ADVENTURES IN SCIENCE—DISCOVERY OF VITAMINS*

THE word "adventure" calls to mind swash-buckling privateers, storm-tossed voyagers, fever-ridden explorers in tropical forests, in hourly peril from savages or treachery. What place is there in this reckless, glorious living for the cool calculated pursuit of scientific discovery? What matter the shadowy truths of an unseen, ill-understood world when life turns on the accuracy of the native's aim, and the loyalty of hired bearers?

To the vast majority of these restless pioneers no doubt science, as such, was unknown, and yet, they depended upon the science of their time for their very lives—navigation and firearms were obvious examples if they had but thought of it. Nevertheless, true scientists were not wanting amongst these careless warriors, for science is not an exclusive possession to be purchased from special instructors, it is the product of a scientific mind, and anyone who takes the trouble to observe carefully, to consider his observations and their possible explanation, and to put his conclusions to the test of experiment has that mind, be he soldier, sailor—or thief.

RECOGNITION OF DEFICIENCY DISEASES

In the writings of these scientist-pioneers are to be found from time to time accounts of diseases produced by lack of certain foods—deficiency diseases we call them to-day. The significance of many of these observations were not appreciated at the time, but bit by bit experience drove home the lesson and confirmed their statements.

In 1720 an Austrian physician, Kramer, wrote that 3 or 4 oz. of orange or lime juice would cure the dreadful disease of scurvy without other help. Captain Lind wrote a "Treatise on Scurvy" in 1757, giving for the first time the results of experiments conducted on sailors and proving that the disease was cured or prevented by the use of salads, summer fruits, &c., while Captain Cook was awarded the Copley Medal of the Royal Society for his dealings with scurvy in his famous voyages commencing in 1768.

Listen to these extracts from the writings of these voyagers and imagine yourself before the mast on the old wind-jammer.

Although the existence of two other diseases—beri-beri and rickets—had been known for a long time (beri-beri was described in the year 2600 B.C.), they were not recognized as deficiency diseases until much later. In 1878, 300 out of every 1,000 men in the Japanese navy were sick with beri-beri. In 1882 another sailor—Admiral Takaki—carved himself a niche in medical

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history, by abolishing beri-beri from the Japanese navy in much the same was as James Cook and his contemporary navigators had banished scurvy from the British navy. There was one important difference, however, which was to prove the forerunner of our present-day concepts. Scurvy had been prevented by the addition of one specific item to the diet—lemon juice; beri-beri was stopped by substituting a mixed diet of vegetables, meat, fish and barley in the place of one consisting largely of rice. There was one other difference. Admiral Takaki lived to enjoy the material benefits of a peerage conferred upon him by a grateful Emperor.

EXPERIMENTAL PRODUCTION OF DEFICIENCY DISEASES

In the history of almost any medical discovery, you will find that the first stage has been careful observation of what occurs in nature. The scientist notices that if certain things are done—or, as in the case of vitamins, not done—certain disease symptoms appear. From this knowledge, some sort of prevention or cure often springs—thus, to cure or prevent scurvy, it was found necessary to have fresh fruit and vegetables.

If knowledge remained at this stage, however, medicine would stay in a very rough and ready state. The next stage in progress is usually to see if one can produce and cure the condition at will, preferably in animals, but if that is not possible, it is sometimes necessary to use human beings. There have at all times been men of sufficient faith and nobility to offer themselves for such experiment—but that is another chapter of medical adventure.

In the case of the vitamins, the next step forward was taken almost accidentally. Eijkman, a Dutch scientist in Java, noticed in 1897 that when the hens in the prison yard were fed the same diet as the prisoners—polished rice—they also developed a kind of beri-beri, but when the hens' diet was changed, they got better. Here, he said to himself, is an opportunity to find out just what it is about the rice diet which produces beri-beri. Fowls are plentiful, they eat much less food and they do not suffer from so many diseases as man; they will make my work much easier. And so he and his colleagues set to work. Even so, it was nine years before they discovered the truth that rice husks contain a substance which is essential for the heart and nervous systems, and that this substance is necessary if polished rice forms the major part of the diet.

Although the observation which started Eijkman off on his trail of discovery was an accident, the same "accident" must have happened hundreds of times before, but none had realized its meaning, and the opportunity awaited Eijkman's acumen. This happy "accident" in the case of beri-beri was followed in 1907 by an equally happy accident in respect of scurvy, this time at the hands of the Norwegian investigators, and the guinea-pig was the animal. This was a very fortunate accident, as the guinea-pig is one of the few animals which do get scurvy, and the investigators were looking for beri-beri at the time.

Of the work of these Dutch and Norwegian scientists, English and American workers were daily bringing confirmation. Hopkins' account of his milk

experiments published in 1912 have been described as ranking aesthetically beside the best short stories of H. G. Wells. He fed rats on a diet which should have been quite sufficient for them, but which consisted of highly purified foods. The rats refused to grow until a small portion of milk was added to the diet.

At this time, a Polish bio-chemist, Casimir Funk, was working in London, and showed that a substance which prevented beri-beri could be obtained in concentrated form from rice husks. He was an imaginative man and, thinking over all that had been written about beri-beri, scurvy, and the like, perceived a single principle behind them all. For the first time he put forward the idea that food, to be adequate to the body's needs must contain more than carbohydrate, fat and protein—it must contain certain other substances which are only required in minute amounts, but which are essential for health. These substances he called vitamins. Thus Funk brought together into a single class governed by a single principle of prevention, diseases which were very different in their appearance. How true was Funk's flash of inspiration we now fully realize. Funk postulated four vitamins, we now recognize at least ten, and many others will probably soon be admitted to the fold.

THE WORLD WAR

Just when scientists of all nations had crossed the threshold of a new discovery, a discovery of the greatest importance to all mankind, there came to the world those dread dark days of 1914 and the subsequent holocaust. The shrill of the bugle, the roll of the drum, merged with the reverberation of gun-fire to drown the silvery pipings of peace-time science. This was no time for the prosecution of obscure imaginings, it was far more important to invent new ways of killing men than of saving rats. Yet how completely was this titanic struggle to vindicate the scientists' contentions. Read accounts of the sufferings of those caught in the toils of the blockade, see their emaciated frames swelling with the dropsy of beri-beri, their gums bleeding from scurvy, infection of all kinds steadily amounting as the body's resistance drops, the collapse of morale and the outbreak of red revolution as the last glimmer of hope dies.

How right were the scientists with their stress on the importance of food and of the minute necessary factors of food—but what a price to pay for proof! A proud nation brought to its knees and the health of thousands upon thousands ruined. Here indeed was adventure—but disastrous adventure of the wrong kind. Once more science had been pressed into the victor's service and her humanitarian gifts converted into a death-dealing weapon.

THE ATONEMENT

People are fond of stressing this subjugation of Science to the art of destruction, but there is another side to the picture. It is undoubtedly true that the demands of war forced the development of very many scientific discoveries which would have lagged behind in peace. So also the catastrophe of war famine drove scientists to further efforts in their examination of foods, vitamins and other accessory factors, as they are called. But so vast is the knowledge, so delicate the technique required that the day of the brilliant individual discoverer is well-nigh over. One man, working alone, cannot examine his work from all the different angles which are necessary, and, in any case, what

he could accomplish depends upon all the other discoveries which have gone before. In the place of a few inspired enthusiasts there is hardly a place of learning which has not its group of vitamin or other nutrition investigators.

It may seem to you that with this factory-like development of science, that romance and adventure have become mere legends, that it is no longer possible to sail a valiant lone voyager on the uncharted seas of natural science. This is not necessarily true as I shall show in a minute, but first let me say a word or two as to where this team-work is taking us in the matter of vitamins.

The oustanding development is the increasing number of vitamins being accepted by even the most cautious scientists. There are a large number of others still on trial as it were. We can sympathize with the candidate who, being asked where the six B vitamins were to be found, replied, " In Professor Peter's brain, Sir !" What was formerly thought to be a single vitamin has more than once turned out to be two or more similar but distinct vitamins. Then new ones altogether have been discovered. To make matters worse, it is no longer possible to draw a sharp dividing line between vitamins and certain other food constituents.

The second outstanding point about recent developments is the stress laid upon the mixed or balanced diet. Vitamins are not things to be added to the diet out of a bottle ; a well mixed diet, containing the different foods in the proper proportions or balance, will generally ensure that a sufficieny of all is obtained.

The third feature of modern work is the manufacture in the laboratory—synthesis, the chemists call it—of some of these vitamins. As much as 1 lb. of vitamin C has been manufactured at a time, but of this, the adult requires only one thousandth part of an ounce daily—1 lb. would last him forty-five years.

MODERN ADVENTURE

As I mentioned before, you may feel that the days of adventure in Science are over. You may say that it was all very well for Captain Cook to notice that lemon juice prevented scurvy ; all he had to do was to look ; everything as simple as that has been found out already.

In the first place, I doubt whether everything that is observable has been observed. There is a vast difference between seeing and observing. In the second place, there is just as much adventure in complex science as in simple observation. Think of the thrill that must have come to Szent-Gyorgy when he first isolated vitamin C, or to the team of chemists who first manufactured it artificially. You can see them working away day after day, month after month, now trying this line of work only to meet with failure, now trying a different line, to fail again. Some member of the team lying awake at night turning the problem over and over, sees a suggestive link. He pursuades his colleagues that it is worth following up. Is it worth while ? Will it mean the dashing of yet another hope, the loss of more months of futile work ? They try, they persevere. At last the final product ! Will it work ? Is it what they have been looking for ? They give it to an animal with scurvy. Just imagine how anxiously thay watch the animal, how fearfully they will go to its cage each morning. On the fourth day the animal is better, in two more it is cured—Eureka : We have found it !