Iowa Science Teachers Journal

Volume 7 | Number 1 Article 12

1969

A Change and a Parting: Nuffield Biology in England

Carmon Slater
South East Junior High

A Change and a Parting: Nuffield Biology in England

CARMON SLATER
Science Teacher
South East Junior High
Iowa City, Iowa

An appreciation of the problems encountered by curriculum innovations in England cannot truly be gained without first catching a glimpse of the educational system in this country, particularly the secondary school system. The British secondary student will usually be found in one of three basic secondary schools, i.e., the traditional grammar school, the secondary modern school, or a comprehensive secondary school.

Known as "public" schools, the prestigious grammar schools are usually found to be private boarding schools and have traditionally been the institutions preparing students for university, especially Oxbridge. They have long been class and status oriented and still prepare most of the society leaders in England. Whether the boarding grammar school, the day grammar school, or the county grammar school, the intellectual standards have always been high and the English have always taken pride in them, particularly when their youngster was or had been one of the 20 per cent, "cream-of-the-crop" students to have been fortunate enough to have been selected to enter the grammar school.

The secondary modern school was established to handle the students who did not gain admittance to the grammar schools after the Education Act of 1944. Their programs vary, some of them even offering grammar school courses (usually in a separate building). Their students, unless grammar school students, are not pressured by external examinations. Some are even associated with technical schools while other secondary modern schools have all three streams —general modern, grammar, and technical.

The biggest impetus in secondary education has been the comprehensive school, an effort by the British to develop understanding among students of various streams. These schools are staffed and equipped to handle students of all ranges of ability. Many times the ablest students still choose the grammar school serving the same area.

Students usually begin their education at age 5 and oftentimes many have attended nursery schools or other similar classes before this. Primary schooling continues to age 11, at which time it has been a tradition to determine the student's future on the basis of an 11-plus examination taken at the end of his primary education. The idea of determining a child's educational stream and consequent future from this early exam has long been a question of debate and the 11-

plus exams are finally losing some of their former tenure. Beyond the 11-plus, every boy and girl in England must stay in school to at least age 15.

The students attending the grammar schools (those most affected by the most recent changes in science teaching) continue for at least five more years beyond the 11-plus. These students are then eligible to take the General Certificate of Education (GCE) "O" or ordinary-level examinations, which mark the end of fifth form. These tests are subject-matter achievement tests in all academic areas. It is necessary to pass them if the student is to qualify for postgraduate grammar schooling, the door to getting into such universities as Oxford and Cambridge. This postgrammar schooling is known as the sixth form and may be one, two, or even three years in length beyond the fifth form. These years consist of directed studies in two or three strong subjects and extensive tutoring. This provides the first break from the rote memory and repressed individual thought of former schooling days. The sixth-form student begins to specialize in these final sixth-form years and is ready to enter the university at the age of 18 or 19. That is, he is ready if he can pass his GCE "A" or advanced-level examinations.

Unlike American courses of a single year, grammar schools teach each science over a period of five years and this specialization in the traditional science of biology, chemistry, and physics often prepares their students in some cases beyond our sophomore college level. General science does not exist at the secondary level in England.

British secondary students of age 11-16 also tend to take a wider range of subjects each week than do their American counterparts, but less time is spent on each. After 16, this situation is reversed and the British students take less subjects but for more hours per week. The bright students are also segregated from the lesser students who will only qualify for a Certificate of Secondary Education (CSE) in England. This certificate was estabilshed to pacify the other students who were compelled by law to remain in school to age 15, but had no reward at the end such as the GCE.

Nuffield Steps In

"National anxieties about the quality and relevance of science teaching and recruitment to the scientific professions were heightened by social and economic needs" in Great Britain.[1] England, like the United States in the fifties, began to realize that both the science curriculum and methods were behind the times of the modern world. Not only were more scientists, both pure and applied, needed but technicians at many levels had to be produced to keep up with industrial competition.

By 1961, the Science Masters' Association had merged with the Association of Women Teachers of Science as the Association for Science Education and together they did some

[1] Peter Kelly, "The Nuffield Science Teaching Project," *The Science Teacher*, January 1967, p. 26.

rather radical rethinking about science teaching in that country and the role they were going to have to take. It was at this time that the Nuffield Foundation began to provide large sums of money to spend on the preparation of new curricula in the British schools and to actually conduct experimental validation of the new teaching methods in the schools. The Nuffield Foundation is somewhat analogous to the Ford Foundation in this country.

It was in 1962 that the Nuffield Foundation began its program to revamp the teaching of physics, chemistry, and biology in British grammar schools. Their offer to finance the revamping of sciences was not sudden and unwelcome, and helped launch the science teachers' professional association in establishing their new policy statement urging that science be taught for understanding. The undertaking was a private benefaction of extreme importance at this time in national investment—a whole new scientific renaissance for England. Nothing of this magnitude and political significance had ever been attempted in England before.

Built-In Problems

It must be remembered that any new curricular developments in England are handicapped by one very important built-in problem, the examination system and the importance placed on the exams. The "O" level examinations are similar to American College Boards in importance. The Schools Council, with special responsibility for these examinations, has been fully aware of project frustrations in this capacity and has tried to cooperate with curriculum developers in this respect. The first "O" level examinations based on the Nuffield Science Teaching Projects were held in 1965 after 170 schools had systematically tried the materials in 1964-65.

The importance of these arrangements cannot be overemphasized. Without them it would have been impossible to have convinced trial schools to participate in the developments which had taken place. Now that the courses are published for all to use, the availability of the special examinations will enable schools to embark on Nuffield courses without hazarding the academic success of their pupils.

The design of appropriate forms of examinations has been a continuing concern of the biology team since the beginning of the development. Between September, 1963, and July, 1965, a number of experimental examinations were held in the trial schools with the object of testing the effectiveness of many new kinds of questions. In all, more than 800 examination questions were tested in this way and the results were analyzed both statistically and in the light of teacher comments. There are 10,000 students now being taught Nuffield in Great Britain.

Nuffield "O" Level Biology Gets Under Way

There were 250,000 pounds initially set aside for the Biology "O" Level Project in December, 1961. The aims were announced in April and the teams were established for various

sections of the program in 1962. The first three sections had the task of providing a range of tested teaching resources in physics, chemistry, and biology, which would be suitable for 11- to 16-year-old students in grammar schools and the upper streams of secondary modern schools. The biology section commenced work in January, 1963, under the guidance of the section organizer and a consultative committee whose members provided expert biological knowledge. Their goal?—to produce a biology course suited to all students to prepare them as future citizens rather than future specialists, while still providing a sound foundation for future scientists and technologists for the country.

With the help of previous British investigations in how to improve their science education and such work as was done by the Biological Sciences Curriculum Studies (BSCS) in the United States in 1958, the Nuffield science team had a good background of ideas with which to start. The sections ideas were subjected to testing in trial schools. It was the preliminary reports of these trials, science teaching newsletters, and the synopsis of the students' biology texts, the apparatus list, and student reactions which began to really arouse the interest of others in the work being done by the Nuffield Foundation. In 1966, the first material was published —a very thorough reappraisal of school biology up to "O" level in England.

The Nuffield Biology Project set out to develop and encourage an attitude of curiosity and inquiry. They wanted to develop an understanding of man as a living organism and his place in nature, how to plan a scientific investigation, and most importantly, to develop a whole series of ideas about the science of biology as it applies to and depends on advances in physics, chemistry, and mathematics.

The Nuffield team wanted to develop understanding in their students, not the blind memorization of information of the past. They wanted to develop understanding by means of inquiry so that their students not only acquired a knowledge of the tools of scientific inquiry but also would be able to appreciate something of its spirit, including the endlessness of scientific inquiry, the balance between certainty and uncertainty in its conclusions, and its proper role in influencing people's opinions.

The Nuffield approach then has been to balance the acquisition of a relevant body of knowledge with an understanding of the principles and evidence that underlie it and the way it is acquired. The emphasis is on the observation of relationships between the organism and its environment rather than merely collecting representative creatures of a particular habitat. Field work is an integral part of the Nuffield Project, not just a special event. Students are sometimes taken away so that they might enjoy working without the interruption of school bells and changing lessons, thus learning also about social values.

There has been a genuine attempt to program the series of courses with age level in mind. Certain basic themes occur every year in the

courses. These are themes which represent major generalizations of biology. It was the aim of the Nuffield team to infuse the student with them so that they would become an automatic frame of reference to his biology thinking.

The Nuffield five-year biology course falls into two parts: a two-year introductory course in which these general biological principles are first studied, followed by three years of study in which more emphasis is placed on detail and quantitative biology.

Each of the "O" Level courses has been devised for the following time allocation, which assumes that students work effectively for thirty weeks each year:

Years 1 (11 to 12 years) and 2 (12 to 13 years), 80 minutes per week

Years 3 (13 to 14 years), 4 (14 to 15 years), and 5 (15 to 16 years), 120 minutes per week

In addition, students would be expected to do about thirty minutes of homework each week. The courses develop continuously over five years, but the first two and the last three can be treated as separate units. However, it is considered inadvisable to start the courses except with years one or three.[2]

For the last two years of the "O" Level course, three periods a week are demanded for each of the three sciences and this together with "maths" may amount to fourteen periods or more for weaker students. Schools attempting Latin and a foreign language would find this somewhat of a squeeze and would obviously have to cut something. This is one of the complaints of the Nuffield Project.

Many in the scientific and technological professions are extremely happy with the Nuffield developments, and the "conservatives" are being squelched by their colleagues into accepting the innovation. There is a grave national shortage of university science applicants in England as well; therefore the universities cannot be unduly discriminating either.

Nuffield "A" Level Projects

The Nuffield Foundation is also continuing its work with a combined physics and chemistry science course for 11-13 year olds, a junior science project, and "A" level courses in the combined physical science as well as biology. They are hoping these courses will help to halt the drift from science and technology.

In setting up the "A" level projects, the Nuffield team clearly had in mind the need to provide the opportunity for transfer either to or within the sciences as late as possible in the student's schooling. There is no certainty that students starting Nuffield "A" level will have followed the whole course in all three subjects up to fifth form. Unlike the "O" level course, "A" level is planned primarily for students who have chosen science and who intend to use it in some way, probably in further education. It was hoped that many students would not be forced into premature choices between biology and physical science or between "arts" and "sci-

[2] *Ibid.*, p. 29.

ence" before the sixth form. It probably will not turn out this way.

If maths, physical science, and biology become the common option, students will no doubt go to the universities knowing few facts about physics, chemistry, and biology. They will, however, probably know more about the modern aspects of science, which was certainly not the case in the former traditional courses taught in England.

Nuffield "A" level courses can be started by schools that have not been involved with parallel work at "O" level. The question remains as to how many "A" levels each student can manage. Since all of them involve periods of open-ended project work, it is very possible to overload the student.

To provide an overall profile of the student, more time will be devoted to the setting rather than the arduous marking of "A" level exams. For instance, a candidate who might be asked to match brief descriptive passages could have those sections marked by a secretary rather than the professional examiner. The teacher would examine the practical work from his continuous assessment of the student. Although this form of exam might very well pose difficulties in demonstrating impartiality on the part of the teacher, a more comprehensive picture of the student would certainly result.

There are an increasing number of university admissions tutors who are accepting and welcoming the structure of the Nuffield "A" level approach, particularly the physical sciences exam and syllabus. Combining physics and chemistry has raised considerable difficulties, but the evidence from the trials thus far has shown that the university tutors believe the balance between the subjects to be an acceptable one. Some universities are still unwilling to accept the new Nuffield physical science "A" level amalgam of physics and chemistry as a suitable qualification for entry into their chemistry or physics degree courses. Exeter adds a fourth year for entrants with physical science only.

Effect of Nuffield Science on British Universities

The total impact that Nuffield science is going to have on the universities in England is going to depend on (1) how widely the Nuffield projects are adopted, (2) the degree to which secondary education in England moves toward the comprehensive schools and away from the grammar schools, and (3) the Schools Council action toward a less specialized sixth form of education.

As more and more students are taking Nuffield science courses in the schools, the universities will probably have to adapt their first-year courses to take account of this change. If they do not, their students with experience in the more imaginative teaching methods of Nuffield could easily lose interest. At least it should help to accelerate long-overdue changes at the university level. It may mean the end of laboratory work for students in their first year at university.

Special entrance examinations are being set for candidates desiring

science places at Oxford University who have been taking the Nuffield Project physical sciences "A" levels. Cambridge, at present, is postponing the choice of specialty within the sciences until after a year at the university; however, the student must make a choice between pure science and engineering when beginning university work. Perhaps this will be the future trend in other universities as well.

If Nuffield science is successful in its attempt to show scientific interrelationships and the demand for a broad first year becomes great enough, the pressure for a four-year honors course may become very strong. At any rate there may be a demand for a postgraduate year for all who intend to become professional scientists or engineers.

For university biologists, Nuffield science should be pure gain, especially if the opportunity to combine biology with the physical sciences and mathematics becomes possible. Some physicists in England feel the students will have to unlearn and relearn physics at the university level because of Nuffield. Other university tutors are afraid the students of Nuffield science will feel they know it all. However, the demand for more bright science students remains rather high. If Nuffield science can provide these bright candidates, perhaps some of these skeptics will be convinced.

Industry also will have to make changes in its training, as only a few students become professional scientists. No doubt, industry will inherit a large proportion of the remaining majority of those students currently in Nuffield science. With a few exceptions, most English industries have shown little concern for the new methods of teaching science in the English schools thus far—a true concern for the Nuffield Foundation supporters.

The Future of Nuffield

The Nuffield courses cover five years. It appears that for three of them—six, six, nine, nine, and nine periods are suggested in successive years. However, the weekly total for most British secondary schools, including physical education, is usually never more than thirty-five periods per week. Many schools feel they cannot justify such a time allotment before "O" level. To get in any alternative subjects one might have to reduce the amount of science to six periods or even four, along with maths and English correspondingly. The alternative in practice is likely to be the disastrous one of omitting biology or maths.

The Nuffield team has redesigned "O" level science, but "O" level itself as it now exists is likely to disappear. Many Britishers feel that Nuffield should have done all of its rethinking into a single "O" level subject, perhaps even a double subject. It has already been proposed that a double subject—a physical science course and a biological science course—designed on Nuffield lines be produced for the GCE, as well as the GSE.

If Nuffield is to become a success, the teachers will have to become familiar with this new and demanding method of teaching. The initial teach-

ers on the project were inspired from participation and with close association with the development of the projects, but what about those who are left to continue the program and maintain the necessary enthusiasm to retain the hard work.

The Nuffield Foundation has already led the way by establishing area committees consisting of many of those who were closely associated with the initial development of the projects. Hopefully these individuals will form the nuclei of regional centers which will continue the work of the Nuffield team in the future. It is also hoped by many Britishers that these discussion and development groups will become a permanent feature of the British educational system. The Schools Council is also now deeply involved, as it will have to continue the experimentation and find the money to support further developments along Nuffield lines when the Nuffield Foundation pulls out in 1971. Hopefully, the spirit of Nuffield and its approaches will have captured the system by then.

For the present it is probably time to let teachers see what they think, a period of temporary stability so as not to frustrate further change. Only then will the Britishers be able to really evaluate what has been achieved. There has been a move to provide inservice training for teachers in England. Their ideal goal is to establish centers within every twenty-mile radius, a center where teachers could learn about Nuffield teaching methods. It is also essential to have laboratory and technical assistants attracted into the schools. Authorities hopefully will arrange training courses for these individuals to provide this initial attraction.

Obviously, there has been an increased interest in England in science education research. They have already created a center at Chelsea which will work entirely in the field of science education. In East Anglia the first chair in chemical education has been established and others have similar plans. Perhaps they will look more to the colleges of education for an economic use of existing resources rather than creating special additional local centers which might be remote and detached from initial training and development work. At least a commitment has been made to further curriculum research if science is to continue to be taught in England as inquiry.

BIBLIOGRAPHY

Periodicals

American Association for the Advancement of Science. "The Nuffield Foundation Science Teaching Project," *Science Education News,* September, 1966, p. 7.

Anderson, N. A. "Nuffield Found Biology: A Review," *American Biology Teacher,* January, 1968, pp. 23-25.

Kelly, Peter. "The Nuffield Science Teaching Project," *The Science Teacher,* January, 1967, pp. 26-29.

Luckin, William. "Science Masters: New Exam for Scientists," *The Times Educational Supplement,* January 12, 1968, 2747:85.

Mylechreest, Murray. "A New Life for Biology," *The Times Educational Supplement,* July 1, 1966, 2711:1520.

Praagh, Dr. G. Van. "What It Costs to go Nuffield," *The Times Educational Supplement,* July 1, 1966, 2711:1523.

Scott, Peter. "Nuffield Science Future," *The Times Educational Supplement,* May 10, 1968, 2764:1568.

_____. "Socially Aware Scientists," *The Times Educational Supplement,* January 12, 1968, 2747:88.

The Times Educational Supplement. "Effect on Universities," May 5, 1967, 2711:1519.

_____. "Future of the £1,333,000 Revolution," May 5, 1967, 2711:15517-18.

_____. "Mass-Produced Science: Nuffield Foundation," April 14, 1967, 2708:1224.

_____. "On From School: Going Nuffield," July 1, 1966, 2667:26.

Wastnedge, E. R. "Into Tomorrow: Nuffield Science Teaching Project," *American Biology Teacher,* January, 1968, pp. 17-22.

Wenham, E. J. Build Yourself Up for Nuffield Science, *The Times Educational Supplement,* May 3, 1968, 2763:1481.

Wyatt, H. V. Science Teaching After Nuffield, *University Quarterly,* January, 1966, pp. 289-295.

Books

Belding, Robert E. *European Classrooms, Schools of Four Nations* (Iowa City: Sernoll, Inc., 1966), pp. 8-33.

Reller, Theodore L. and Edgar L. Morphet. *Comparative Educational Administration* (New Jersey: Prentice-Hall, Inc., 1964), pp. 54-73.

Nuffield Science Teaching Project. *Biology* series (Baltimore: Penguin Books, Inc., 1967).

NSTA Science Source Book for Junior High Available

"A Universe to Explore," a source book resulting from a joint project of the National Aeronautics and Space Administration and the National Science Teachers Association, features illustrated lessons in space science that have been successfully performed by junior high school students.

Twenty junior high school teachers coordinated their planning with officials at NASA's Goddard Space Flight Center, Greenbelt, Maryland. The teachers worked out the activities described in the book with their students who contributed significantly to the material.

Content ranges from the earth and the celestial sphere to solar cells and power sources for spacecraft. One section details how to simulate the space environment in the laboratory.

"A Universe to Explore" is available for $4 from the National Science Teachers Association. A discount of 10 per cent is applicable on requests for more than one copy to ten. With an order of ten or more copies, a 20 per cent discount applies. Payment should accompany orders for $2 or less.