

of the muscles, and every mental act, whether conscious or unconscious, invoke the same physiological phenomena both of muscle and nerve. The immediate effect of these is a determination of blood to the part, a quickening of the heart, pulse, and respiration, a raising of the temperature, and an increased molecular activity. According to physiologists this metabolism originates by-products of a toxic or poisonous nature, and it is the accumulation of these that gives rise to the symptoms of fatigue. These products are acid in reaction, and can be removed from the fatigued structures. The fatigue poisons are eliminated by the excretory organs under the influence of rest or repose of the part or centre involved.

#### SIGNS OF SYMPTOMS OF FATIGUE.

We all know the deliciously tired feeling at the end of a day fully and well spent, and have also experienced the wretchedness and depression of weariness and jading. The picture of a naturally fatigued child is characteristic—his tired drawn look, his clumsy movements, his listless conversation, his aversion to exert himself, and his readiness to fall asleep. Here the poisons seem to act like a narcotic, and these signs of simple fatigue all vanish with the night's rest, the morning finding him normal and refreshed. When, however, the products and effects become cumulative, and the condition is passing into a chronic state, another set of signs begin to manifest themselves. Thus, the morning finds him sleepy and languid, his eyes are dull, his pupils large, and the expression limp and wearied. He drags himself to school slowly, without alertness, his walk is tottery and awkward. In school he lacks attention and responds feebly, his gaze wanders, his attitude is slouching, and he becomes peevish. The same causes continuing to act, matters aggravate, and he arrives at the borderland of actual disease. He becomes pale and pinched, suffers from headache, there is muscular twitching or inco-ordination, he is more liable to colds and susceptible to infectious disease: stomach troubles ensue, with loss of sleep and exhausting dreams. Here, in the absence of specific disease, begins that long train of serious symptoms known as neurasthenia, or nervous debility. The differential diagnosis of pseudo-fatigue in experimental work, and of laziness in the scholar, must be borne in mind.

#### DIAGNOSIS AND TESTS OF FATIGUE.

How can one measure fatigue, or record the advance of the later fatigued states? There are two methods—the physiological and the pedagogic.

All the tests for fatigue up to now are too

difficult of application, except in scientific hands, to be generally used. The varying factors of the individual scholar, his varying states of mind and body, the presence or absence of hygienic and body conditions, the amount of voluntary attention during the test, the influence of practice, the agreeableness, or otherwise, of the test, and the complicated question of the discharge of energy by passion or emotional states, make the testing of fatigue a speciality which requires much time, much observation and considerable knowledge.

The practical results, however, of these scientific workers are for the most part in unison, and in addition to those noted under etiology, the following three have a practical direct bearing on educational schemes:—

(1) Work in the morning after the reparative night's rest is much more active and productive than that of the afternoon. Combining with this the relative fatigue figures of different subjects, *e.g.*, arithmetic, languages, history, drawing, etc., a teacher can make a scheme which will lessen the total fatigue.

(2) Work in the beginning of the week, up to Wednesday mid-day, is of better quality than during the rest of the week. Hence the wisdom of the mid-week half-holiday.

(3) The work of the scholars, their attention, their response, and their aroused interest are better during the first half of a school term. This fact is a matter of common observation during the autumn and early winter session, when the days rapidly shorten, Nature seems dead, and the conditions of our lives for many weeks become artificial and unnatural.

#### THE CAUSATION OF FATIGUE.

Leaving aside the view that children are "born tired," we find that there are two sets of causes—educational and environmental.

On the former much scientific work has been done, and the following questions present themselves for still further elucidation:—How long, according to age, can a child's attention be fixed? What is the effect of change of subjects? Is fatigue less in subjects which children like?

The environment causes more closely concern the school doctor:—

(A) *Inside School.*—Among these the following are to be reckoned with: Defective ventilation, bad lighting, bad desks or equipment, wrong attitude, defects of eyesight, of hearing, and the whole host of diseases and unhygienic conditions among school children.

(B) *Outside School.*—Here the following causes are at work:—

(1) Deficient, improper, and badly cooked food.

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