdominal organs may be primarily affected. The udder becomes diseased in about 3 per cent. of cases, but primary affection of the gland is rare.

In *pigs*, as a rule, the disease is abdominal in origin, the liver, spleen and glands being affected. In other cases a caseous Pneumonia is found and in other instances again

the organism produces a chronic affection of the lymphatic glands, known as Pig's Scrofula. Tubercular affections of the muscles are less rare in pigs.

In *the horse,* the abdominal organs are the primary seat of the disease, the spleen being enormously enlarged and crowded with nodules. Occasionally, the primary lesions are pulmonary. The mesenteric glands become enlarged. The disease may spread to the lungs, causing miliary Tuberculosis. In the *cow,* on the contrary, the disease generally commences in the lung with a local tubercle, later the pleura are affected causing grapes and, later on, there may be a small amount of miliary tubercle.

Action on the Tissues.—The local lesion is a Tubercular nodule of a central giant cell which has many nuclei, often in a ring towards the periphery, but sometimes in a clump at one end. Round this are spindle-shaped epithelial cells, and round these uninucleated leucocytes. Giant cells are found especially where the caseous change is relatively not active. Caseation, softening, calcification or fibrous changes may occur. The general action is to produce Pyrexia, perspiration, wasting and waxy degeneration.

In cattle the organism is very often found in the giant cells, and scattered irregularly through the cellular connective tissue elements of the lesion, if little or no caseation is present.

In the horse and in birds one may see enormous numbers even though the lesion be not very acute.

Paths of Infection.—(1) Air passages ; (2) alimentary canal ; (3) wounds in the skin ; and (4) the genital organs, but this method is very rare. If infection is *via* the alimentry canal, the disease usually commences in the pharynx or small intestine.

To detect Tubercle in Carcasses.—It is necessary to examine most carefully the following portions of the carcass :—(1) The pleura and peritoneum for grapes, which present the appearance of nodules of varying size on the serous mem-

branes. If either the pleura or peritoneum in part or whole is missing, the carcass should be rejected. (2) The various organs, *e.g.*, the liver, spleen and kidneys for the presence of tubercles or small nodules; and if these organs are missing, then examine the glands (this should be done in all cases). (3) The glands to be examined have already been referred to in detail, but special attention should be paid to the postpharyngeal, because they are often early infected, and to the sub-maxillary and pre-auricular because these are often overlooked by the butcher, who may remove some of the more prominent amd more easily accessible glands. If on examining a carcass, it is found that the organs have been disposed of and the glands removed and the pleura stripped from the ribs and the diaphragm removed, it is almost certain that the carcass was tuberculous, and it should be condemned. Stripping of the pleura *per se* cannot always be held to be indicative of an attempt to hide evidence of Tuberculosis, as it may have been removed as the result of staining, owing to oversticking in the course of slaughter. This staining spoils the appearance. The glands should be most carefully examined before passing as fit for food any animal which has had its pleura stripped for such an alleged cause.

The question of the suitability for human consumption of an animal suffering from Tuberculosis is at present almost entirely determined on the lines of the recommendations of the Royal Commission, appointed to report on this question. They advised that the entire carcass should be seized, when—

(1) there was miliary tubercle of both lungs;

(2) Tubercular lesions were present in the pleura and peritoneum;

(3) Tubercular lesions were present in the muscular system, or in the lymphatic glands lying in or between the muscles;

(4) Tubercular lesions were present in any part of an emaciated carcass ;

and that the affected organs or parts containing lesions be condemned when the lesion was confined—

(1) to the lungs and thoracic lymphatic glands ;
(2) to the liver ;
(3) to the pharyngeal lymphatic glands ;
(4) and to any combination of the above when collectively small in extent.

In the case of the pig, if Tuberculosis is present in any degree, the carcass should be condemned.

Experimental Inoculation.—If a guinea-pig be inoculated in the leg, in 9 or 10 days the popliteal and superficial inguinal glands on the same side will be enlarged ; in 14 days the deep inguinal and lumbar will also. In 21 days the retro-hepatic and splenic glands are enlarged and the spleen and liver show small nodules. Later on, it is difficult to say which side was inoculated and the difficulty increases the further forward one goes. If the guinea-pig be inoculated in the peritoneal cavity, the first gland to become enlarged is the retro-peritoneal near the junction of the mesentery and the abdominal wall, next the retro-hepatic and then the post-sternal.

PSEUDO-TUBERCULOSIS.

As the name implies, this disease is occasionally mistaken for Tuberculosis. It is seen frequently in sheep and affects cattle and swine also. It is due to the presence of certain forms of strongyli ; other varieties are seen in rabbits and cats. Sheep are affected with the Strongylus filaria and rufescens ; cattle with the Strongylus micrurus, especially young cattle, and swine with the Strongylus paradoxus.

The strongyli cause lesions in the lungs, and are liable to be mistaken for Tuberculosis. It must be remembered

that this disease is rare in sheep (·2 to ·3 per cent.). The strongyli are filiform bodies with lobed tails occasionally. They live in the bronchi, and the female travels to the terminal alveoli, and there lays her eggs. These eggs may undergo development and set free larvæ which may cause irritation in various parts of the lung, or the young may cause a localised inflammation. As a result of the irritation caused by the eggs or the larvæ, Bronchitis or diffuse Pneumonia may arise and, in addition, small nodules form and it is these nodules that are liable to be mistaken for true Tuberculosis.

Structure of a Nodule.—In the centre one may see an egg containing an embryo, or a free embryo may be seen, or yet again, only a degenerated mass may exist. There is considerable small-celled infiltration of the alveolar walls and an accumulation of corpuscles in the alveoli involved. At a later stage, fibrous tissues form in the alveolar wall. In the neighbourhood of the worm itself, one may see degeneration simulating a fibrous capsule. Occasionally calcification occurs in the nodule. It is very rare to see a giant cell in these nodules.

Mode of Spread.—All the year round numerous free embryos are found in the mucus in the air passages. In England they are specially numerous in March and September. They escape from the animal with the mucus and live on the moist ground for a very considerable time. They can resist drying for a long period. They are probably taken up in the food. Their life history is not accurately known and it is a matter for conjecture whether from the stomach they bore a way to the lungs, or whether, *via* the œsophagus, they creep to the larynx and thence to the lungs. The disease is not communicable to man.

Appearance of the Lungs :—The lung appears firmer than usual. The surface presents a blotched appearance. Some parts are brown-white, others are pink or pale-pink in colour.

Nodules of a yellowish white colour are seen on the surface and also in the substance of the lung ; they are of firm consistence and vary in size from a pin's head to an ordinary marble. Only the very bad ones need be seized.

ACTINOMYCOSIS.

Actinomycosis affects man, oxen, horse, sheep, pigs and dogs. It is most common in cattle. It is sometimes seen in sheep and pigs, occasionally in the horse and dog, and more rarely in man, resulting from direct injury from the spikes of barley and not from infected meat.

In man and the pig, disease is characterised by chronic suppurative processes, which often extend to internal organs producing a chronic Pyæmia. In the ox and horse, it is characterised by abundant formation of granular tissue resulting in tumours, especially on the tongue in cattle.

The disease is due to a parasite which grows in the form of little round masses about the size of a small pin's head. When suppuration is present, they lie free in the pus and, when suppuration is absent, they lie embedded in the granulating tissue. They may be transparent or jelly-like, opaque, or may appear as white, yellow, green or black according to age.

When examined under a microscope, these small masses are seen to be composed of three elements : (1) comparatively thin filaments, often of great length, between which is a fine granular substance ; (2) coccus-like bodies formed by segmentation of the filaments ; and (3) club-shaped bodies formed by a hyaline swelling of the sheath at the end of a filament.

In the human being, it produces chronic inflammatory changes usually ending in suppuration, which spreads slowly, and is usually associated with an abundant growth of the organism in the filamentous form. Multiple foci of suppuration are seen at the spreading margin.

In cattle, the disease assumes more of a formative type, resulting in abundant growth of granular tissue, forming tumours more or less nodulated. It is rarely seen to a greater extent than 1 or 2 per 1,000 in England. It affects the tongue, lower jaw, lungs, tonsils, liver and intestines, etc.

The tongue becomes large and very hard, due to a great accumulation of fibrous tissue under the mucous membrane, especially in the back and sides. The jaw becomes enlarged, bulged out and nodulated; when cut across, dense bony tissue is seen with spaces containing soft purulent granulation tissue, occasionally a cavity filled with pus is found, or nodules with a mulberry-like spot in the centre.

There is, as yet, no evidence that man is directly infected with the disease from animals, but nevertheless, any animal infected with Actinomycosis should be condemned as human food. This is the rule in most of the American States and in England.

BOTRYOMYCOSIS OR DYSCOMYCOSSIS.

Botryomycosis or Dyscomycosis is a disease very rare in man, common in the horse, less so in cattle. It is a chronic disease resulting in the formation of large masses of fibrous tissue in various parts of the body. These masses enclose small purulent foci and may cause fistulous openings just as in Actinomycosis. On microscopical examination, instead of the typical Actinomycosis in small lobuli, one finds clumps of small cocci in rounded masses of from 50 to 100 m.m. in diameter, each mass being surrounded by a zone of hyaline matter, and containing small yellow granules. Each mass is held together by fibrous tissue. The disease is due to a coccus—the Botryomycosis Equi. Grown on potato, it produces a bright orange colour like the Staphylococcus pyogenes aureus, but differs in causing a smell of fresh strawberries. There is no evidence that the flesh is capable of producing the disease in man, in whom the disease is very

rare. Cattle and the pig suffer but rarely. The sheep, goat, dog, rabbit, guinea-pig and mice may suffer possibly. In the horse, the skin, subcutaneous tissue and the fibrous tissue of the spermatic cord may be affected. In the ox, the udder and viscera are occasionally attacked.

ANTHRAX.

Anthrax is a disease which occasionally occurs epidemically among herbivora, especially oxen and sheep. The horse, deer and goat are less susceptible. Rabbits, guinea-pigs and mice are very susceptible. Pigs are sometimes attacked. The white rat, adult carnivora, birds and amphibia and Algerian sheep are not susceptible ; the brown rat is. The disease is readily contracted by man. Anthrax is a very common disease in India, Persia and Siberia.

It is due to a large non-motile, spore-bearing bacillus, which has a comparatively low power of resistance, being unable to stand exposure to 60° for long. If kept dry at ordinary temperature, it dies in a few days. It can grow without oxygen, but it grows much better with it. No spores are formed in the absence of free oxygen, and this fact has great value in the question of the disposal of carcasses of animals dead from this disease. Though the organism itself has but low power of resistance, it is quite the reverse with the spores : if kept dry, they will live for a year or more. They resist boiling for five minutes and require a dry heat of 140° for several hours to kill them. They will live in sewage, in the soil and in distilled water for several months. Spore-formation does not occur in the body of a dead animal owing to the absence of free oxygen. Both the bacilli and the contained spores die speedily if kept within the intact carcass. This points to the urgent necessity of preventing the effusion of blood when disposing of a dead carcass.

The disease manifests itself in various forms. The worst form is very sudden ; it is seen especially in sheep and cattle, and, from its nature, is called fulminant or apoplectic. The animal has sudden loss of appetite, trembling movements, irregular movements, backwards or to one side, dyspnœa, cyanosis, convulsions, ejection of blood by the nose or with the urine and fæces ; death occurring in from a few minutes

to 4 or 5 hours. Another form is splenic fever or splenic apoplexy. This is especially virulent in oxen and sheep. The animal is excitable and restless, and its temperature rises 3° or 4°. The mucosæ are congested, and in sheep this may show on the finer parts of the skin, *e.g.* inside the forearm or thigh. There may be tremors, erection of the hairs, dullness, prostration, thirst, grinding of the teeth, colic, passage of mucus and blood per rectum, and discharge of blood from the nose. The blood is very dark and usually has a thick tarry appearance. Death usually supervenes, in sheep in 24 hours, and in cattle in from 2 to 5 days, and in horses 1 to 6 days. In more prolonged cases, there is widespread œdema, extensive enlargement of lymphatic glands, and, in those about the neck especially, necrosis and ulceration may occur. This sub-acute form is seen more particularly in horses, which are less susceptible than cattle and sheep.

Post-mortem appearance in the Ox.—The spleen is very greatly enlarged, dark red in colour, very soft and friable. The liver is enlarged and congested and shows signs of acute cloudy swelling. The kidneys and lungs are also congested. The heart shows cloudy swelling, and the intestines are congested and filled with a bloody fluid. The glands, especially the mediastinal, mesenteric and cervical, are much enlarged and surrounded with œdematous tissue ; the lymphatic vessels are also swollen and both the glands and vessels contain bacilli, as also do all the organs, especially the spleen. The flesh is darker than usual and is also often dropsical and bile-stained. Putrefaction of the carcass is often rapid. In the very rapidly fatal cases, the changes in the blood and tissues may be but little marked, and after removal of the enlarged engorged spleen and infiltrated internal organs, the carcass is sometimes placed on the market and may pass unnoticed. In more prolonged cases, the changes mentioned above have occurred, and there is therefore more liability of detection.

The flesh of an animal suffering from Anthrax, in whatever stage, should invariably be condemned. Great care must be exercised, in disposing of the carcass, to prevent any effusion of blood. The best method of disposal is by cremation of the entire carcass.

Anthrax in the pig is comparatively rare; when it does occur, the body is livid and sodden and darker in colour, and the spleen and other organs are affected much as in the case of the ox.

EMPHYSEMATOUS ANTHRAX.

Synonyms.—Symptomatic Anthrax, black quarter, black leg, or quarter ill. An acute infectious disease characterised by hyperthermia, lameness, and a localised, hot, painful swelling on the shoulder, quarter, leg, neck, trunk or elsewhere, tending to emphysema and gangrene, and, when incised, showing black extravasated blood, clotted or frothy. It is due to a rod-shaped microbe with rounded ends, found singly or united in pairs or very short filaments. These microbes form spores even in the body of the affected animal. They are motile and anærobic.

Post-mortem appearance.—The carcass is liable to be bloated with gas and a reddish, frothy fluid often escapes from the mouth, nose and anus. Gas is particularly abundant in the neighbourhood of the tumour, which on being incised exposes a mass of extravasated blood and lymph exudate. The muscles beneath are of a dirty brown or black colour and readily break down under pressure of the finger. They are infiltrated with gas and crepitate on pressure, and in them the bacilli are present in large numbers. The swelling may occur also in the tongue, pharynx, pleura, lungs, heart, mediastinum, pericardium and the peritoneum, etc. The liver and kidneys may be hyperæmic. The spleen is rarely enlarged. The disease is often speedily fatal.

The carcass should be cremated without being cut in any way. The meat is entirely unfit for human consumption.

RINDERPEST OR CATTLE PLAGUE.

Rinderpest is a contagious disease indigenous to the Asiatic steppes of Russia, India, Persia, China, Burma, Tibet and Ceylon. It has a period of incubation varying from 4 to 8 days; it runs a definite course and frequently terminates

fatally. Though bovines are by far the most susceptible, and it is by them that the disease is mainly propagated and in them that the mortality is greatest, infection may be communicated to the sheep, goat, gazelle, deer, camel, giraffe, dromedary and buffalo. The horse, dog, rabbit, bird and man are immune. The earliest symptom is an abrupt rise of temperature (104° F. to 108° F.), usually reaching its maximum on the third or fourth day, falling when other symptoms are developed. In two days the rise of temperature is followed by white eruptions on the inner sides of the lips closely resembling thrush, and there is an alteration in the appearance of the mucous membrane of the vagina. The following day the animal appears definitely ill and its appetite is less. After the fourth day the animal is seriously ill, drooping head, hanging ears, distressed look, rigors and twitchings of the superficial muscles, failing pulse, oppressed breathing, fetid breath, and discharge from mouth, nose and eyes. On the sixth day the pulse becomes feeble and thready and the limbs weak, the temperature begins to fall also, the belly becomes tender, and the preliminary constipation is followed by Diarrhœa with much rumbling. When the disease is fully established, the respirations are often characteristic, consisting of a sudden closure of the glottis, with an audible clicking sound in the course of an expiration and, after a perceptible interval of holding the breath, the expiration is resumed with or without an accompanying moan. The secretion of milk is arrested, often in a sudden and complete manner. The animal grinds its teeth, arches its back, and draws its legs together. In the mouth, in some cases, small round nodules, seldom larger than a millet seed, are observed, through which a yellowish material may be seen. In a few hours the epithelium gives way leaving a small superficial ulcer, which however heals rapidly leaving no scar. The vaginal mucous membrane becomes of a deep dark-red colour.

Post-mortem appearance.—The mucous membrane of the mouth, larynx and pharynx, and of the fourth stomach and small intestine are marked with streaks and patches of red and the follicles are reddened. The terminal portion of the rectum is especially liable to marked congestion and blood extravasations with more or less desquamation and erosions. The spleen is normal, in strong contrast to that organ in Anthrax, in which disease similar lesions are found in the intestine, specially the rectum. The liver is usually rather pale and soft. The skin may be yellowish, red or dark with a general scurvy condition and eruptions of a rounded wart-like nature on the teat and udder. The blood is at first but little altered, later, however, there is a marked increase of fibrin and a decrease of water; and before death it becomes black and incoagulable. In the advanced stages, the flesh is dark, has a disagreeable odour, and may crackle on pressure.

The flesh is considered unfit for human consumption and should always be destroyed.

FOOT AND MOUTH DISEASE.

Foot and Mouth Disease is an acute infectious disease of lower animals, especially ruminants, characterised by a slight fever and the eruption of vesicles or bullæ on the skin and mucous membranes and most usually seen on the feet, mouth and teats. Sheep and pigs suffer less often. Man is susceptible, as are horses, dogs, cats and fowls, when they are inoculated or fed upon infected material, *e.g.*, milk or other products.

Symptoms.—The incubation period varies from 36 hours to 5 days, and occasionally longer. There is a rise of temperature (102° F.–103° F.), with shivering, dryness and heat of the muzzle, redness of the mucous membrane of the mouth and teats, and impaired appetite, tenderness of the feet and extension backward and shaking of the hind feet in turn. On the second day, the eruption usually appears and the fever moderates and bullæ may be found on the inside of the lips and cheeks or on the palate and tongue with, in many cases, a congested areola. These vesicles burst leaving a red sore covered with the remains of the vesicle, suppura-

tion may ensue and, if very severe, abscesses may form in the liver and lungs. On the teats the bullæ appear about the same time, but they are usually smaller than the buccal bullæ. On the feet eruption shows especially in the interdigital space and, if exposed to dirt, these ulcers may extend and result in the shedding of the hoof.

The Board of Agriculture do not permit infected animals to be brought into public abbatoirs. If the disease is not very severe, the flesh may be passed for food, but the affected parts are not to be used as food.

EPIZOOTIC PLEURO-PNEUMONIA.

Epizootic Pleuro-Pneumonia is an infectious, febrile disease occurring in cattle, characterised by a prolonged incubation period, an insidious onset, inflammation of the bronchi, lungs and pleura, and a profuse exudation into the interlobular connective tissue and chest, and a very extensive area of consolidation in the lungs. Several micro-organisms have been assigned as the cause of this disease.

Post-mortem appearance.—If death has occurred early, the lesions are essentially pulmonary, though the pleura and mediastinum may be implicated. The bronchial, mediastinal and prepectoral glands are enlarged. Later, the glands of the pharynx, mesentery and sublumbar region and groin are enlarged and there is hyperæmia and congestion of the intestinal follicles and intermuscular tissue. The lungs show various stages of hepatization. The flesh is dark.

Pleuro-Pneumonia of cattle does not appear to be conveyed to man. In Germany the flesh is allowed to be sold after it has been thoroughly well-cooked and left till perfectly cold. The lungs, however, are to be destroyed in every instance. In the early stages of the disease, the flesh appears to be normal in appearance, colour and consistence, later it becomes emaciated, discoloured and flabby. In England it is customary to condemn only those carcasses which show signs of the disease in the muscular tissue, and to pass the carcass if it presents no departure from natural conditions.

GLANDERS AND FARCY.

Glanders is of importance to the meat Inspector mainly because of the occasional substitution of horse flesh for that of the ox.

Glanders chiefly affects horses, mules and asses. It is also seen in guinea-pigs and field mice, and in carnivora such as dogs, cats, lions and tigers. It also affects man as the result of inoculation. Cattle, swine, the house and white mice are immune.

In the horse one may see either Glanders proper, or Farcy which is a different manifestation of the same disease, or both may be seen together. The disease may be acute or chronic. The disease is characterised by a rise of temperature and rigors. The septum nasi and adjacent parts are most affected. The mucous membrane of the nose becomes congested, sometimes only on one side, and later nodules form, which are at first firm and translucent and of a greyish appearance. They are accompanied by a profuse discharge. Later, the nodules soften in the centre and ultimately ulcerate; several small nodules may coalesce to form one large ulcer with a raised margin. The septum is usually first affected and the turbinate bones may become so later. The lungs may show Broncho-Pneumonia and nodules. The Pneumonia may be more or less general and accompanied by intense hyperæmia. The nodules exist in various parts, especially under the pleura; they may be very small, but are generally larger than the tubercular nodule; moreover, they are fewer in number, and do not show the same tendency to coalesce. There is marked hyperæmia around them. Microscopically, they are seen to consist of, in the centre, leucocytes, chiefly with much exudation of blood-stained fibrinous lymph in the alveoli, the walls of which are very congested. There are no giant cells. Later, the central part becomes granular and opaque, and around this is a zone of leucocytes and epitheloid cells

and perhaps a few giant cells. Associated with these lesions in Glanders proper, there is usually some inflammation of the glands in the neck, and mediastinum, and there may be grey or yellowish nodules in the spleen and liver and orchitis. Dyspnœa, difficult deglutition, Diarrhœa and emaciation are present usually.

Farcy—or Glanders of the Skin—is less common in chronic Glanders than in acute. Small swellings, which are really localised abscesses, form: the usual site being the limbs, flanks, shoulders, breast and neck. The nodules are known as Farcy buds and they vary in size from a pea to a moderate walnut. They cause secondary inflammation of lymph-glands and vessels, forming Farcy pipes or cords. Infection occurs through an abrasion of the skin. The affected glands become larger and firm and may at a later stage suppurate and ulcerate. Secondary nodules may occur in the internal organs and on the nasal mucous membrane. Acute Glanders is generally seen in asses, chronic in horses, and both forms in mules.

The disease is due to the Glanders bacillus, which is a minute rod with rounded ends, straight or slightly curved. It is about the same length as the bacillus of Tuberculosis, but is slightly thicker. It is non-mobile, non-sporing and non-retentive of Gram's stain. It is sometimes seen in short filaments. In the tissues it lies scattered irregularly among the cellular elements, mostly extra-cellular. It is sometimes seen in the leucocytes and connective tissue corpuscles. It is most abundant in acute lesions and may be difficult to find in chronic nodules. It is not killed at once by drying, but is ultimately. It is not easily killed by putrefaction and it offers but a feeble resistance to heat and antiseptics. Injected into the peritoneum of guinea-pigs, it is followed by a very rapid and semi-purulent affection of the tunica vaginalis in 3 to 4 days, and there are also nodules on the peritoneum. The diagnosis of Glanders is assisted by the inoculation of guinea-pigs and by the injection of mallein into the suspected animal.

Mallein is prepared by growing Glanders bacilli on glycerine bouillon, subsequently sterilising and filtering and adding a little carbolic acid (5 per cent.) to prevent decomposition. One c. c. is injected subcutaneously at the base of the horse's

neck. The animal's temperature should be taken before injection, and at 6, 10, 14 and 18 hours after. In a Glandered animal, at the site of inoculation a painful local swelling forms, which is at its maximum size (5 inches) in 24 hours. The temperature rises 1·5 to 2 degrees and is at its maximum in 8 to 16 hours. If the temperature never rises 1½ degrees, the reaction is doubtful. In negative animals, the temperature may rise 1 degree and the swelling may reach 3 inches, but it subsides next day.

Glanders and Farcy are not always acute forms of disease but may both be chronic. The disease is, however, always infective. Indeed, the so-called "Occult Glanders," the only external manifestation being occasional slight nasal discharge, is infective. As Glanders is readily and directly communicated by the nasal discharges, characteristic nodules are soon produced probably in from a few days to a fortnight. The intensity of the disease is proportionate to the rapid formation and softening of the nodules. The human subject, like the horse, may be inoculated through wounds or scratches, or through the application of the nasal discharge of a Glandered animal to the mucous membrane of the nose or mouth. Acute Farcy in man runs a very rapid course, the average period being from two to three weeks, and perhaps one patient in ten may recover.

At a temperature of 77 deg. Fah. the bacilli grow and develop outside the body, especially in such material as fodder, manure and stable refuse. However, a temperature of 131 deg. Fah. continued for ten minutes is sufficient to destroy the bacilli.

A stable which has been occupied by a Glandered horse may remain infective for some weeks. It may be efficiently disinfected by good washing with boiling water. A solution of carbolic acid (containing 4 per cent) applied to the nasal discharge will make it innocuous in a minute.

The duties of the local authority as regards Glanders are to disseminate information about it; to see that all cases are duly reported and dealt with, so as to prevent the spread of the disease; and to inspect, more efficiently than is usual, all knackers' yards, and prevent the sale of Glandered carcasses.

The experience of the siege of Paris in 1870 does not tend to show that any ill-effects were experienced as the result of eating horses which had suffered from Glanders and Farcy.

SHEEP-POX.

Sheep-pox is a contagious and infectious disease analogous to Small-pox and Cow-pox. It prevails among sheep

and goats and is characterised by early and marked hyperthermia followed by the appearance, on the bare or merely hairy portion of the skin, of diffuse redness, a rounded papular eruption passing into vesicles, pustules, and scabs which ultimately fall off in 15 to 20 days. There are two main forms: (1) malignant, in which the sheep lose their eyes, the wool falls off, the skin cracks in a zigzag manner and the nostrils fill with a fetid discharge; and (2) benign, in which a genuine blister forms, leaving pits on which the wool never grows again.

Symptoms.—An initial fever followed later by red nodules deeply bedded in the dermis and usually first seen on the inner aspect of the arm and thighs and the cheeks, lips and the undersurface of the tail and round the anus. The animal is usually dull and thirsty, and the eyes bloodshot. The papula develops into a flat vesicle which ultimately becomes turbid and, forming a crust, is cast off with the epidermis.

The head is held low, the animal lies by itself in a corner with breathing quick and short, and a discharge from the nose. A secondary eruption may occur, but only papulæ form. The duration is usually about three weeks but, in cold weather, it may reach four.

Post-mortem appearance.—The body is swollen and exhales a fetid odour. The eye and nose are closed by a dry discharge. The mucous membrane of the mouth, nose, pharynx, æsophagus, larynx, bronchi and of the rumen are covered with large nodules, and occasionally in the larynx there are ulcers. The lymphatic glands in various parts are enlarged and the subcutaneous tissues are engorged with blood. The pleuræ are often congested and there may be petechiæ, exudation and discoloration. The flesh becomes soft and dropsical.

The flesh should be condemned as unfit for human food. Except in the early stages, the flesh has a most disagreeable odour. In the later stages the flesh becomes soft, pale and dropsical.

Swine Erysipelas.

Swine Erysipelas is a disease of swine, characterised by high fever, great prostration and muscular weakness and a violet hue of the visible mucosæ and a red or violet discoloration of the skin in spots or patches, or even universally, and enlarged lymphatic glands and spleen. The disease is due to a bacillus which is found in small numbers only in the blood and vascular system, but in large numbers in the lymphatic glands, spleen, kidneys and red marrow. The incubation period is about 3 to 4 days. The animal shows signs of fever, the respiration and the heart are accelerated, the animal refuses to move; at first there is costiveness, later Diarrhœa. Discoloration of the skin appears early; it may be red or violet, and is noticed round the root of the ears, neck, breast, the inside of the arms, and thighs, abdomen and perineum. The isolated spots may coalesce and form one large mass on the abdomen or the back. The mortality is very high.

Post-mortem appearance.—There are many extravasations into the skin, the lymyh-glands are enlarged and become dark-red or almost black in colour. The liver and spleen are congested, as are also the lungs and kidneys. Rigor mortis is lessened and, if the disease has been of long duration, there is emaciation and Dropsy.

Hog Cholera.

Hog Cholera is a contagious disease of swine, of an acute or subacute form, characterised by fever, congestion, exudation, ecchymosis and necrotic ulceration of the intestinal mucous membrane and of the stomach, and by a profuse Diarrhœa, enlargement of the lymphatic glands with congestion and blood extravasations, by effaceable blotches and ineffaceable petechiæ of the skin, snout and visible mucosæ, with a tendency to necrotic changes, and less frequently by pulmonary congestion and degeneration and by a high mortality. The disease is due to an actively motile bacillus, mostly occurring in pairs.

Post-mortem appearance.—The spleen is found enlarged, soft and dark.

There is no evidence that the flesh of swine suffering from Hog Cholera causes illness in man. In Germany, the sound flesh of animals infected may be sold, with a declaration as to its nature, after thorough cooking. The infected parts must be burned or buried. In England, the disease is considered one which renders the flesh unfit for food.

COCCIDIOSIS.

Coccidiosis is a disease met with in rabbits, sheep and cattle. It is very occasionally seen in man. It is caused by sporosperms. On examination, the liver of the affected rabbit is seen to be studded with nodules which may approach ½ inch in diameter. A common form is the Coccidium Oviforme. It is to be found in the bile ducts, or enclosed in the epithelial cells thereof. If a nodule be opened, clear, ovoid bodies with a capsule of high refraction giving a double contour will be seen. The fæces of affected animals contain these bodies. Somewhat similar forms may be seen in dogs, calves, sheep and birds. Development takes place in the epithelial cells of the liver and bowel.

In so far as suitability for human food is concerned, it is sufficient that the liver and intestines be destroyed.

MALIGNANT ŒDEMA.

Malignant Œdema is an acute disease of domestic and wild animals, characterised by a painful and often crepitating swelling in the vicinity of the affected part. The tissues become swollen and, in the case of an open wound, there are a profuse discharge of a yellow, watery or serous aspect, and bubbles of gas possessing a fetid odour.

The flesh should be destroyed.

RABIES.

Rabies may attack dogs, wolves, foxes, jackals, cats, lions, tigers, pigs, horses, cattle, sheep, goats, deer, rats, mice, chickens and pigeons.

The flesh of edible animals should be destroyed.

ACUTE RHEUMATISM OR JOINT ILL.

The animal is lame, or may even be unable to rise. The affected joints contain a clear fluid which may, however, become purulent, and abscesses may form in the neighbourhood of the joint. When the disease is severe, the flesh becomes dropsical, in which case it becomes unfit for human consumption.

PARASITIC DISEASES OF ANIMALS.

There are 3 main types concerned : the Trematodes, Cestodes and Nematodes.

Trematodes (flukes).	Cestodes (tapeworms.)	Nematodes (round worms).
1. Short flat worms.	1. Long flat worms.	1. Long and cylindrical.
2. Alimentary canal present.	2. No alimentary canal.	2. Canal present.
3. Nearly all are hermaphrodite (Bilharzia, not so.)	3. Hermaphrodite.	3. Sexes separate.
4. Skin chitinous.	4. Skin cellular.	4. Skin chitinous.
	5. Adult worm inhabits the alimentary canal.	

It is possible to refer only to a few of the more common worms which are found in animals and which in turn affect man. Those mentioned are more or less typical of their

class, and are mentioned as such and not necessarily because they are found in India.

FASCIOLA HEPATICA (THE LIVER FLUKE).

This worm belongs to the order of Trematoda.

Its geographical distribution is cosmopolitan.

Its hosts are man, cattle, sheep, swine, and sometimes the horse and rabbit.

It is very common in the bile ducts and liver of sheep, less so in cattle.

Its habitat is the liver and bile ducts.

The Distoma Hepatica are flat, conical worms, always longer than broad. At the anterior end is situated the mouth surrounded by a sucker. A second sucker is situated in the median ventral line. The surface of the flukes is generally more or less covered with minute spines.

The digestive tract consists of the mouth and pharynx, below which is a circular muscle which cuts off the œsophagus from it. Near the ventral sucker, the œsophagus divides into two blind sacks which run parallel to the sides and give off branches which again divide. A few short branches are given off internally. None have an external opening. A central canal runs from the junction of the upper and middle third to the posterior end of the worm, terminating in the foramen caudale. At the anterior end, it has three branches, one medial and two lateral ; the main trunk gives off branches which subdivide.

Genital organs.—The worm is hermaphrodite. The genital pore is in the medium line, just above the ventral sucker. The penis is in a pouch which also encloses the receptaculum seminalis into which run the vasa deferentia from the testes which are two in number. The female organ comprises the vaginal orifice which is very small and is situated in the genital pore near the penis. The uterus is much coiled and lies just above the testes.

Life-history.—This is very complex, for the adult parasite, instead of producing young similar to itself and capable of developing into adults in cattle, produces eggs which develop into organisms totally different to the adult form, living a parasitic life in other animals. The ova are oval in shape and about ·14 m.m. by ·11 m.m. in size. They are ciliated and have an operculum and contain an embryo. The eggs escape from the uterus of the adult and are carried to the intestine of the host with the bile, and then pass out with the fæcal matter. Many of them become dried and undergo no further development, but others are dropped in the water of marshes or into damp soil. After a longer or shorter time, a ciliated embryo is developed; the time varying with the temperature: at 20° to 26° (C.) it takes 10 days to 3 weeks, at 16° (C.) 2 to 3 months. As long as the eggs remain in the dark, the miracidium will not escape from the egg. When, however, the free, swimming, ciliated miracidium does escape, it swims in the water and seeking out certain varieties of snails, attacks them and, seeking the liver there, develops into a sporocyst which grows slowly at first and then more rapidly. When they are about two or three weeks old, rediæ escape from them and in the liver of the snail increase in size. The redia has a mouth, pharynx and a blind intestinal canal.

The redia, as well as the sporocyst, may be looked upon as a female organ and in its body cavity are found a number of germ cells which develop into cercariæ, which resemble the adult in having suckers and an alimentary canal; but they have no genital organs. They have a large tail. When developed, they leave the body of the sporocyst or redia and the snail, and swim about in the water. After a time they attach themselves to blades of grass, etc., and lose their tail. They now remain quiescent until they are swallowed by some other animal, when, *via* the gall-ducts or possibly the portal veins, they reach the liver where they develop into the adult hermaphrodite. This curious development lasts about 10 to 12 weeks, and there is a constant potential increase in the number of individuals; for the sporocyst may give rise to 5 to 8 rediæ and each redia to 12 to 20 cercariæ and each adult to from 37,000 to 45,000 eggs. This fertility is necessary because the life-history is complicated, and comparatively small chance exists for any one egg to complete its life-history. As a general rule, it can be said that the disease is found usually on the lowlands, marshes, valleys, etc.

If the disease be not widespread, only the liver of the sheep need be destroyed.

If there is marked anæmia, cachexia, general weakness and bile discoloration of the tissues, the flesh should not be placed on the market.

In the sheep the worm is easily demonstrated by pressing on the bile ducts.

CESTODES OR TAPEWORMS.

The more important cestodes, as far as meat inspection is concerned, are four in number, *viz* :—

(1) Tænia Mediocanellata (Synonym, Tænia Saginata),
(2) Tænia Solium,
(3) Tænia Echinococcus, and
(4) Bothriocephalus Latus.

The cestodes are long, ribbon-like worms. They exist in different forms in the alternate hosts. The adult tapeworm inhabits the intestinal canal.

TÆNIA MEDIOCANELLATA (CESTODE.)

The Tænia mediocanellata (*Vel. Saginata*) is the commonest found in England. It is distributed over the whole world, being found in Europe, Asia, Africa, America and Australia. Its chief host is man and its intermediate host is the ox.

Description of the adult worm found in man.—This tapeworm can approach 25 feet in length. The whole body of the tapeworm (the strobila) consists of a head and neck (the scolex) and a series of segments (the proglottides).

The head is somewhat square-shaped, about $\frac{1}{8}$th of an inch in size, and is provided with four suckers. There are no hooklets and no rostellum. There is much pigmentation, however. Growing out from the posterior end of the head is the thin neck which merges into the segments or proglottides. Each proglottis is hermaphrodite. The male organs comprise testes and vasa deferentia. The female organs comprise ovary, uterus and vagina. The uterus is composed of two main branches and a large number of ramifying lateral branches, which are so numerous and closely packed as to appear parallel. They number 20 to 30. The genital pore is sometimes alternate but may vary greatly.

The proglottis has a narrow anterior part and a broader posterior. In all there are a vascular apparatus and sexual organs.

The ova are impregnated in the uterus and, after a lapse of time, pass down to the vagina.

The Tænia mediocanellata produces about 1,200 segments and from about the 600th each segment is sexually mature.

Life-History.—Starting with the adult tapeworm in the intestine of men, the egg escapes from the uterus of the worm and passes out with the excreta, or segments containing eggs may break loose and pass out. In either case, the eggs become scattered upon the ground or in water and reach cattle by their food or drink. Upon arriving in the stomach of the ox, the egg shells are destroyed. The embryo then bores its way through the intestine walls with the aid of six minute hooks with which it is provided and wanders to the muscles where it rests, or if it bores its way into a vessel, it may be carried by the blood to any organ in the body. When it comes to rest, it loses its hooks and increases in size, developing into a small round bladder worm. The head of a future tapeworm is then developed in an invagination of the cyst wall, and the complete organism thus formed is known as a cysticercus or bladder worm. The total time taken is about 7 to 18 weeks.

The Cysticercus bovis has been found in the skeletal muscles, heart, the adipose tissue round the kidney, sub-peritoneal connective tissue, lymphatic glands, brain, lungs and liver.

It lies between the muscular fibres.

It is not known in the human subject. It is white or grey in colour and has a small yellowish spot on it due to its invaginated head. The bladder contains but little liquid, and has only one scolex.

These bladder worms are specially seen in the jaw, muscles, diaphragm, tongue and shoulder. The breast, eyelids and heart are also frequently affected.

The only parasites likely to be confused with the cysticercus are (1) the Cysticercus tenvicollis which, however, has 28 to 40 hooklets and, moreover, is found under the serous membranes of the body cavity and not in muscles, and (2) the Tænia echinococcus in which either the head is absent, or there are numerous armed heads in broad capsules, the cuticle is thick and laminated and its form is round, where-

as in the Cysticercus bovis the form is oval, the cuticle thin and there is an unarmed single head.

TAENIA SOLIUM (CESTODE).

The Tænia solium is very common in Ireland and Germany. The adult stage is seen in man, and the larval (the Cysticercus cellulosæ) in the pig.

The adult worm as found in man.—The head is smaller than that of the Tænia mediocanellata, measuring about ½ inch. It has four suckers and a rostellum, at the base of which are two rows of hooklets numbering about 26 and rarely exceeding 30. It is smaller than the Tænia media and but seldom reaches more than 15 feet in length. The proglottides resemble those of the Tænia media in shape, but are smaller. The genital pore is lateral and alternates regularly. The uterus is less branched, having about seven to ten only. There are about 850 segments, each being sexually mature after the 450th.

Life-history.—The life-history is exactly the same as in the Tænia mediocanellata, except that the pig, and not the ox, is the intermediate host and that this bladder worm is occasionally found in man. It is rare to find more than one T. mediocanellata in the same patient, but several cases are on record of two or more T. solia being found. The pork bladder worm is larger than the beef, reaching a maximum of half an inch. It is usually found in the muscles of the tongue, neck, shoulder and in the liver and kidneys, abdomen, jaw, inter-costals, diaphragm, pectorals and the adductors of the hind legs. The parasite in the pig which is most likely to be confused with the Cysticercus cellœ is the Cysticercus tenvicollis, which is not transmissible to man. It is larger and has more hooks (28 to 40) and is found under the serous membranes of the body cavities and not in muscles.

Both measly beef and measly pork should be condemned.

TAENIA ECHINOCOCCUS (CESTODE).

The Tænia echinococcus is perhaps the most important parasite in meat inspection.

Its parasitic life is spent in any organ, but more parti-

cularly in the lungs and liver of man, cattle and sheep. The adult stage is seen in dogs, but not in man ; when eaten by dogs the hydatid developes into an adult tapeworm. It is also seen in the dingo, jackal and wolf.

The disease in man caused by the larval stage of this worm is known as Hydatid Disease.

The disease is very common in Ireland, India and Australia ; it is also seen in England.

Description of the adult worm.—The head is much smaller than that of the two preceding worms. It is about $\frac{1}{40}$ inch. There is a rostellum and also a double row of hooklets of two different sizes. In all, the hooklets number about 30 or 40. There are also four suckers.

Proglottides.—There are four segments only, of which the 4th alone is mature.

The worm is about $\frac{1}{4}$ inch long and the structure is but ill-defined. The uterus is central and presents a rosette appearance. The genital pore is laterally placed.

Life-history.—Starting with the adult worm in the small intestine of the dog, wolf or jackal, the eggs are scattered on the ground and are swallowed by the intermediate hosts (man, cattle, sheep, swine) in water, or food. Upon arriving in the stomach, the six-hooked embryo escapes from the egg shell and wanders, or is carried, to various organs of the body, *e.g.*, liver, lungs, ovaries, bones or skull, where, losing its hooks, it develops first into an acephalocyst, which may develop further. Any heads formed upon being swallowed by a dog, wolf or jackal then develop once more into an adult worm.

The cyst after a short time is seen to be composed of two layers: (1) a striated chitinous external layer, and (2) a parenchymatous layer of two parts, a superficial granular and a deeper cellular containing a water vascular system and muscular fibres.

Soon this inner parenchymatous layer becomes vesiculated and very granular here and there, a small cavity forms in which developes a scolex with a row of hooklets and four suckers. This may occur at several places. These daughter cysts separate and go into the body of the main cyst. If any of these scolices are eaten by the dog, etc., they develop into an adult tapeworm.

Sometimes a cyst remains single, and at other times it produces a large number of daughter cysts (seen commonly in man). Sometimes the daughter cysts are contained in fissures in the outer layers, finally becoming free

outside (seen in cattle—Echinococcus veterinorum). Sometimes many cysts appear which are not connected together, called Echinococcus multilocular; lastly, occasionally in the liver, lungs and peritoneum of cattle a large cyst is found without any head or hooklets in it. It is then recognised as a hydatid by the fact—

(1) that the fluid has no albumen in it;
(2) that the fluid has a low specific gravity;
(3) of the presence of the chitinous external layer.

This variety of cyst is known as an acephalocyst.

It must be remembered that the daughter cysts may give rise to grand-daughter ones.

Organs infected with the Echinococcus should be most carefully destroyed, so as to prevent dogs, etc., eating them.

In a country where the disease is prevalent, the companionship between man and dog should not be too intimate.

Under no circumstances should any dog ever be allowed into a slaughter-house.

All stray and ownerless dogs should be destroyed. This is a most important point in the prevention of the spread of this disease, and should never be neglected.

BOTHRIOCEPHALUS LATUS (CESTODE).

Bothriocephalus Latus is seen frequently in Russia, Sweden, Switzerland and Japan. It is rare in England. It is a very large worm and may attain 25 feet in length; it is reddish-grey in colour.

The adult life is passed in the intestine of man, the dog and the cat.

Its intermediate host is the common pike, the ling, the perch, and several members of the genus salmo.

Description of the adult worm as found in man.—The head is long and narrow. There are no hooklets, no rostellum and no suckers, but in place of the latter are two lateral slits or grooves like suckers.

The proglottides number about 4,000 and are sexually mature from about the 600th. They are short and broad.

The genital pore is central and the uterus is rosette-shaped.

The cystic stage is not fully known. The larvæ which escape from the operculated eggs are ciliated and swim in the water for a long time, until eaten by certain fish (pike, perch, etc.), when the cilia and 6 hooklets are lost. It is subsequently conveyed to man in his food.

THE GID BLADDER WORM (CŒNURUS CEREBEALIS) (CESTODE).

The larval stage is passed in sheep, calves and goats, and the adult stage in dogs and wolves. (*Tænia Cœnurus*).

Life-history.—Starting with the adult worm in the intestine of the dog, the eggs are scattered on the ground and, living 3 or 4 weeks in a moist place, are taken up by sheep or calves along with their food or water.

On becoming free in the intestine, the embryo bores its way through the internal wall and reaches the brain or spinal cord, probably aided in its wandering by the blood current. Arriving in the brain, the young worm loses its hooks and developes into a cyst, which preserves for some time the power of locomotion, and burrows small canals in the nervous tissue. In 14 to 19 days after infection, small cysts are found in the brain substance and similar structures are sometimes found in the muscles, especially of older animals. Those in the muscles generally atrophy and those in the brain develop causing the symptoms of Gid or Staggers.

When found in the sheep, the parasite should be destroyed by heat so as to prevent infection of dogs. In dogs the Tænia Cœnurus developes in 3 to 8 weeks.

TRICHINOSIS (NEMATODE).

The disease is due to the presence of the Trichina spiralis. This parasite is found affecting man almost throughout the world, especially where much pork is consumed, and when insufficiently cooked. The natural host would appear to be the rats and the disease is kept up by the habit they have of eating their dead. Pigs eat rats and perhaps portions of other infected pigs, and finally man eats the pig. The Trichina

spiralis in its adult stage lives in the small intestine. Its larval stage is passed in the muscles. It is communicated to man by eating the flesh of pigs and the disease Trichinosis is due to the emigration of the embryo. Trichinæ, present in the flesh of the pig, if encapsulated, may be seen with the naked eye as small round white specks, but often a microscope is necessary. To prepare a section, take a thin slice of flesh, place it in some liquor potassæ (1 in 9) and let it stand for a few minutes till the muscle becomes clear. The white specks stand out clear and the worm can be seen coiled up inside. If the capsule is too dense to allow the worm to be seen, add a drop or two of acetic acid. The cysts lie with their long axes parallel to the muscle fibres. The larvæ in the muscle are about ·6 to 1 m.m. in size; they lie coiled up in an oval capsule, which is at first translucent but later opaque and perhaps calcified. At either end of the capsule are small fat globules. When the diseased flesh is eaten by man, pig or rat, the capsule is dissolved and the embryo is set free. The larvæ develop in the intestine and become sexually mature in about 2½ days, and the female, after impregnation, produces about 1,000 eggs. In about one week these eggs set free small worms, and the male and female adult worms disappear. The adult male measures about 1·2 to 1·5 m.m. and the adult female about 1·5 to 2·0 m.m. As soon as born, the embryo trichina leaves the intestine and (*via* the peritoneum and connective tissues) in all directions penetrates to and lodges in the muscles, especially in the diaphragm and tongue muscles near their tendons. From the time of ingestion of the food to the lodgement of the worms in the muscles, about two weeks elapse. Sometimes 2, 3 or 4 worms may be seen in one capsule. In 3 or 4 weeks these larval worms become fixed in their final position in the muscles and do not undergo any further development. The capsule gradually becomes thicker and may become calcified; in man this may occur in about 4 to 6 months, but in the pig, it may be delayed for many years. Once

lodged in the muscles, the larvæ may live for an indefinite number of years. Experimentally, one can infect guinea pigs, rabbits and cats and, with difficulty, dogs. In the pig trichinæ, like the cysticercus, cause few, if any, symptoms. The animal may appear quite healthy and well nourished.

Mode of Infection.—The disease is conveyed by the ingestion of imperfectly cooked pork. If all parts of the joint are thoroughly cooked, the danger is perhaps remote. Salting and smoking are quite insufficient to afford protection.

Symptoms, etc., produced in man.—A few days after eating infected pork, there is pain in the abdomen, loss of appetite, vomiting, and sometimes Diarrhœa : the latter is by no means always constant, but it may be very severe. In addition there may be general debility and pains in various parts of the body. Between the seventh and tenth day, but sometimes not till the fourteenth, chills may occur, but not commonly. There is generally fever, sometimes of an intermittent type and sometimes of a remittent type, pain on pressure and movement of muscles, accompanied by swelling of the same and if the muscles of the jaws and of the larynx and pharynx are involved, there is some difficulty in mastication, deglutition and respiration. In severe cases, the involvement of the diaphragm and intercostal muscles causes Dyspnœa which may prove fatal. Œdema may occur often early in the face and later in the extremities when the stiffness and swelling of the muscles are at their height. There may be profuse sweating tingling and itching, and occasionally Urticaria has been seen. The general nutrition is impaired and there is emaciation and Anæmia. The patella reflex is absent. The sufferer is usually conscious except in very severe cases when there is delirium, dry tongue and tremors as in Enteric Fever, Bronchitis, Pleurisy and Pneumonia may supervene and prove fatal. The prognosis is variable, the mortality ranging from 2 to 30 per cent. In mild cases, recovery occurs in from

10 to 14 days. In the more severe cases, it occurs in from 6 to 8 weeks. The prognosis is more favourable in children, and when early Diarrhœa and moderately severe gastro-intestinal disturbance are manifested. Constipation is unfavourable. The most important diagnostic points are the pains and swellings in the muscles, the presence of œdema and the shortness of breath.

In the pig the capsules are specially to be seen in the tongue diaphragm and intercostal muscles.

Trichinosed flesh should invariably be condemned.

PRESERVATION OF FOOD.

The usual methods are by cold, drying, salting, smoking, heat and exclusion of air by tinning, and by the use of chemical substances.

PRESERVATION BY COLD.

This can be done in two ways, either (1) by freezing the flesh and keeping it so; or (2) by keeping it in a chamber the temperature of which is at or just below freezing point.

Frozen meat is often very tender and of excellent quality, though sometimes it is lacking in flavour. The juice is less abundant and less red in colour than that from fresh meat, and, according to Maljean, the corpuscles in the juice of the former are more or less distorted in form and decolorised. Bacteria in general offer great resistance to cold, which, while not killing them, prevents their development; this at any rate is more particularly the case in regard to the putrefactive bacteria. The flesh has a uniform pink appearance. The fat is of a dead white colour. Refrigerated meat can be recognised by the fact that the fat is pinkish in colour, while the outside of the meat presents a dead white colour. When frozen meat thaws, there is much oozing of fluid, the flesh has a parboiled appearance and the fat has a

dead white colour. It is important, especially if the piece is a large one, to ascertain the condition of the interior, as the outside may be apparently all right and yet the interior be decomposed. This can be done by inserting a knife or thick skewer and, on withdrawal thereof, noting the presence or absence of any offensive smell. This should be done especially in the neighbourhood of joints and bones, as putrefaction sets in early there.

On removing the cloth, in which refrigerated meat is wrapped, a disagreeable smell may be noticed. The meat should not be too hastily condemned on this account, as the smell may be due to the wrapper and not to any deeper-seated trouble. Klein has recently published a report on the nature of the black spots occasionally seen on chilled beef. It appears that the meat shipped to England from the Argentine occasionally developes circular black spots which may be in groups or isolated. On the lower or thin parts they are seen in the fascia, and on the thick parts in the fatty portions and in the fat belonging to the inner surfaces of the flanks. According to Klein, they are due to a mycelium of a fungus of the nature of an oidium, which he has proposed to call Oidium Carnis. It forms oval gonidia either by short lateral branches of the free hyphæ or along and at the ends of the superficial threads in the fatty tissues. The oval gonidia are capable of multiplying in the manner of yeast cells. He is of opinion that the material of the black spots is harmless to the animal body, a view which is confirmed by direct experiment; further, that the presence of the mycelium does not in any way alter the normal character of the tissue elements themselves, either those among which the mycelium is situated or those beyond its extension.

PRESERVATION BY DRYING.

Flesh can be dried either by the sun or by artificial heat. When so treated, much water is lost and consequently the

flesh does not offer much inducement to bacteria to flourish. If kept dry, such meat will last a long time.

PRESERVATION BY SALTING.

Brine is usually composed of saltpetre 1 part to salt 32 parts and sugar 2 parts. This latter is added in order to hinder putrefaction.

The salt acts by removing water from the flesh and also as a faint antiseptic. As it frequently causes discoloration, potassium nitrate (saltpetre) is added. Care should be taken not to add too much, as evidence exists to show that saltpetre has the power of inducing irritation and inflammation of the mucous membrane of the intestine. The nutritive value of flesh when salted is very much lessened. One must examine the meat very carefully to see if any has gone bad, which occurrence would be indicated by the meat being paler than usual, with green patches here and there, and the presence of an unpleasant smell. Streptococci and the Tubercle bacillus can retain their virulence for months in salted flesh, so also the spores of Anthrax bacilli. Cysticerci, etc., are not killed by salting.

The brine is sometimes poisonous, due apparently to the products of the decomposition of animal substances which have passed into it. This occurs in cases where the brine has been used for several relays of meat.

Instead of curing meat by placing it in brine, the same object can be effected by what is known as dry salting. In this the flesh is treated by repeated applications of salt and saltpetre to the external surface. Klein has recently discussed the nature and cause of taint in miscured hams. The hams examined were dry-cured only, no other method of salting, injection or pickling in fluid being used. The hams had a distinctly putrid smell, the muscles were more or less discoloured, in the slightly tainted part the characteristic red tint of well-cured muscle had given way to a pale or

dirty grey tint, while in the strongly tainted parts the colour was dirty grey to green and, moreover, the muscle tissue was swollen and soft like jelly. On microscopical examination, small linear clumps of tyrosin crystals were found, many being seen near blood vessels. The muscle fibres lose their transverse striation, swell and break down and contain numerous empty spaces (gas bubbles). These all indicate putrid decomposition of the proteid constituents of the muscle. The reaction is alkaline to litmus. In all cases, the decomposition is most pronounced at and around the knee. The taint starts here and gradually progresses towards the femoral and gluteal regions. In badly miscured hams, the condyles of the femur, patella, condyles of the tibia, crucial ligaments, semilunar cartilages, connective tissues, tendons and muscles adjoining the capsule are green and very putrid to the smell. The essential cause in all hams examined was one and the same species of cylindrical microbe, found in great numbers in the tainted part and proportionate in number to the degree of taint. All the affected parts contain the organisms. The free surface of all parts within the articulation are covered with a slimy moist film which, when examined under a microscope, is seen to be composed of a continuous mass of the microbe which has been named the Bacillus Fœdans.

PRESERVATION BY SMOKING.

This method acts mainly by reason of its drying effect and to a lesser extent on account of the antiseptic action of some of the constituents of the smoke. It does not kill many of the bacteria but retards their development. Subsequent to smoking, certain articles now appear to be subjected to an artificial colouring process. Smoked haddock and catfish are dipped in a dye, not annatto, but one of the coal tar derivatives, somewhat of the methyl orange type largely used in colouring sweetmeats and imitation Demerara sugar.

While such may not be actually poisonous, there are grave objections to the use of such dyes when other and innocuous materials are at the disposal of the manufacturers.

PRESERVATION BY HEAT.

Steam is used to sterilise the article, which is then placed in tins or in glass or earthenware jars.

Poisoning, as the result of eating tinned foods, may arise from (1) decomposition of the flesh owing to imperfect sterilisation or from incomplete sealing of the tin ; (2) the flesh having been poisonous originally, as is sometimes seen in fresh flesh from exhausted animals and in certain fish ; or (3) metal having been dissolved from the can or from the lead used to seal it.

The most dangerous tinned foods are those containing much moisture, *e.g.*, milk, salmon, lobster and mixtures of meat and vegetables. The simpler the preparation, the better it stands the climate. Beveridge states that in warm climates no tinned meat stored in the open, exposed to varying temperatures and the sun and rain, should be kept for more than one year.

Metal is more likely to be taken up by the acid food stuffs *e.g.*, jams, fruits and vegetables. On opening certain tins, *e.g.*, of marmalade, rhubarb, tomato soup, etc., a blackened appearance may be noticed ; this is due to the action of the vegetable acids on the tin plating : if only slight, and there be no fermentative changes present, it may be neglected.

A tin, the contents of which are sound, usually has slightly concave ends, owing to the partial vacuum caused during sterilisation. The jelly surrounding the flesh should be solid ; if it is found in a liquid state, it indicates that decomposition has probably occurred.

Dented tins may be passed, if they are intended for early consumption ; otherwise, if kept too long, they are apt to

rust and perforate and so prepare the way for the decomposition of the contents.

Bulged or blown tins can be tested by puncture under water. If necessary the tins may first be boiled for an hour, which act causes the ends to bulge and, if the contents are unsound, the convexity due to the contained gases is marked.

Re-soldering of the tins should be most carefully looked for, as this is suspicious of blown tins having been tapped and resealed. The presence of moulds is sufficient to condemn the contents, because, even if not definitely harmful in themselves, they indicate faulty sterilisation and, moreover, they impart an unpleasant taste to the contents, and may cause Diarrhœa in the consumer.

METALLIC CONTAMINATION.

All kinds of tinned foods are liable to this ; the amount depending on the length of time in the tin. Lead, if present, is generally there as the result of careless soldering. Copper may be present owing to the preparation of the article in vessels of that metal, or it may have been present in the food itself originally, *e.g.*, in certain shell fish, but more frequently it is present, due to the introduction of salts of copper for the purpose of preserving the green colour of vegetables, *e.g.*, peas, spinach, asparagus, etc. Dr. Buchanan and Dr. Schryver, in a report to the Local Government Board on "The presence of tin in certain canned foods," submitted in December 1908, make the following statements :—"Practically all foods canned in the ordinary way become to some extent contaminated by tin. The metal is taken up to a greater extent by meat extracts and essences than by other meat foods, due to the acidity present in these preparations. Certain canned fruits and vegetables, *e.g.*, peaches, cherries, apricots, pineapples, tomatoes, asparagus and also canned soups, *e.g.*, tomato soup, are specially liable to take up tin. The tin may penetrate into the sub-

stance of solid foods and, in the case of tinned foods which are of both liquid and solid portions, the metal after solution in the liquid portion of the contents may, in the course of time, become absorbed in or chemically combined with the solid part.

"As time goes on, the quantity of tin taken up increases, but there is reason to believe that, in the case of solid acid food-stuffs, the rapidity of solution is somewhat slower in the later period than in the first few months after canning.

"Much depends on the quality of the tin plating; when the thickness thereof is reduced to a minimum, then a comparatively small amount of erosion will, in parts, expose the steel or iron basis of the can and thus permit of an electrolytic action, resulting in acceleration of the further solution of the tin.

"If solder, which contains both tin and lead, is allowed to gain access to the interior of the can, a very conspicuous solution of tin may take place; this results in a double risk of poisoning from tin and lead."

Ungar and Bodlander, experimenting on animals, found that minute doses of tin salts, when introduced into the body by subcutaneous injection and continued over a considerable period, produce a marked effect on the general nutrition and in particular affect the nervous system, causing paralysis and other symptoms.

Dr. Schryver refers to a recorded case of chronic tin-poisoning in man in which nervous symptoms occurred similar to those experimentally produced in animals. In this case, however, the tin was not taken up by the alimentary canal and he has not yet succeeded in tracing instances in which similar symptoms have followed the continued ingestion of small doses of tin along with food. He also experimented on himself, and is of opinion that there is not much probability of serious risk of chronic poisoning by tin as a result of a diet which consists largely of

tinned food, even when continued over a long period of time.

The greatest danger from tinned foods is from decomposition of the contents.

PRESERVATION BY MEANS OF CHEMICAL SUBSTANCES.

The preservation of food by chemicals occurs on a very large scale at the present day. The substances most usually employed are boracic and salicylic acids, formaldehyde, sulphur dioxide, and sulphites, benzoic acid and sodium benzoate, the two latter being largely used in preserving cider, perry, grape juice, mincemeats, jellies, jams and catsups. They may cause discomfort and malaise, nausea, headache and a weakness and a burning or irritating sensation in the œsophagus, hunger, indigestion and loss of weight. When added to food, both must be considered injurious to health.

Boracic Acid and Borax are very largely used as preservatives of hams, fish (especially potted fish), sausages, milk, cream, butter, brawn and many other food substances. They are cumulative drugs and are eliminated but slowly from the system. Much conflicting evidence exists in regard to the influence of these drugs on health. Halliburton states that the addition of these drugs to milk in any quantity is harmful, as it interferes with the process of digestion by the natural gastric juices, and the lime salts in the milk are rendered insoluble. They are especially dangerous to any one suffering from kidney disease, as it is by that organ that they are excreted. In pregnant women they may cause abortion. Kenwood holds similar views, and states that they produce headache, indigestion and flatulence.

Sulphurous acid and its salts, the sulphites of calcium sodium and magnesium are largely used to preserve meat, potted meats, sausages, perry, cider, wines, dried fruits, syrups and molasses. In the case of meat, the sulphite is

only partially decomposed and expelled by cooking. In the case of wines, the cleansing of the barrels by the action of burning sulphur prevents those secondary changes which would otherwise produce the ripening of the wine. In the manufacture of syrups and molasses, it is quite customary to expose the freshly expressed juice of the cane to sulphur fumes. The SO_2 forms more or less stable compounds with the components of the juice and a part of it passes into the finished product, especially in the case of molasses, low grades of which contain extraordinarily large quantities of free and combined sulphur dioxide. Apricots, peaches, pears and other fruits are frequently sulphurred before desiccation in order to produce a clear and intense yellow colour to prevent fermentation and decay, to conceal decayed portions of the fruit, to protect from insects and their larvæ and to hasten the drying process. It is worthy of notice that highly sulphurred fruits are preserved with a lower degree of desiccation than those that are not sulphurred. It is not difficult in this way to preserve a water content of 30 per cent. in the finished product, thus enabling the manufacturer to obtain a greater yield from a given weight of raw material.

Wiley carried out a series of experiments on students who observed their usual and regular hours of sleep, work and exercise, etc. The preservative was administered in two forms : sodium sulphite in capsules was given to one-half of the students, and sulphurous acid to the other half in their drinking water. The average daily consumption for 20 days was 0·392 to 0·628 gramme of sodium sulphite or 0·213 to 0·343 gramme of sulphur dioxide. The results showed that sulphurous acid and its salts in the free state produce harmful effects, metabolism being disturbed and the health, particularly digestion, being injuriously affected. In the great majority of cases headache, sensations of dizziness and occasional nausea, indigestion, pain in the stomach,

exhaustion, weakness and, in some cases, palpitation of the heart and other unfavourable symptoms were noticed. Of these the most prominent symptom was headache. Abundant evidence was obtained to show that these preservatives unfavourably influence the metabolism. The assimilation of food materials containing organic phosphorus was retarded, while the sulphur catabolism was increased. The sulphur balance sheets showed that the kidneys were called upon to remove from the body nearly all, if not all, the added sulphur in the form of sulphuric acid or its salts. Microscopic examinations showed an increase in the number of crystalline and amorphous bodies in the urine, indicating the unusual demands upon the kidneys. The habitual overworking of these organs might be expected, sooner or later, to produce lesions possibly of an incurable type. It was also observed that there was a marked tendency to albuminuria. The most important results of these experiments relate to the reduction in the quantity of hæmoglobin and in the number of red and white blood corpuscles, particularly the latter, under the action of sulphurous acid and its salts. The administration of a substance which diminishes to a notable extent these important constituents of the blood is regarded as highly prejudicial to health. Throughout the experiments, the variations of the metabolic functions from the normal were never of a character favourable to a more healthy condition of the system. The evidence all points to the fact that sulphurous acid and its salts are purely drugs having no value as foods and exerting nothing but harmful effects. The conclusion is, therefore, drawn that the use of sulphurous acid and its salts in any quantity or for any periodas preservatives of foods should be avoided.

Formaldehyde has been used for preserving nearly every variety of perishable foods. Solutions of formaldehyde and special preparations containing it are used. It is a very powerful disinfectant and may retard digestion even when

largely diluted and, as it readily combines with the proteid constituents of foods, it forms a compound which is less digestible than the original substance. Schryver found that formaldehyde could be recovered from not only various parts of the surface of the meat, but also from parts below the surface, especially where the muscles had not been covered by connective tissue or fat. He found that boiling and roasting appeared to reduce or even remove the formaldehyde; grilling, however, appeared to make it penetrate further into substance. Articles like mincedmeats, fish, kidneys, etc., which expose a large surface in proportion to weight, cannot be exposed to fuming in formalin safes without absorbing a relatively large quantity of the drug.

Salicylic Acid is frequently found in beer, wines, milk, and jams.

ARTIFICIAL COLOURING.

A few remarks may be made at this stage on the artificial colouring of food-stuffs. Many substances are used to produce a good colour in the materials to be sold, *e.g.*, aniline dyes in Demerara sugar, black mallows, cochineal, fuchsin, indigo, Campeachy and Pernambeco wood, beet juice, raspberry and cherry juice in wines, coal tar dyes, salts of copper and chlorophyll for peas, peroxide of nitrogen in the artificial ageing of floor. Armenian bole, the colouring principle of which is red oxide of iron, is occasionally used for sausages, potted meats, anchovy and bloater paste, sweets, etc., but this, along with logwood and camwood which were formerly used for the purpose, are now being superseded by red coal tar derivaties.

Graphite is occasionally used to improve the colour of tea and peppercorns. Turmeric, oxide of iron, Prussian blue and caramel are used to colour tea and coffee.

For dairy produce, the most commonly used colouring matter is annatto, a vegetable extract from Bixa Orellana.

This and certain other yellow colouring agents of vegetable origin, *e.g.*, saffron, turmeric, have generally been considered harmless in the quantities used; but these substances are now being gradually ousted by yellow coal tar derivatives, the action of which upon the human system is not fully known. A large number of margarines are similarly coloured. The coal tar yellow most frequently used is known as butter yellow, its chemical name being dimethyl-amido-azo-benzene. It is generally supplied to the trade ready dissolved in oil, either cotton seed, rape, linseed, or sesame oil. Tropeolins, which are sulphonated azo-derivatives of coal tar, are also coming into use. Sweets and confectionery are often coloured yellow by compounds of barium, arsenic, antimony and lead; compounds of arsenic and copper are used to give a green colour or compounds of barium and zinc to confer whiteness, and Prussian blue to produce a blue colour. Coal tar products are largely employed in almost every class of food and drink, chiefly, however, in the preparation of jams, temperance drinks, sweets and confectionery, fruit jellies, syrups and cordials and sugars. Exhausted tea leaves are sometimes treated with catechu to give them a fresh and new appearance.

The English Departmental Committee, appointed in 1901, to inquire into the use of preservatives and colouring matters in food recommended as follows :—

(1) That the use of formaldehyde or formalin or preparations thereof in foods or drinks be absolutely prohibited and that salicylic acid be not used in a greater proportion than 1 grain per pint in liquid food or 1 grain per pound in solid food. In every case its presence must be declared.

(2) That the use of any preservative or colouring matter whatever in milk offered for sale in the United Kingdom be constituted an offence under the Sale of Foods and Drugs Act.

(3) That the only preservative which it shall be lawful to use in cream be boric acid or a mixture of boric acid and borax, and in an amount not exceeding 0·25% expressed as boric acid, and the amount of such preservative be notified by a label on the vessel containing the cream.

(4) That the only preservative to be used in butter and margarine be

boric acid or a mixture of boric acid and borax in an amount not exceedin 0·5% expressed as boric acid.

(5) That in the case of all dietetic preparations intended for the use of invalids or infants, chemical preservatives of all kinds be absolutely prohibited.

(6) That the use of copper salts in the so-called greening of preserved vegetables be prohibited.

The United States Department of Agriculture has issued a provisional decision on the question of the use of dyes and chemical preservatives in foods. It has been determined that in general no drug, chemical, or harmful or deleterious dye or preservative be used. Common salt, sugar, woodsmoke, potable distilled liquors, vinegar and condiments may be used. Saltpetre is permitted pending further inquiry. No prosecution is to be instituted in the case of the application of the fumes of burning sulphur ($S O_2$), as usually employed in the manufacture of those foods and food products which contain aldehyde, sugars and so on, with which sulphurous acid may combine, if the total amount of sulphur dioxide in the finished product does not exceed 350 milligrammes per litre in wines or 350 milligrammes per kilogramme in other food products. Of this amount, 70 milligrammes may exist in the free state. Foods and food products packed or manufactured during the season of 1907, which contain sodium benzoate in quantities not exceeding one-tenth of one per cent., or an equivalent of benzoic acid, will be permitted, provided it has been customary to use this preservative in such foods. The label of every package containing sulphurred foods, or foods treated with benzoic acid, or benzoates, must bear a statement to that effect. No statement is allowed on the article to the effect that the article is guaranteed to conform to the requirements of the Foods and Drugs Act. The use of any dye, harmless or otherwise, to colour or to stain a food in a manner calculated to conceal damage or inferiority, is specifically prohibited, and the use in food, for any purpose, of any mineral dye or any coal tar dye, except certain ones which are listed, will occasion ground for prosecution. Pending investigations proceeding, certain coal tar dyes are permitted, provided they bear a guarantee from the manufacturer that they are free from subsidiary products and represent the actual substance the name of which they bear. The list includes the following colourings :—Red shades—amarnath, ponceau, erythrosin. Orange shade-orange 1. Yellow shade—naphthol yellow. S. Blue shade—indigo di-sulpho acid. So far the question of the use of copper salts for colouring peas, etc., has not been finally settled, but for the present all vegetables, which are greened with copper salts and which do not contain an excessive amount of copper, will be admitted to entry, provided that thel abel bears a statement that copper salts have been used.

The Swiss and German Governments have prohibited the use of chemical agents in the preservation of meat and meat products with the exception of salt and saltpetre.

Milk.

Milk is the natural secretion of the adult female mammal intended for the use of its newly-born offspring. Milk contains all the constituents needed for the entire nutriment of a young growing animal. The constituents of milk—fats, sugar and proteids, are all formed from the protoplasmic contents of the cells of the epithelium, lining the ramifications of the ducts of the mammary gland, through the vital activity of the cell itself. This fact must be borne in mind, as it is generally assumed that a diet rich in fat would naturally increase the proportion of this constituent in milk ; but this is not so ; the reverse is the case. In a fatty diet, all fats taken up by the lacteals of the intestines are consumed in the production of heat and energy ; all fats not so taken up are discharged with the dung. Metabolism in the organism is stimulated to greater activity by nitrogenous foods ; it is retarded by fatty foods, and all the fats obtained in milk are derived from albuminoids and not from fats and carbo-hydrates ; the latter are consumed in the production of heat and energy. It is found in practice and by experiment that a cow at grass yields in her milk more fat than is ingested with her food. The sugar too is formed by the same protoplasm and not from the carbo-hydrates taken in with food.

Milk, whether human or animal, is essentially of the same constitution, and as cow's milk has been most thoroughly investigated and enters largely in the diet of man and infant, it will be treated first. Cow's milk, as obtained, is an emulsion, consisting of particles of finely divided fat, suspended in a solution of protein bodies, milk, sugar and salts. It is non-transparent, white or with a slight tinge of yellow, and having faintly sweetish taste. The particles of fat and solids are uniformly diffused.

The reaction of fresh milk is generally amphoteric towards

litmus and turmuric papers. Milk when exposed to air gradually changes, and the reaction becomes more and more acid : this change depending on the gradual transformation of milk-sugar by the action of micro-organisms. The composition of milk is fairly constant in each species ; and this is strictly true so far as casein and sugar are concerned, but the percentage of fat varies, depending upon a variety of factors *e.g.*, the period of lactation, season, food, etc. A highly *nitrogenous* food increases the fatty constituents ; oily food increases the quantity but renders it *watery*, hence the practice of the *gowli* to feed his cattle on cotton seed.

Fresh milk does not coagulate on boiling but forms a pellicle consisting of coagulated casein and lime salts ; if this is removed, it re-forms. The property of coagulation increases with the formation of lactic acid, until a stage is reached where milk coagulates forming a solid mass at ordinary temperature. Milk undergoes various fermentations ; the chief of which is the lactic acid fermentation produced by the action of the Bacillus acidi lactici of Hueppe.

Besides the lactic acid fermentations, milk undergoes other fermentations owing to the action of certain bacteria. Thus succinic and volatile acids such as butyric, acetic, etc. may be formed. The lactic acid, etc., are formed chiefly by the decomposition of milk-sugar or lactose. If a little "rennet" be added to fresh milk, it coagulates quickly to a solid mass, from which a yellowish liquid or sweet whey is pressed out. This coagulation occurs without any formation of lactic acid.

CONSTITUENTS OF MILK.

Milk is made up of milk plasma, in which fat-globules are suspended, and contains proteins: (1) casein, (2) lacto-albumin, (3) lacto-globulin, (4) nuclein ; also carbo-hydrates, chief of which is lactose or milk-sugar and certain extractives, creatine, cholesterin, lecithin and mineral salts.

Casein belongs to the group of nucleo-albumins, contains phosphorus and coagulates with rennet enzyme ("*rennin*") in the presence of a sufficiently large amount of lime-salts. The curd thus formed contains large quantities of calcium phosphates. In the process of coagulation, a cleavage process occurs: the casein is split off as para-casein and whey-protein, the latter remaining in solution. In the digestion of casein with pepsin and hydrochloric acid, a phosphorised proteose substance is formed which is further split off in the tryptic digestion as ortho-phosphoric acid and pseudo-nucleine. Protein in milk ranges between 2·5 to 5 per cent.

Lactose or milk-sugar is a carbo-hydrate and is always in solution. Milk-sugar is split into dextrose and galactose by the action of an enzyme "lactose" existing in yeast. Preparations of "milk wine" or "koomyss" from mare's milk and "kephyr" from cow's milk are based upon this fact. Other organisms, such as Bacillus acidi lactici, produce lactic acid fermentation in the milk-sugar, rendering the milk sour. After this is fully established, the casein begins to decompose and protein-ptomaines of a highly poisonous nature are formed.

Other micro-organisms produce a change in the character of milk. Thus Proteus vulgaris renders it bitter by formation of peptones; Micrococcus viscosus renders it slimy and ropy. Besides these, other organisms, such as Bacillus butyricus, produce coagulation and butyric acid fermentation. Some bacilli change the colour of the milk: thus B. cyanogeneus renders it blue, B. synxanthus yellow, Micrococcus prodigiosus red. In all these cases, the milk so rendered is unsuited for food and may cause dangerous poisonous symptoms. The quantity of lactose in milk ranges from 3·5 to 6 per cent. The mineral bodies in milk are calcium and magnesium phosphates and chloride salts of potash and sodium. It contains a very small amount of iron and citric acid.

Milk fat consists of extremely small globules of fat suspended in milk plasma : they occur in milk as an emulsion. Each milk globule is enveloped in a fine membrane or stroma-substance. Milk fat separates on standing and forms cream ; warming hastens the process of formation of cream, but does not increase it in quantity, while an artificial centrifugal separator does and that in a very few minutes. Milk fat consists of olein and palmitin with triglycerides of volatile fatty acids. Milk fat constitutes about 3·5 to 6 per cent. of the total weight but good milk contains about 8 to 12 per cent. of cream. The water in milk varies from 85 to 88 per cent.

In India, the milk of the buffalo is very largely consumed, even more so than that of the cow. The reasons for this probably are : (1) the yield of milk per buffalo is greater than that of the cow, hence commercially, other things being equal, it is more advantageous to the supplier ; (2) buffalo milk is richer in total solids and fat ; hence a superior and larger return in the produce in cream and butter, etc.

The composition and quantity of milk supplied depend on the breed, stock, and age of the buffalo.

CHEMICAL COMPOSITION OF MILK AND MILK STANDARDS FOR INDIA.

The composition of milk in India differs from that of milk in Europe and America in many respects. Besides cow's milk there is buffalo's milk to be dealt with in India. The latter shows a higher percentage of proteids and fat. The most complete data available in India are those given by Dr. Lemuel L. Joshi, Municipal Analyst of Bombay, in his "Milk Problem in Indian Cities." The following tables are taken from Dr. Joshi's book.

Complete Analysis of Indian Buffaloes' Milk.

—	Number of Samples.	Specific gravity at 15·5° c. (60° F.)	Non fatty Solids per cent.	Water per cent.	Fat per cent.	Proteids per cent.	Lactose per cent.	Mineral Matter per cent.	Remarks.
1—BOMBAY.									
Lemuel L. Joshi .									In Series A the fat was determined by Adam's method and in Series B by Gerber's method.
Series A	50	1·0315	9·5	82·3	8·2	4·0	4·4	0·8	
Series B	50	1·0308	9·8	81·6	8·6	3·89	4·52	0·78	
2.—POONA, Kirkee.									
J. Walter Leather.	..	1·0321	9·69	82·22	8·09	4·34	4·56	0·76	Fat by Gerber's method.
3.—BANGALORE.									
Shrinivasa Rau ..	129	1·026	8·8	85·13	6·07	3·92	4·13	0·75	Fat by the Werner Schmidt method.

For a routine examination, the following constituents only need be found out, *viz.* :—

Total solids, fat, specific gravity and "solids not fat." Great variations are found depending on many factors such as breed of animal, the kind of feed, time of calving, season, time of day, &c.

It appears that the amount of milk given by the Delhi and Jafferabadi breeds is usually more than the yield of Surti buffaloes. The milk of the latter breed is, however, found to be much richer in fat than that of the others.

Meggit and Mann ("Memoirs of the Department of Agriculture in India"; The composition of the milk of some breeds of Indian cows and buffaloes and its variations,"

Part II, by A. A. Meggit, B.Sc., and Harold H. Mann, D.Sc., p. 200) give the following figures for fat :—

Date.	Number of Samples.	Percentage of Fat.	
		Morning Milk.	Evening Milk.
January, 1908	6	6·6	8·0
February ,, ...	19	6·9	8·4
March ,, ...	21	6·9	8·0
April ,, ...	16	7·0	7·4
May ,, ...	17	7·5	8·0
June ,, ...	13	6·7	7·8
July ,, ...	6	7·0	8·1
August ,, ...	4	7·2	7·5
September	10	6·7	7·5
October ,, ...	12	7·0	7·6
November ,, ...	7	7·9	8·3
December ,, ...	12	7·4	8·0
January, 1909	12	7·2	8·2
Average	155	7·06	7·92

Dr. Lemuel L. Joshi gives the following figures taken from 271 " genuine " samples of buffaloes' milk examined

from time to time at the Bombay Municipal Laboratory. Most of these were samples of morning milk :—

Average Composition.

Months.	Number of Samples.	Specific gravity at 60° F.	Total solids %	Fat %	Solids not fat %
January	31	1029·41	17·76	8·21	9·55
February	30	1029·79	17·35	7·7	9·65
March	9	1028·83	16·94	7·11	9·83
April	20	1029·06	17·37	7·57	9·80
May	26	1029·36	16·96	8·15	8·81
June	22	1028·63	17·45	7·81	9·64
July	33	1028·58	17·50	7·64	9·86
August	30	1027·41	17·73	8·06	9·67
September	13	1028·18	16·75	7·33	9·42
October	17	1028·07	17·04	7·41	9·63
November	24	1029·30	16·57	7·26	9·31
December	16	1029·77	16·94	7·22	9·72
Total ..	271	1028·87	17·36	7·62	9·66

The results obtained by Mr. Meggit and Dr. Mann in Poona and by Dr. Joshi in Bombay show that the average per centage of fat in genuine buffalo milk may be taken as 6 to 8 per cent., but should never be below 5 per cent. The "solids not fat" are usually found to be between 9 and 10 per-

cent. This may be taken as the standard of buffalo milk in India.

As regards *Cow's milk* the percentage of fat is higher in the case of Indian cows than in European or American cows. In other respects, there is not much difference. Meggit and Mann give the following as the "average composition of milk of cows of the Poona Dairy Herd" :—

Date.	Number of Samples.	Percentage of Fat.	
		Morning Milk.	Evening Milk.
January, 1908	6	3·98	5·30
February ,, ...	19	4·10	5·20
March ,, ...	22	4·34	5·30
April ,, ...	15	4·50	5·40
May ,, ...	18	4·40	5·20
June ,, ...	13	4·20	5·20
July ,, ...	5	4·50	4·90
August ,, ...	5	5·00	5·90
September ,, ...	10	5·00	5·10
October ,, ...	12	4·50	5·10
November ,, ...	7	4·90	5·60
December ,, ...	12	4·80	5·85
January, 1909	12	4·50	5·77
Average	156		

Average Composition of "genuine" Cows' Milk in Bombay. Analysis of 50 Samples.

1913-1914.	No. of Samples Examined.	Specific gravity at 60° F.	Total solids per cent.	Fat per cent.	Non-fatty solids per cent.	Remarks.
June, 1913 ..	5	1·027	15·05	5·52	9·53	These samples were obtained from different breeds of cows including Sindhi, Gir, Surti, &c. The same analytical methods were used as in the case of buffalo milk.
July ,, ..	2	1·030	17·22	7·75	9·47	
August ,, ..	8	1·032	14·18	5·23	8·90	
September ,, ..	12	1·030	15·29	6·33	8·96	
April 1914 ..	3	1·030	13·1	4·4	8·7	
May ,, ..	18	1·030	14·35	5·39	8·96	
July ,, ..	2	1·030	15·10	5·95	9·15	
Total ..	50	1·029	14·89	5 79	9·10	

The following is the average composition of cows' milk in Bombay according to Dr. Joshi :—

Specific gravity at 60° F.	1030·87
Total solids %	13·9
Fat %	4·85
Solids not fat %	9·04

It would appear from these figures that in genuine samples of milk of Indian cows the amount of fat should not fall below 4 %

Adulteration of Milk.—Out of a total of 1,363 samples of milk examined at the Bombay Municipal Laboratory during a period of five years, only 282 were found to be genuine. This gives 79·3 per cent. of adulterated or watered samples of milk in Bombay. There may also be a fraudulent abstraction of cream on the part of the milk supplier.

Until recently, even in Presidency towns, the stabling of milch cattle was most insanitary. Municipal by-laws are now being brought into operation for the provision of proper sanitary stabling with sufficient cubic space accommodation,

for each animal. There was a time when animals were huddled together, without even sitting accommodation, and in consequence there was great over-crowding. Improved expert supervision is now provided and the milch cattle stables are regularly inspected by the Veterinary and Sanitary Inspectors, who see that the stables are kept in proper sanitary condition; special attention is paid to the drainage and the dung receptacle. Stabling accommodation is insufficient in a city like Bombay for the number of animals required for the milk supply of the population of the city. The milk suppliers, therefore, are compelled to stable their animals near a Railway Station within a reasonable distance of the city, or purchase milk from others in the neighbouring villages and stations. On the Western side of India, the buffalo takes the place of the European or the Northern India or Calcutta cow. These animals are stabled on the outskirts of the city and elsewhere in cadjan sheds, without sufficient air or sitting space. The floors are *kutcha* and covered with a thick layer of excreta of animals. There is no drainage—or if any, to a cesspool which is never emptied. The animals' hind quarters are dung-laden and the udders thickly coated with dung or mud. There is no separate place for storage of milk. The shed itself is dark and ill-ventilated and offensive-smelling.

In connection with such stables, one often notices dwelling rooms either on the left of the shed or by the side of it, and it has been the experience here that cases of Small-pox, or other infectious diseases have been removed to isolation hospitals from such rooms.

The mode of collection too needs a little description. The milkman may or may not wash or clean the udders, or may only just throw water on them, but usually they show dry dung adhering to the hair. The dust-laden tail, whisked about to drive away flies, adds its quota to the milk. The brass *lota* in which the milk is collected has been washed with the

contaminated water of a neighbouring well. The hands of the milker may be clean or full of dirt, but without any attention to their cleanliness he proceeds with the milking of the animal. The *lota* receives the expressed milk, with all the dirt of the hand, udders and tail added on to it. The milk thus collected into large brass *lotas* is now ready for transit, and to prevent splashing and tilting up of the contents during transit, hay, straw or green grass from the stable floor is put into it to cover the opening. No provision is made to guard against the ingress of dust, etc. In this condition it is exposed for sale in the milk market or sold to retail vendors. Here it may become further contaminated. Experience has proved that milk will not keep sweet for any length of time ; this is due to the fact that it is contaminated with bacteria during collection and transit. It is a matter of common knowledge that milk is the best medium for bacteria to multiply, and their products spoil the milk. Several methods have been devised to keep the milk as sweet and fresh as possible, without any prejudicial effect on the milk.

BACTERIA IN MILK.

Milk, as secreted by a healthy animal, is a sterile fluid. It may be contaminated in various ways from the udder to the consumer.

The sources by which bacteria may gain access to milk may be grouped as follows :—

(1) Intra-mammary.
(2) Introduced during the milking process.
(3) From milk utensils.
(4) By contamination during transit.

Bacteria may enter the lactiferous ducts from outside as there is no special obstacle to prevent their entry, the only one being the sphincter muscle at the lower end of the teat. The "fore milk" contains most of the bacteria, but the

latter milk or "strippings" least. The most frequent bacteria found are the Streptococci, Staphylococci and Pseudo-diptheritic bacilli. All these gain access to the milk cistern, through the milk column in the teat canal in the udder, and also to the finer ramifications of ducts from outside through the teat orifices. Bacteria introduced during the milk collection may be from the (1) hair, udder or teat of the animal; (2) from dust of the milk-shed or clothes of the milker or from dirt of the hands of the milker. As the hindquarters and udders of the animal are laden with dry or wet dung, some of it, of necessity, finds its way into the milk pail. The air and dust of the shed are full of bacteria, which may contaminate the collected milk either during the process or when stored, as the pails are almost always uncovered. Milk vessels when improperly cleaned form a grave source of contamination of milk. The water used for cleaning these vessels must be from a pure source. During transit, milk may be contaminated if not conveyed with tightly fitting covers. It can be imagined how badly milk may be contaminated in India by the *gowli* who covers the milk, to prevent splashing, with a handful of hay, straw or green grass which he finds handiest; or again, when exposed for sale in open *lotas* in the streets, it may receive dust laden with particles of dried street and domestic refuse; flies, which may have fed on excreta and other decomposing matter, may alight into the same.

The Streptococci found in milk indicate that the pollution is undesirable if from outside, or that they are derived from local pathological lesions such as mastitis or ulceration in the udder. The former may be saprophytic and harmless while the latter pathogenic and harmful. Staphylococci are almost always abundantly present in milk, but their presence does not indicate any pathological significance. The presence of Streptococci indicates manurial pollution, and they are harmful to infants inasmuch as they

cause Gastro-Enteritis and infantile Diarrhœa ; Bacillus Coli and allied forms indicate an undesirable pollution, either manurial or fæcal, and such contamination may be obviated by observing scrupulous cleanliness during milking. B. Coli and Coli-like bacilli are lactose fermenting bacteria of intestinal origin and their presence in milk is largerly proportional to the amount of cleanliness exercised during milking.

Bacillus Enteridis Sporogenes shows that the pollution is manurial or fæcal, as the spores of the same occur abundantly in fæces and dung.

Bacillus Butyricus resembles the Enteridis Sporogenes. They are both anærobic and both seem not harmful to man ; B. Enteridis, however, is of importance as it indicates pollution from dung. Besides these there almost always occur B Subtilis, B. Mycoides, B. Mensentericus Vulgatus. These are aerobic but non-pathogenic. They indicate contamination from outside, probably hay, and have a decomposing effect on milk. They are also very heat-resistent and therefore constitute most of the bacilli left in imperfectly sterilized milk.

For a fuller discussion on bacteria in milk, see " The Milk Problem in Indian Cities " by Lemuel L. Joshi, M.D., B.Sc., etc.

ACUTE INFECTIOUS DISEASES AND MILK.

Milk may be infected by the specific organisms of infectious disease. The infection may be conveyed by direct human infection, or indirectly, or may be of bovine origin either direct or indirect. Direct infection may be from persons actually suffering from infectious diseases, or have recently suffered and act as " carriers " ; or the milker may have somebody ill with infectious disease in his family. Milk may be adulterated with water containing Typhoid bacilli or

Cholera vibrios, either by the addition of such water or cleaning of vessel with such water, or also by the animals, while drinking such water, contaminating their udders. When milk is the cause of infection, the incidence of disease is only upon those households to which the milk is supplied. Some of these households may escape, as the milk in those may be boiled and rendered harmless, while others, where milk is not boiled, may suffer severely, or in some instances they may have been protected by a previous attack and thus gained immunity.

DISEASES OF MILCH CATTLE.

Many milch cattle suffer from acute diseases, and their yield of milk changes in quality and may produce harmful effects on the consumer. Thus an animal may suffer from acute infectious disease, such as bovine Scarlatina or acute bovine Tuberculosis. Such milk is decidedly harmful. Instances have been known where Foot and Mouth Disease was communicated to man. The animals may suffer from inflammation of the udder or have ulcerated teats.

All outbreaks of infectious disease due to milk are sudden and explosive, of short duration and come to an abrupt and equally sudden termination. There have been many epidemics which were distinctly traced to this kind of infection. There have been epidemics of Typhoid, Diphtheria, Scarlet Fever and septic affections of the throat, Diarrhœa and Cholera. It also happens that milk, if not properly cooled before transit to a long distance, or if kept too long or in a dirty pan, becomes poisonous, ptomaines forming in the same. A ptomaine was isolated by Dr. R. H. Firth, I. M. S., of the Punjab, who called it *lacto-toxine ;* independently of him, another observer, Vaughan of Michigan (America), also isolated a ptomaine and called it *tyro-toxicon.*

The symptoms produced by this ptomaine are severe gastro-intestinal irritation with marked effect on the nervous system, the symptoms simulating those of Cholera. In April 1911, in a Mahomedan quarter of this City, certain guests, who attended the celebration of a wedding, suffered severely from ptomaine poisoning. Careful inquiries were made and it was discovered that only those who partook of milk and ices suffered severely.

In connection with this, it is necessary to mention that two other milk preparations are liable to cause these symptoms : (1) *Mawa* is desiccated milk ; it is prepared for commercial purposes in Gujerat by exposing milk in pans to a slow heat. It is sold in Indian *bazaars* in pieces and used in the preparation of sweets and ices. Dr. Joshi, the Municipal Analyst, examined bacteriologically many samples of *Mawa*. In the majority of samples examined, Bacillus Coli Communis and Coli-like organisms were detected ; there were also found in large numbers Streptococci and Staphylococci showing contamination of an excrementitious nature. (2) *Basundi* is another preparation of milk. It is prepared in the same manner as *Mawa*, but the process stops when milk has come to thick consistence ; condiments are then added and well-mixed. This makes a highly delicious preparation and is indulged in by the wealthy. It is exposed for sale in brass *lotas*, where it may be contaminated, or kept long enough to develop ptomaines. Instances have been known where whole families have suffered severely after indulging in such sweets. The symptoms were of severe gastro-intestinal irritation not unlike Cholera.

BACTERIOLOGICAL EXAMINATION OF MILK.

This is for the purpose of finding out any contamination with microbes, dirt, cow-dung, &c. There are hardly any

data available in India excepting the recent investigations carried out by Dr. L. L. Joshi at the Bombay Municipal Laboratory. The following are a few extracts from Dr. Joshi's researches mentioned in his book on "The Milk Problem in Indian Cities" :—

Microbes per c.c. —Average of 240 *Milk Samples.*

Date.	No. of Samples.	Average of total count of microbes per c.c. on Agar at 37° C. for 48 hours.	Average mean temperature. Fahr.	Average humidity.	Remarks.
1913.					
April	12	46,363,000	82·0	·761	Average number of microbes per c.c. from April, 1913 to July, 1914=36,385,000.
May	30	63,481,000	86·5	·723	
June	2	34,125,000	83·7	·822	
July	31	35,801,000	81·5	·864	
August	10	29,750,000	81·4	·815	
October	18	38,027,000	82·7	·785	
November ..	24	30,297,000	79·8	·697	
1914.					
January	18	30,905,000	79·8	·699	
February ..	24	26,366,000	76·0	·684	
March	21	26,131,000	78·0	·784	
April	18	22,105,000	82·0	·747	
June	16	35,462,000	85·0	·802	
July	16	39,025,000	82·0	·866	
Total ..	240	....	..	..	

Microbes per c.c. in 240 Samples of Milk expressed in millions.

More than 1 but less than 5 millions.	More than 5 but less than 10 millions.	More than 10 but less than 20 millions.	More than 20 but less than 30 millions.	More than 30 but less than 50 millions.	More than 50 millions.
3	9	32	82	68	46

The highest count was 118,400,000 microbes per c.c. and the lowest was 250,000 microbes per c.c. The above figures are only approximate for, as Savage says : "There are no nutrient media and no known conditions of growth which will allow all the bacteria in milk to develop." Without entering into a detailed discussion, it may be said that the count has a relative value when the samples are examined under identical conditions. The number of microbes varies a great deal, depending upon—(1) conditions of collection and transportation of milk ; (2) time elapsing between the collection and the examination ; (3) temperature.

The above figures show a much higher count in April and May, when the heat is intense in Western India, than in July and August, when it is cooler on account of the rains.

A few cows and buffaloes were brought to the Municipal Laboratory and several samples taken under aseptic precautions and examined immediately. The average of several samples was found to be 386 microbes per c.c. This shows the value of collecting milk with proper care.

The importance of the microscopic examination of the milk sediment, the significance of B. Coli, Streptococci, Pus Cells, etc., in milk are discussed fully in Dr. Joshi's book to which the reader is referred.

As regards bacterial standards, there are many difficulties in the way of adopting a standard for *legal* purposes. A working standard, however, would be very useful for administra-