

tinues, a copious exhalation without a moment's intermission, is going on, and not a movement can be performed which does not, in some degree, increase the circulation and add to the general waste. Now there is a set of organs exactly fitted for this object, just as there is one for supplying, secreting and preparing the raw materials. These organs pass under the general designation of excretory, or exhalants, and are evidently intended as outlets to those particles which are useless to the system. The liver, the kidneys, the bowels, the lungs and the skin may be all classified under this head.

The most important, however, of these, and the one which perhaps receives the least share of attention, is the skin, or the cutaneous system of organs.

Physiologists generally consider this system as composed of three parts—the cuticle or epidermis, the mucous membrane or rete mucosum, and the cutis vera or true skin. The first, or that part of the skin which is seen with the eye and which is raised by a blister, is insensible, and serves as a safeguard or sheath of protection to the whole of the cutaneous apparatus, impeding the evaporation of the fluids on the one hand, and the absorption of the poisonous vapours on the other. The *rete mucosum* is neither more nor less than the newly formed layer of the cuticle. In this membrane there exists a peculiar kind of paint which imparts colour to the complexion. This deposit of colouring matter varies in different individuals and in different races. In the Negro, it is black, in the Indian, it is copper coloured; and in the European, it is white. As a general rule, it is increased by the stimulus of light and heat; the complexion becoming dark in summer from its increased secretion, and relapsing into paleness on the approach of winter, when the stimulus of the solar light and heat is withdrawn. The next is the cutis vera, or true skin, which is a complicated network of fibres interlaced in every direction, possessed of great extensibility and elasticity, and is the outlet through which a large proportion of the waste of the body passes. The means by which it effectuates this end, is through the medium of innumerable glands called the sebaceous, or the oily, and the perspiratory glands. The former are spread over the parts of the skin most exposed to the changes of temperature and moisture, and are made up of that oily fluid with which the skin is bedewed and rendered soft. The latter separate from the blood the perspiration or sweat. They are exceedingly numerous, being about two thousand to every square inch of skin, or five millions, or, according to some, seven millions in the natural covering of the body. These discharge themselves either by sensible or insensible perspiration. Every one knows that when the body is overheated by exercise, a copious sweat breaks out, which by evaporation carries off the excess of heat, and produces an agreeable feeling of coldness and refreshment. This is called sensible perspiration, because it is apparent. Dr. Smith of London has made some interesting experiments on the subject of exhalation from the skin and lungs jointly. Eight persons in the Phoenix Gas Works were weighed before going to work and immediately afterwards. In one experiment in the month of November they continued to work for an hour and a quarter, and the loss they had sustained during that time was 2 lbs. 15 oz. In another experiment in the month of June, the same number of men lost 5 lbs. 2 oz. in about the same time. But in the ordinary state of the system, the skin is constantly giving out a large quantity of waste materials in the form of vapour, which, being carried off by the surrounding air, is invisible to the eye, and hence is called insensible perspiration. This cuta-

neous exhalation is of immense importance to the welfare of the system at large, and has led to many attempts to form an accurate estimate of its amount; but so many difficulties have stood in the way of obtaining precise results, and the difference in different constitutions, and even in the same person at different times, is so great that we must be satisfied with an approximation to the truth. "Among the first inquirers," says Combe, "whose accuracy can be in any degree relied on, Sanctorius deserves to be honourably mentioned. With a zeal and perseverance worthy of greater success, he carefully weighed himself, his food and his excretions, in a balance every day for thirty years, and came to the conclusion that *five* out of every eight pounds of substances taken into the system pass out of it again by the skin and lungs, leaving only three to pass off by the bowels and kidneys." The celebrated Lavoisier and Berthollet afterwards entered on the same field of inquiry, and with more satisfactory results. They discovered by experiment that the largest quantity of insensible perspiration from the lungs and skin together, amounted to 32 grains per minute, three ounces and a quarter per hour, or five pounds per day. Of this, the cutaneous consumed three-fourths, or sixty ounces in twenty-four hours. The smallest quantity observed amounted to eleven grains per minute, or one pound eleven and a half ounces in twenty-four hours, of which the skin furnished about twenty ounces. The *medium* or average amount was eighteen grains a minute, of which eleven were from the skin, making the cutaneous perspiration in twenty-four hours about thirty-three ounces. Whatever be the nature or the condition of the constitution at the time, it is now agreed by all eminent physicians that between 30 and 40 ounces of substance pass off through the skin of an adult in usual health, every 24 hours. And what is the nature of the material thus exhaled? It is composed partly of watery vapour and partly of animal and mineral substances—in the proportion per 1000 of 986 to 14—that is, there are 986 parts of watery vapour, consisting mainly of carbonic acid, to 14 of earthy and mineral substances, which consists mainly of concentrated animal substances,—a very energetic poison.

But the skin is not only a powerful exhalant, it is also an absorbent. By means of this function substances placed in contact with the skin are taken up and carried into the general circulation, either to be appropriated to some new purpose, or to be speedily thrown out of the body. This process is carried on by the blood-vessels, which are ramified in a close network immediately under the epidermis, and also by another class of vessels called the *absorbents*. Of the absorbing power of the skin we have a familiar example in the process of vaccination as a protection from smallpox. This process, as is well known, is the insertion of a small quantity of cowpox matter under the cuticle on the surface of the true skin and the leaving of it there. In a short time it is acted upon and taken into the system by the cutaneous vessels.

Such is a brief exposition of the structure and functions of the skin; and brief though that exposition be, it is, we trust sufficient to show the important practical bearing of this system of organs on the whole subject of physical education, and, especially, on that department referred to in the proposition now under consideration. If the healthy action of the skin depend on the free and equal circulation over every part of its surface; or a free and equal perspiration being kept up in every part, and on the scrupulous and timeous removal of the residuum or remains of the perspired matter, and all external impurities ac-