

Case 2.—The infant was delivered by normal labour at full term. The mother, aged 23 years, was healthy. Birth weight 8 lb. Natural feeding. By the 4th week it was marasmic in appearance. Artificial feeding with scalded cow's milk, milk diluted and vitamin C (orange juice) added, a proprietary food, diluted cow's milk again, whole milk, made little difference to the weight, which was 8 lb. 8 oz. in the 4th and the 20th week. Then vitamin D (ostelin) was added to each feed. The weight then increased as follows :—21st week, 9 lb.; 24th week, 11 lb.; 28th week, 13 lb.; 32nd week, 15 lb. 2 oz.; 36th week, 16 lb. 8 oz.

Ostelin, the preparation referred to above, is prepared by "Glaxo," the first firm, we believe after years of research, to produce a standardised concentrate of the anti-rachitic substance contained in cod-liver oil and known as vitamin D. One drop of ostelin contains the vitamin D of four ounces of cod-liver oil. It is therefore put up in various dilutions, and in the glycerine preparation four drops equal one teaspoonful of cod-liver oil.

IMMUNITY

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Theories of Disease

Probably one of the earliest notions of the cause of disease was a belief that an evil spirit or demon entered into or possessed the body of man and there wrought various ills. This is the belief still widely prevailing among the savage tribes and this demonistic conception of disease still finds expression in the practices of their medicine men and wizards. Two modes of treatment are possible: the spirit may be lured out by propitiatory sacrifices, promises, etc., or he may be forcibly evicted by powerful charms, beating of drums, or by beating or abusing the body of the patient. Examples of both methods of treatment may be found among the savage tribes.

As civilization advanced the demon or evil spirit theory lost ground and was superseded by the Hippocratic theory, called after Hippocrates, "the father of medicine." This was the dominant theory all through the middle ages. According to this theory the body contained four humours: blood, phlegm, yellow bile and black bile. Health consisted of a proper mixture of these four humours; disease occurred when the balance was disturbed. The efforts of the physicians were directed towards keeping the

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humours in their proper relations to one another. This theory held sway for a long period and was followed by others more vague and unsatisfactory.

At last, after centuries of vagueness and confusion of theories, emerged the definite germ theory of disease. The germ theory of disease developed from the germ theory of fermentation and owed its origin to Louis Pasteur (1822-1895), all within the last hundred years. In 1876, only fifty-one years ago, it was proved without doubt that the anthrax bacillus found in the blood and internal organs of cattle dead of this disease, was the cause of the disease. This was the first micro-organism to be proved definitely to be the cause of a disease. Since then the causative organisms of many diseases have been found and it is an indisputable fact that such diseases as tuberculosis, typhoid, cholera, anthrax and tetanus are due to germs.

When pathogenic micro organisms gain entrance to the body and give rise to disease the process is spoken of as an infection. Disease is the reaction between the body and the invading organisms. The mere entrance of pathogenic micro-organisms into the body does not necessarily cause an infection. The opportunities for such entrances are so numerous and the contact of the body with the germs of disease so constant, that if this were true, human life would be extinct. Pathogenic organisms are more or less constantly present in various parts of the body, such as the mouth, throat, nasal passages, eyes, intestines, etc. Diphtheria germs are frequently found in the throats of otherwise normal people and apparently healthy individuals may have pneumococci in their mouths or carry typhoid bacilli in their gall bladders. The body must possess some means of defence which disposes of or prevents pathogenic bacteria from causing disease. This means of defence or resistance to infection is known as Immunity.

The power of resisting infection may be the natural heritage of a race or species and is then spoken of as **Natural Immunity**. It may, however, be acquired, either accidentally or artificially during the life of the individual and is then known as **Acquired Immunity**. For example, most human beings are susceptible to small-pox and typhoid but may be immunized through vaccination.

Natural Immunity : It is a well-known fact that many infectious diseases that commonly affect man do not occur in animals, *e.g.*, typhoid, syphilis, cholera, leprosy. Conversely, many diseases of animals do not attack man. Flesh eating animals are immune to many of the diseases of herbivora : such as tuberculosis, glanders, anthrax and cold. The factors which determine this natural immunity of species are not clearly understood. The temperature of the body, the diet and body metabolism may account in a great part for it.

Just as differences exist in the natural immunity, or conversely, the natural susceptibility of species, so the races or varieties among the species may show marked differences in their susceptibility or resistance. American Indians, Eskimos, and Negroes show a greater susceptibility to tuberculosis than do the white races, while the Negro shows a greater immunity to yellow fever. Jersey cows are much more susceptible to tuberculosis than Holsteins. Field mice are highly susceptible to glanders and house mice are almost completely immune.

Again we have an individual difference in natural immunity in members of the same family. Members of the same family, exposed at the same time, under the same conditions, show great differences in susceptibility. In an epidemic of typhoid due to an infected water supply where the bacteria are more or less uniformly distributed, all water drinkers even in the same household do not contract the disease. This is due to differences in individual immunity. Individual resistance may be lowered by fatigue, malnutrition, prolonged exposure to extremes of heat or cold, oxygen starvation or overwork. Chickens ordinarily immune to anthrax may be infected if exposed to intense cold. Frogs, cold-blooded animals, also immune to anthrax, may be infected if the body is heated.

Acquired Immunity : Acquired immunity may be either active or passive. Active immunity is due to the direct participation of the organism concerned and is due to increased cell activity induced by or as a reaction against some bacteria or toxins which have gained entrance to the body.

Passive immunity, on the other hand, involves no active participation of the immunized individual. He is simply the recipient of some substance formed in the body of another animal. Diphtheria antitoxin is prepared by immunization of a horse by giving increasing doses of diphtheria toxin. The horse develops an active immunity by the action of its body cells. When a human being is exposed to diphtheria the antitoxin prepared by the horse is injected and causes a temporary passive immunity. From the standpoint of preventive medicine, active acquired immunity is the most important form. Passive acquired immunity is quickly acquired but is temporary, and it is impossible to immunize all those recently exposed to infection as it is impossible to know who have been exposed.

Many theories have been advanced as to the method by which acquired immunity is produced in the body. One theory, known as the exhaustion theory, was that the micro-organisms living in the infected body used up some substance essential to their existence and that by lack of nourishment they were destroyed. Another theory was that the invading organisms produced some substance in the body that eventually destroyed them. This was known as the retention theory. It is now known that the infected body itself produces protective substances that neutralize the poisons of the bacteria or act directly on the bacteria themselves,

causing dissolution or agglutination or some other destructive action. It is known that there are many different antibodies, as these substances are called.

Active immunity may be brought about in many different ways but until recently the only known way was by having an attack of the disease. This means of acquiring immunity has been recognized for centuries, but it was left for Louis Pasteur to show the possibility of preventing disease by producing immunity without danger to the immunized. His first discovery was made accidentally during experiments with chicken cholera. The failure of chickens to die after inoculation with an old culture of bacilli which was virulent a few weeks previously was the starting point for a long series of investigation from which we derived methods of immunization against many of the diseases of man and animals, such as typhoid, cholera, anthrax.

Active acquired immunity may be brought about in various ways. Attenuated cultures or cultures of lowered virulence may be used, as was discovered by Pasteur in his experiments with chicken cholera. In this way sheep and cattle are immunized against anthrax. Attenuation of bacteria may be produced by growing at a higher temperature than is best suited to them, or by growing in the presence of weak antiseptics or by heating the grown cultures at 55°C. for a few minutes. The injection of attenuated cultures may be followed by injection of fully virulent cultures as is done in vaccination against anthrax.

Active immunization may be produced by sublethal doses of a fully virulent organism. This method is not much used. It may also be brought about by the use of increasing doses of dead bacteria. This method is extensively used against typhoid fever, cholera and plague. This vaccine, as the preparation is called, does not in itself produce the immunity but stimulates the production of an antibody by the body cells. Again, active immunity may be brought about by introduction into the body of poisons produced by the bacteria. In this way antitoxin for tetanus and diphtheria are produced in the horse and used for passive immunization of man, and also for neutralizing the toxin present in actual cases of the disease.

Of recent years active immunity to diphtheria has been produced in human beings, especially children, by the use of diphtheria toxoid. This is a preparation of diphtheria toxin which is injected into the body and promotes the formation of antitoxin in just the same way as the antitoxin is produced in the body of the horse.
