

being exposed to polarised light, one to ordinary light, the third being kept in darkness. After thirty to sixty minutes, depending on the strength of the diastase, rapid hydrolysis can be seen to take place on the slides exposed to polarised light, while in the two controls the starch granules remain almost intact for some hours. By the use of a delicate thermocouple, the temperature was proved to be the same in all three cases. When the light is intense, the starch granules in the case of the polarised light break down entirely to little masses of dextrin and crystals of sugar which give deposits of cuprous oxide on warming with Fehling's solution. These results have been obtained with potato starch and the endosperm of maize and of wheat, the latter without the addition of diastase if freshly prepared.

In view of the suggestiveness of these observations the investigation is now being extended in various directions, and I hope to communicate the results in due course.

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December 16.

Medical Education.

REFERRING to my letter (NATURE, December 9, p. 769), Prof. Dakin writes (NATURE, December 23, p. 845): "I am not quite clear whether this question has been propounded to invite answers, or to introduce another of Sir Archdall Reid's favourite discussions on mutations and fluctuations, etc." Prof. Dakin may rest assured that I do not invite a discussion about mutations and fluctuations. To be frank, I do not think such a discussion, conducted on purely scholastic lines, out of touch with reality, would be profitable. My object was simply to protest against the waste of time to which, as I supposed and still suppose, unhappy medical students are compelled. Here are some truths, none of which, I think, Prof. Dakin will deny categorically, but all of which, in practice if not in theory, are repudiated by many teachers of biology.

(1) Every relevant and verifiable fact, no matter how observed, is equal before science. Experiment is only one way—a very good way when need arises—of observing. The vast majority of authentic facts about living beings is derived from direct observation. People who limit their data to facts derived from experiment, or any other mode of observing, are, like those who insist on purely Christian, Mahomedan, or Hindoo testimony, merely sectarian. Dwelling in an islet of evidence they ignore the continent of truth which lies at hand.

(2) Our powers of observing are proportionate to our familiarity with the objects of study. Thus we can scarcely differentiate between peas in a pod or sheep in a flock; to an Englishman newly arrived in China all the natives seem much alike; but among our own kind, whom we study from birth to death, especially among our intimates, we see differences of every shade (*i.e.* fluctuations) between vital and enormous extremes—as, for example, in powers of resisting disease. Obviously, the experimenter who works among plants and lower animals knows nothing about fluctuations, and less than he ought to know about mutations. Lacking the necessary powers of observation, he merely guesses. That he guesses wrongly was abundantly demonstrated by my letter.

Can Prof. Dakin deny (*a*) that men, the only living beings minutely observable, are subject to stringent natural selection, (*b*) that this selection occurs amid

fluctuations, (*c*) that evolution, proportionate to the length and severity of the selection, has resulted, (*d*) that human races never differentiate while there is interbreeding, but differentiate rapidly and invariably when separated by time and space, (*e*) that human races blend perfectly when crossed except in traits linked with sex, (*f*) that in spite of multitudinous human racial differentiations, there has never yet been recorded a useful human mutation, or one that changed the type of a race, (*g*) that human mutations (*e.g.* club-feet, idiocy, albinism) are not *inherited* independently, but are only *reproduced* independently, and (*h*) that lost ancestral traits never appear among natural varieties, but frequently among artificial varieties, even when purely bred.

Unless a biologist is able (*r*) to accept the foregoing propositions, or (*2*) to disprove them, or (*3*) to demonstrate that man is outside the scheme of Nature, he is not competent to teach biology to medical students; for, after these students leave him, they will observe for themselves, and be taught by men who have observed, with a minuteness and accuracy impossible to workers among plants and lower animals, and the things they then learn will be directly contrary to the teachings of the biologist.

I have before me the synopsis of instruction in biology of the Royal Colleges of Physicians and Surgeons. I must admit that it is a vast improvement, chiefly by way of elimination, of the rubbish (for a medical man) that I was taught as a student and which I supposed was still taught. The syllabus for 1923 will be even shorter and better. Biology, which should make doctors, in their vast numbers, the most potent scientific influence in the community, is disappearing from the curriculum. But I observe that the student must still learn the general structure of the Hydra and Lumbricus, the general structure and elementary physiology of Scyllium and Rana, and the elementary facts of evolution, heredity, and variation. But of what use, as taught by biologists, can these subjects be to the medical student? What, for example, will he learn about evolution, heredity, and variation? Will he learn that some characters are "innate," and the rest "acquired"? Recently I spent eighteen months trying to find out what biologists meant by these words and none could tell. Will he learn from a Lamarckian teacher that acquired characters are inherited, or from a neo-Darwinian that they are not? I spent a like period in trying to find out what was meant by "inherited," and failed again. Will he learn from a Darwinian that fluctuations furnish the materials for evolution? Or from a Mutationist that only mutations do so? Or will he be presented with such statements as the following: "The standard deviation of a coefficient of correlation computed from data derived from classes, members of which are mutually correlated, with special reference to the case of fraternal and parental correlations calculated from entries of sibs" ? Will any biologist tell him that every character is a product of the combined action of nature and nurture (that is, is equally innate and acquired), that the human being is of such a nature that he is especially responsive to the nurture of use, and that this peculiarity bestows on man his position in the scale of life and has made him the educable and therefore, according to the teaching he receives, the rational animal—able to learn, for example, sense or nonsense concerning biology.

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