SCIENCE TEACHING AT KING'S COLLEGE, TAUNTON

ON July 6, H.R.H. Princess Margaret opened a new science block, consisting of four laboratories, two preparation rooms and a science library, at King's College, Taunton. Incorporated in the front of the new building is a memorial gateway to those Old Boys of the College who gave their lives in the Second World War.

There is in the nature of the memorial a special significance for those connected with the College, for King's was probably the first school in Britain in which science was seriously taught. The person responsible for this early start was the Rev. William Tuckwell, headmaster of Taunton College School, as the school was then called, during 1864–77. When Tuckwell was first appointed head, the school was situated in the old buildings erected in 1522 by Bishop Fox. They are now Taunton's municipal buildings. Within a year of his acceptance of the post, Tuckwell had bought the land where the school now stands, south of Taunton. The site was acquired in 1865 and the new buildings opened in 1870. Tuckwell had introduced the teaching of physical science in 1865 and he built his laboratory in 1869.

An eminent botanist and a scholar of English literature, Tuckwell wrote books on both these subjects, and, during his term of office as headmaster, delivered a course of public lectures and read papers on the teaching of science before the British Association. His revolutionary ideas met with much reactionary opposition among the classically prejudiced. In his paper "Science-teaching in Schools", read before the British Association at Exeter in 1869 (which was published in the first issue of *Nature*, November 4, 1869) he stated, referring to his science pupils, ". . . they will pass out into the world immeasurably superior to their contemporaries who know not science, with doors of knowledge opened which can never again be closed ; with a fund of resource established which can never be exhausted ; with minds in which are cultivated, as nothing else can cultivate them, the priceless habits of observation, of reasoning on external phenomena, of classification, arrangement, method, judgment".

Tuckwell held that the syllabus should include two years of mechanics, two years of chemistry and one year of botany, and that any further time at school should be spent studying physiology. He recommended that three hours of science should be taught each day. For the teaching of mechanics, he maintained that the necessary apparatus should include ". . . a good air-pump, a set of pulleys, models of the force-pump and the common pump" ; using as a text-book Newth's "Natural Philosophy". He took his pupils on visits to various 'manufactories', because he believed that they ought to have practical knowledge of the application of this apparatus in everyday life.

For chemistry he considered a laboratory essential : ". . . No matter how rough or shabby a room, so that it will be well ventilated, have gas and water laid on, and will hold from sixteen to twenty boys . . .". His benches cost about £4 each. ". . . The general laboratory stock, including a still, a stove or furnace, gas jars, a pneumatic trough, a proper stock of retorts, crucibles, tubing, etc., and the necessary chemicals will cost under £12. Each pair of pupils must have also between them a set of test tubes, a washbottle, a spirit lamp . . . and twenty-four bottles of test solutions, while each boy has his own blowpipe, tripod and stand, pestle and mortar, and three beakers. These will cost each boy about eight shillings. . . . The text-book used should be Roscoe's, or Williamson's, and a large black board is quite indispensable . . .".

He suggested such books as Lindley's "Descriptive Botany" as a text-book for botany ; and for botanical experiments, he thought that ". . . every boy should be furnished with a small deal board, a lens, and a sharp knife . . . Flower trays . . . should be kept constantly in use . . . Their cost per tray, holding eighteen bottles, is under two shillings . . .". He also deemed it necessary to possess a skeleton, the cost of which he estimated at £5.

Tuckwell also thought that schools studying science should have a set of meteorological instruments, which he estimated would cost between £16 and £20. Also he suggested that a special room should be devoted to the collection of scientific specimens, such as minerals, fossils, zoological specimens and physiological preparations ; the driest corner of the room he assigned to the herbarium. He recommended a small library and a botanical garden.

He probably put some of these ideas into practice even when

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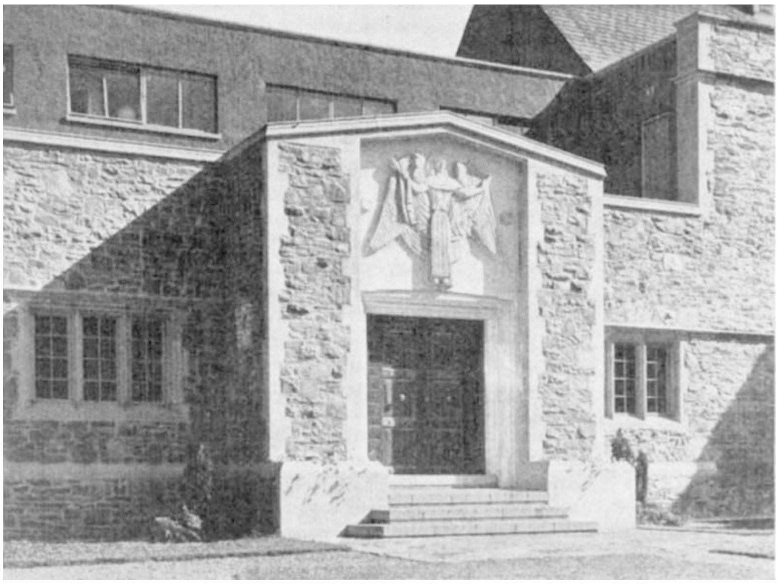

Fig. 1. Memorial Gateway and entrance to new science block at King's College, Taunton

Taunton College School was still called the Free Grammar School.

In 1864, Queen Victoria appointed Lord Taunton as chairman of a Public Schools Inquiry Commission. At this time Lord Taunton was also president of the Board of Governors of King's. He called Tuckwell to give evidence before the Commission concerning the teaching of physical science at his school. In giving evidence, Tuckwell satisfied the Commissioners that a scientific education gave his pupils inestimable advantages in later life.

Tuckwell met with much adverse comment, and although he may not have realized it, his chief obstacle to teaching science in his school was that, in order to move the school to its present premises, a joint-stock company with a governing body had been formed. No longer was Tuckwell free, as he had been under the former constitution of the governing body. Under the old system, the headmaster had received an endowment, which was not accompanied by any sort of restrictions or obligations as regards his teaching or conduct. The duties of the trustees had been to appoint a headmaster, not to maintain the school. His governors grew to dislike this arrangement, with the College School "with a classical side trying to lead in the new science teaching". They disliked as headmaster "a pioneer in the teaching of science and a brilliant exponent of it against the old specialisation in classics". In the face of this, Tuckwell resigned at the end of 1877.

In 1880 the school was acquired by the Woodard Corporation and from that date until recently no startling advance was made; science teaching was continued, but no new facilities were introduced to keep pace with the rapidly expanding school.

However, in the late 1930's it was decided to build a new science block; plans were drawn up; materials ordered and work was due to start in October 1939; but the project had to be temporarily postponed. It was, however, necessary to have additional laboratory space of some description, and so a temporary wooden laboratory was erected, Tuckwell's old laboratory then being given over to the teaching of biology. This new laboratory served its purpose admirably, and in 1943 another of these laboratories was acquired, this being used for the teaching of physics.

After the War, a memorial fund was opened, and in 1947 it was decided that the war memorial and science block should be incorporated in the one building. In 1955, Tuckwell's old laboratory was pulled down to make way for the erection of the new block. When the building was started, £8,000 had been given to the fund, and £20,000 had been lent, by relatives of the bereaved and by friends of the school.

When first designed, the block was intended to consist of two chemistry and two physics laboratories only. However, in 1956 the Industrial Fund for the Advancement of Scientific Education in Schools gave the school a grant of £10,000, and so made it possible to extend the block to include two preparation rooms and a science library, and to fit the laboratories with modern equipment and apparatus. It is interesting to notice the difference in the floor space of laboratories; the new block has a total floor space of 6,000 sq. ft. as compared with the 300 sq. ft. of Tuckwell's old laboratory. The only reminder of the great pioneer who did so much for King's is a plaque set in the wall of the new block, approximately over the site of Tuckwell's laboratory.

GENETICAL HAZARDS OF RADIATIONS*

A YEAR ago I reviewed in *Nature* a report on the biological dangers of nuclear and applied radiations which had been prepared by the Medical Research Council and published by the Government. I concluded with an urgent appeal for an easily readable digest of this important document. However, no such help has been given to the public, which is getting more and more anxious to understand the position. Instead of this, there has been a plethora of statements by scientists which, unfortunately, has probably contributed more to the confusion than to the enlightenment of the public. For the technically trained reader it is easy to see that all these statements agree on certain fundamental facts and conclusions, but the emphasis is placed in such different ways that the general reader may well feel it is more or less a matter of choice or philosophy whether ionizing radiations are considered dangerous or not. Much of this confusion could be dispelled if a recent popular lecture by Dr. Warren Weaver, of the Rockefeller Institute, could be made available to the broadest possible public at the lowest possible costs.

In ten lucidly written pages, Dr. Weaver makes the reader acquainted with the indispensable scientific background to the problem of radiation hazards. He limits himself almost entirely to genetical hazards; the dangers to the immediately exposed persons are scarcely considered. It is true that this leaves out of consideration just those effects—like bone cancer caused by strontium-90 or leukæmia caused by diagnostic X-rays—which at the moment cause most concern. But these are also the dangers which can be most easily understood by the lay person, whereas the much more subtle and yet in no way less real genetical dangers are not easily appreciated. It is the great virtue of Dr. Weaver's lecture that it states quite clearly and unequivocally those basic facts of radiation-induced mutation about which there is general agreement. He summarizes them in a paragraph which seems so important to me that I should like to quote it in full: "First of all, the change produced by mutation is practically always a change for the worse. Second, the amount of mutation varies directly with the amount of radiation. Third, there is no minimum amount of radiation which is genetically safe—all radiation is genetically bad. A little radiation is a little bad, and a lot is a lot bad. Fourth, once exposed to some radiation, this never 'wears off'; this is to say, the genetically important number of mutations depends on the total dose that one accumulates from his own conception up to the time of conception of his last child. Fifth, the radiation that is important genetically is only that which reaches the gonads—that is to say, the male testicles and the female ovaries. Sixth, what counts from the point of view of society as a whole is the total number of mutated genes. Thus a small radiation dose to a large number of persons is, socio-genetically speaking, equivalent to a large dose to a few".

Finally, there is an excellent brief discussion of the reason why, in the face of this generally accepted situation, scientists yet differ among themselves in

* "Radiations and the Genetic Threat." By Warren Weaver. *Franklin Inst.*, 263, No. 4 (April 1957).