NATURE

SATURDAY, MARCH 12, 1927.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.
Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.
Telegraphic Address: PHUSIS, WESTRAND, LONDON.

Pestalozzi and the Teaching of Science.

JOHANN HEINRICH PESTALOZZI died at Brugg, Switzerland, on Feb. 17, 1827; and in the hundred years which have passed since then, a great change has taken place in educational thought and practice. Especially is this so in the province of school science, a growth almost entirely of the latter part of the nineteenth century. But as with all growths, we must search for the roots in the history of a far earlier period than this; and then we discover what science teachers owe to the pioneers of old, one of whom, Pestalozzi, will always hold an honoured place.

During the Middle Ages, when Aristotelian doctrines dominated intellectual thought and the grammar schools in England were precluded by their statutes from teaching any but grammatical subjects, there were already many people alive to the fact that a knowledge of science would be of advantage to the rising generation. They were not, however, thinking of science as we understand it to-day; all they advocated was a study of the scientific works of the classical authors, and by the middle of the seventeenth century a few, but very few, schoolmasters endeavoured to emphasise books of this nature.

Following the rise of modern science, and about the time of the foundation of the Royal Society (1662), a few pioneers urged a reform of the school curriculum in the direction of science teaching. But whether it was Comenius in his wide embracing encyclopædic fashion urging complete reform, or Milton and Cowley advocating a closer study of scientific Latin and Greek books, or Hartlib and Petty emphasising the need of school science of a practical nature, little success attended their labours. Their schemes were all premature; the English grammar schools were not allowed by law to teach science until 1840.

A hundred years after the beginning of the scientific movement came Rousseau, with his vigorous revolutionary doctrines, bent on making his Émile a model youth. The old order was to be swept away and Émile's education was to proceed on novel lines. Amongst other things he must learn science, not book science, but practical, everyday science. No pedant was to teach him, he must teach himself: "Let him not be taught science, let him discover it." No book for Émile but that of the world, for books "only teach us to talk about things we know nothing about." Wordiness in education must disappear, and in its place come things, a first-hand acquaintance with things, so bringing into use the boy's powers of observation, reasoning, and invention.

At the time, in 1762, when "Émile" was published, Pestalozzi was a student at the University of Zurich. He was enraptured with the book, and became ensnared in the revolutionary ideas of his hero Abandoning in turn his course of study for the ministry and for the law, he turned to farming, where his idealism was rewarded with bankruptcy. He then became schoolmaster, a profession he was to follow until his death in 1827.

In this short article we are not concerned with his general views on teaching or with the methods he devised or adopted. It is enough to say that he believed that the true basis of knowledge was sensory experience, and that education should be based on personal, first-hand observation. Out of this grew the familiar object lessons of the nineteenth century, and these are of great significance in the history of science teaching. For during them much scientific information was imparted to the children, since Pestalozzi and his numerous followers took for the subject matter familiar and interesting objects. The pupils learnt to look at things more closely, to examine plants, animals, and inanimate objects. Pestalozzi, it may be recalled, had had experience in farming, and it seems highly probable that in the lessons he himself gave, agricultural topics would frequently be mentioned. Occasionally excursions were made into the surrounding districts, when, under the supervision of the teacher, many interesting titbits of natural history were learnt. But unfortunately this science, if such it can be termed, was taught generally without plan and was of a haphazard nature. It was largely of the demonstrative type, where the attention of the child was directed to some particular part or property of the object, the name of which, when given by the teacher, was repeated aloud and memorised. Such lessons had for their chief function the teaching of words, not science.

In addition, however, to the smattering of scientific information which he gave in this manner, Pestalozzi included physics and chemistry in the curriculum of the school at Munchunbuchsee, and, in the "Report to Parents," special mention was made of science teaching, thus :

"We are also trying at the same time to organise the teaching of experimental science. So far we have demonstrated to the boys the principal facts concerning Electricity and Magnetism and the behaviour of certain gases. We are, in this connection, trying to establish a satisfactory course of instruction in the language of physical science. A local doctor gives weekly lessons in this direction to the older children with the aid of excellent apparatus in his possession."

Natural history was also taught, for, as he pointed out, almost every child is sure to be familiar with "half a dozen mammals, and as many birds, fishes, insects, amphibians, and worms." In short, he endeavoured to connect the course with the things the boys could see around them, such as the behaviour and structure of the common animals and plants.

All this Pestalozzi was doing, whilst in England and most other countries little, if any, attention was being paid to science in the schools. It is rather significant that many schools, when first introducing science, did so in a similar manner. For example, Dr. Arnold, of Rugby, persuaded the boys to collect specimens of rock, etc., from their neighbourhood to form a science museum, and his successor, Dr. Tait, invited a local physician to give lessons similar to these suggested by Pestalozzi.

The latter had no misgivings on how science should be taught, as the following extract from "How Gertrude Teaches Her Children" shows:

"All science teaching that is dictated, explained, analysed by men who have not learnt to think and speak in accordance with the laws of Nature, all science teaching of which the definitions are forced, as if by magic, into the minds of children, like a *Deus ex machina*, or rather are blown into their ears by a stage prompter, so far as it does, this must necessarily sink into a miserable burlesque of education."

Pestalozzi's influence on science teaching rests, however, on his object lessons, for they were widely imitated in England, largely owing to Dr. Mayo and his sister. After Dr. Mayo's return from visiting Pestalozzi he opened a school at Epsom and later at Cheam, and in time the Home and Colonial Infant School Society's training college resulted. Here intending teachers were trained to give these object lessons. Further, the two Mayos published books on methods of teaching, the most important for our present purpose being Miss Mayo's "Lessons on Objects." In it were given typical object lessons on numerous scientific subjects, and these served as models to numerous teachers. Lessons of this type became very common in England, especially in the elementary schools, and for many years, in fact until the introduction of Lowe's Revised Code in 1861, they were the only means by which children at such schools were brought into touch with science. But the lessons departed from the model of Pestalozzi, and readers of Dickens will recall the type of lesson Bitzer of "Hard Times" had to endure with his "Quadruped, graminivorous forty teeth, etc.," or the one Nicholas Nickleby caught Squeers giving.

Pestalozzi's influence was not confined to the elementary schools, however, and many secondary schools taught object lessons often with the idea of giving scientific information. Thus, from its foundation in 1832, University College School, London, made use of Miss Mayo's book on "Lessons on Objects," but not for long, since it was found, as Dickens saw later, that these lessons tended to degenerate into a mere explanation of hard words, and hence they were soon discontinued at this school.

Yet though Pestalozzi did little to establish modern school science—the science of his day was not sufficiently organised to serve as a school subject, whilst he himself was chiefly interested in young children—his name must be revered by science teachers because of his patient research into better methods of teaching.

The Industrial Revolution.

Health, Wealth and Population in the Early Days of the Industrial Revolution. By M. C. Buer. Pp. xl+290. (London: G. Routledge and Sons, Ltd., 1926.) 10*s*. 6*d*. net.

THE author of this book is lecturer on economics in the University of Reading. The work is one which, in our opinion, is of first-class importance, written in a most interesting style, and we heartily commend it to all our readers. It is difficult within the compass of a review to give an adequate idea of the value of its contents. It deals with a subject which has caused acute controversy, and still awakens intense emotion in the minds of many of our countrymen—namely, the so-called industrial revolution. Although the author approves of the use of this term, and indeed states that the industrial revolution was of such magnitude as to dwarf all political revolutions, yet we think that the word revolution is misapplied in this case. This word has always been held to denote a violent upheaval and overturning of the social order by insurgence from within; but the industrial revolution was merely an extremely rapid evolution due to purely natural causes, as the author convincingly shows; and it had declared itself, shown all its characteristic features, and accomplished much of its course before any political change took place at all.

The popular conception of this change, which still figures largely in Socialist literature (we remember hearing it expounded with great vehemence by the late Mr. Hyndman in 1890), was that it involved the seizing of the common land of the poorer people by the landlords, whilst the dispossessed were then transformed from freeholders into tenants-at-will or driven into the towns, where they were 'exploited' at starvation pay by greedy manufacturers. It was, so far as we can recollect, Dean Inge who first forced on public attention the fact that this change was accompanied by an enormous and rapid increase in our population. The Dean's estimate was that the population of England had increased by 30 per cent. between 1700 and 1800, and by 300 per cent. between 1800 and 1900; it is with the causes and time of beginning of this increase that our author first sets herself to deal.

The first census of England was made in 1801, but various sources of information exist from which fairly trustworthy estimates of the population at earlier dates can be made. The author weighs the evidence, and comes to the conclusion that at the beginning of the eighteenth century the population of England was $5\frac{1}{2}$ millions; that it decreased during the first decade and then began to rise, and that it showed a net increase of one million by 1750, but that between 1750 and 1820 the population doubled itself. The rapid increase therefore began long before the invention of the steam engine, and before the expansion of manufacturing industries. It must obviously have been due either to immigration, or to an increase in the fertility of marriage, or to a fall in the death-rate. The author proves that the last was the real cause, and that it was not an increase on the longevity of adults which took place, *but a fall in the infantile death-rate.* She goes on to show that amongst primitive peoples population is regulated by an appalling wastage of child life. Persia, for example, is a country without motors, railways, or manufactures; there is widespread peasant proprietorship and few large towns—yet in some districts 85 per cent. of the children die before attaining the age of ten years, and in other districts only one child in ten attains maturity. In this, man resembles the lower animals, for the greater part of 'natural selection' takes place at the expense of the young.

Now in the sixteenth, seventeenth, and eighteenth centuries, but especially during the first two,