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ON NATURAL AND ARTIFICIAL IMMUNITY.

BY O. LOEW, MEMBER OF THE UNIVERSITY OF MUNICH, FORMERLY MEMBER OF THE WHEELER EXPEDITIONS, WEST OF THE 100th MERIDIAN, OF THE U. S. CORPS OF ENGINEERS.

SINCE the beginning of the extensive bacteriological investigations of Pasteur, about twenty years ago, the new-born science of bacteriology has developed to gigantic proportions, and, although this science is still in its youth and capable of an immense extension, it has become of an extraordinary importance and of universal interest. No other science can boast of such rapid development. Many investigators, botanists, hygienists, physicians, and chemists, have contributed their share to raise the science to an imposing figure. We name here above all: C. Nägeli, R. Koch, Rudolf Emmerich, Hans Buchner, M. Nencki, the Italians Tittoni and Cattani, the Americans Billings and Dixon, the Japanese Kitasato and Tsuboi, the Englishman Hankin, and the Germans Hüppe, Scholl, and Baumgarten.

It was Koch who invented excellent methods of isolating different bacteria species and made us acquainted with the bacillus of tuberculosis and the comma-bacillus; Kitasato isolated for the first time the bacillus of influenza and of tetanus (lockjaw); Nencki, Krieger, Hüppe, and Scholl isolated poisonous albuminous products of different bacteria species. But it was essentially Professor Rudolf Emmerich of Munich,[1] whose everlasting merit it is to have taken the first successful steps for solving the mystery of natural and artificial immunity.

We know now that nine-tenths of all diseases of man and animals are due to certain bacteria species that either by the lungs or by the stomach enter the body, multiply in the blood, and yield poisonous secretions that finally attack the nervous system and kill the body if no powerful reaction sets in that kills the bacteria, while their poisonous secretions are expelled by the body by oxidation or by the excreta.

Now, this reaction against bacterial evil-doings is the most interesting and marvellous process in the science of bacteriology and medicine, a process that was surrounded by a deep mystery, and the more interesting as it became evident that an animal having passed through a certain infectious disease, had acquired a certain resistance for a certain period against the same cause of disease. Experiments of Pasteur had shown this to be the case in various diseases. This resistance gained by passing through an infectious disease is known by the name of artificial immunity.

There exists, however, also a natural immunity, that is, the resistance of certain animal species against certain kinds of bacteria, without ever having passed through an infectious disease. For instance, rats and dogs are incapable of getting tuberculosis or swine plague (roth lauf), rats are incapable of anthrax, most animals are incapable of typhoid fever and Asiatic cholera.

It was Professor Emmerich who discovered first, in 1886, that the blood of an animal that had recovered from an infectious disease can cure another animal from the same disease or even prevent the development of the same disease if subcutaneous injections are made. He had proved, for the first time, that the bacteria in question are killed rapidly in the blood of an animal that had acquired immunity. He supposed, at that time, that there are formed certain albuminous combinations that act as poisons upon the barteria. Sometime afterwards, H. Buchner proved indeed that the fresh blood of various animals contains albuminous bodies detrimental to bacteria and that the natural immunity is thus easily explained, while for the artificial immunity this was proved later by Emmerich. This was to many a remarkable surprise, for all albuminous substances had been heretofore considered as the best nutrition for every living cell.

But this surprise was not altogether justified, for two Americans, S. Weir Mitchell and Edward Reichert, had demonstrated that the poison of the rattlesnake consists of two albuminous bodies, and a little later such poisonous combinations have been isolated from the seeds of *Abras preratorius* and of *Ricinus communis*. Now, if there existed albuminous bodies noxious for the higher animals and not for bacteria, there could not more be wondered at, if albuminous bodies existed noxious to bacteria and not for animals. There exists, however, a third class of albuminous substances (proteids) noxious to both animals and bacteria.

Here must be mentioned, also, the theory of Metschnikoff in regard to the disappearance of bacteria in the blood of an infected animal. He had observed that the white blood-corpuscles or lymphatic cells devour living bacilli, for instance, the bacteria of anthrax, and he believed, therefore, this to be the principal way to get rid of the entered bacteria. This theory of the phazorytose, however, did not give sufficient explanation in several regards.

The investigations of Professor Rudolf Emmerich have shown us that the albuminous bodies of the serum of dogs' blood, when precipitated by alcohol and redissolved in water containing 0.4 p. mille caustic soda had microbicide properties even then, if by the treatment with alcohol this property had been lost in consequence of a slight chemical change. This proved that a certain atomic constitution can be restituted by the very diluted solution of caustic soda. Not so easily changeable by alcohol is, however, the albuminous body causing the artificial immunity, as Emmerich has found, and while it is easy to cure with blood of artificially immunized animals, no one was able until now to observe a cure by application of blood of naturally immune animals. One cannot immunize, for instance, with dog's blood against tuberculosis of man or with the blood of rabbits against typhoid fever.

Professor Emmerich and Professor Tsuboi have investigated the blood of rabbits that were artificially immunized against swine-plague (roth lauf). The serum of this blood was (after separation of the globulin) concentrated at 42° C. in vacuo, whereby an albuminous body of prominent curing properties was precipitated. The filtered liquid, however, gave upon precipitation with alcohol also a substance of the same curing qualities. This substance was washed with alcohol and ether and dried at a low temperature. This dry powder possessed all the curing properties of the blood itself against swine-plague. Thus we have for the first time the curing substance (Heilsubstanz) in a dry state, although mixed yet with inactive albuminous substance. This is a fact of immense importance, the most important discovery in bacteriology relating to medicine. Emmerich and Tsuboi gave also a plausible theory in regard to the formation and the mode of action of this remarkable substance, as may be studied in their publication, "Die Natur der Schutz und Heilsubstanz des Blutes," Wiesbaden, 1892. We hope to communicate later more of the investigations of Emmerich and Tsuboi.

A few additional remarks may be permitted to the writer. The great admirable transatlantic republic, with its unrivalled wonderful development, with its immense natural resources, and an unheard of liberality and magnanimity and generosity of

[1] Professor Emmerich is the most successful student of the far-famed hygienist, Professor Dr. Max v. Pettenkofer of Munich.

prominent citizens, as Senator Sanford, Johns Hopkins, Clarke, Lick, Cooper, etc., ought also to take the development of bacteriological research in consideration. Should there not exist a second Lick, who will help revealing with microscopes mysteries of just as high interest and still more practical bearings, like the first Lick with his telescope helped to reveal mysteries of the heavens? Thus far Europe is ahead in such studies, but I know that the ambitious Americans want to excel all other nations in every respect. The United States is bound to become in every scientific branch the first country on earth. This is my firm conviction.

SOME RELICS OF PRIMITIVE FASHIONS IN INDIA.

BY MR. KEDARNATH BASU, COR. MEMB. ANTHROP. SOCIETY, BOMBAY.

"THE ideal," says Theophile Gautier, "torments even the rudest natures. The savage who tattoos his body, or plasters it with red or blue paint, who passes a fish-bone through his nostrils, is acting in obedience to a confused sense of beauty. He seeks something beyond what actually is; guided by an obscure notion of art, he endeavors to perfect his type." Coquetry and neoterism are the peculiar characteristics of man. From the dawn of the Stone Age onwards man is known to have adorned himself with feathers, coral, shells, bone, wood, and stone ornaments; but the exact time when he commenced painting and tattooing his body and face is beyond the ken of history.

Tattooing the body and the face is one of the favorite, though painful, methods of adorning the body among savages, more especially among the Polynesian Islanders. This savage ornamentation of the body has permeated many of the so-called civilized and semi-civilized people, such as the modern Hindoos, the Burmese, etc. There is no mention of this savage and rude art, to my knowledge, in any of the ancient Sanscrit works, where other methods of decorating and ornamenting the body in all times and on all occasions are put down in detail. This art, if it may be so called, was not known to the aborigines of India till a recent date, and it may, therefore, be surmised that the Hindoos borrowed the rude and savage art from some race or races outside of India. I strongly incline to believe that this practice came to India from the Malayan Archipelago through Burmah to eastern Bengal, and through southern India upwards to the whole northern part of India.

The rude and savage custom of tattooing is still in vogue among almost all classes of Hindoo females and in almost all parts of India. The face, chest, and the arms are generally tattooed with varied and fantastic designs. The remnant of the savage custom of painting the person is to be seen in the red paint over the forehead, extending to the crown, among the married women of India. Both of these customs are rapidly waning with the refinement of the people. I do not see the same profusion, as I saw ten or twelve years ago, of tattoo-marks and red-ochre or red oxide of lead (*sindur*) over the forehead and crown among the women of Bengal. The rapid stride of female education and the consequent refinement in æsthetic taste are the causes of the decline of this rude and savage adornment; but the people of Behar, the North-Western Provinces, etc., still cling to these remnants of savagery. The up country women, besides tattooing their bodies and painting the head with red paint, bore the lower lobes of their ears, and insert big and heavy wooden cylindrical plugs, which almost sever the lobes from the ears. The plugs are sometimes as big as two inches in length with a diameter of an inch and a half, and as much as two ounces in weight. These heavy plugs pull down the lobes of the ears as far as the shoulders, and give the wearers a hideous look. The Marwaree women, besides tattooing their bodies and faces, ornament their upper incisors by drilling holes and plugging them with gold, and sometimes with carvings or engravings. The latter ornamentation is usually in the form of two or more concentric rings. The women in the North-West Provinces, Behar, Bengal, and elsewhere sometimes, color their teeth black with a kind of astringent tooth-powder, called *misi* or *manjan*. Painting the feet with scarlet paint (*alakta*) is prevalent among the Hindoo women from a remote age. The Mahomedan women, and the Hindoo women after them, paint the tips of their fingers and the palms with *henna* (*Lawsonia alba*) leaves. The Jains, on certain social ceremonies, paint their hands and feet with *henna* leaves. The up-country and Marwaree women wear their *sarees* and petticoats below the navel, and artificially cause the muscles of the belly to hang down loosely in a fold over their wearing apparel, thus causing an ugly appearance to the contour of the trunk. Some of the men also adopt this fashion, and destroy the natural beauty of the abdomen.

The Burmese men tattoo their entire bodies from the legs up to the chest and shoulders with blue and red pigments, with designs of animals and dragons. The lower limbs from the waist down to the ankles are tattooed in blue, while the parts above the waist are ornamented in red. These people tattoo their bodies as a mark of manhood, and ascribe special *charms* to every particular design. A Burmese priest or *phoongie* told me that men only are decked with tattoo-marks, the women do not mar their natural beauty with permanent pigments. The Burmese women look down with contempt upon men who fail to tattoo their persons, and would not marry a man who has not been tattooed. But the *Mugs*, both men and women, tattoo their bodies.

The wings of butterflies and wing-cases of beetles were, and are to some extent, in use as ornaments among the women of India. The wings of butterflies have now given place to artificial ones, made of mica sheets and paints, which, however, bear the name of butterflies or *ticklies*. The wing-cases of gaudy beetles are still in use in Bengal and elsewhere. The wing-cases of the Indian blister-fly (locally known as *Kánch pôká*, or glass insect), are generally used by women of Bengal. These wing-cases and *ticklies* are worn stuck upon the forehead, in the space between the eyebrows, or a little above it.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

Notes on a Captive Pocket-Mouse.

IN November, 1889, I found a pocket-mouse (*Perognathus fallax*) in one of my traps, alive and unhurt, though torpid with cold, and took a fancy to keep it a captive to study its habits. It warmed slowly, and was some hours in regaining its usual state of activity. I have found individuals of other species and genera of this family (*Saccomyidæ*) chilled in traps, and it seems probable that, while they can bear considerable cold if free to move about rapidly, if compelled to keep quiet, they speedily succumb to cold. On this November morning the cold was sufficient to produce but a slight rime on the grass. This pocket-mouse was not wild, but allowed handling freely from the first. It would walk up my sleeve, around my neck, and down the other arm, and for a year or more would not try to jump to the floor, but later it seemed to have lost the sense of depth, and now it will jump down after a little walking about, even if the fall is far enough to injure it. It has never tried to bite me, and will quietly bear stroking and carrying about in my hand, though it seems to be getting somewhat wilder. I put it in a wooden box of perhaps a cubic foot in capacity, and put in an inch or so in depth of dry sand. For the first two years its habit was to dig and scratch in this sand each night, often making noise enough that I could hear it through my closed bed-room door, just outside of which the box was placed, but I never heard it scratching in daylight, and for some months I have not heard it in the night. It has not gnawed the wood as true mice would have done, and has not lifted the lid, which was kept closed by but its weight. If taken out of the box after dark and turned loose on the floor of the sitting-room, it moves about actively a few minutes, usually by short, deliberate, rabbit-like jumps, but if frightened it leaps two feet or more, as if shot off by a spring. After it has satisfied its curiosity, it creeps into some dark place behind a piece of furniture. In daytime it hunts a dark place immediately, if al-