

is explained in terms of partial reversion to a highly ordered state probably resembling that of the original collagen. This concept is supported by other properties of the matured solutions, for example, their ability to give fibres with precipitants and their resistance to complete digestion by trypsin. Dr. K. Little (Nuffield Orthopaedic Centre, Oxford) showed some electron micrographs which she had obtained on the precipitated materials and which exhibited undoubted fibrous forms.

The afternoon paper, "Glueing in the Furniture Industry", was contributed by Mr. M. J. Merrick (Furniture Research Association). Attention was directed to the increasing mechanization of the modern furniture industry with the concomitant

features of high production-rates and low labour content. Three main adhesives are in use, namely, animal glue, urea-formaldehyde and polyvinyl acetate. The more obvious differences between the properties of these, such as strength or resistance to water, have but a minor influence on the manufacturer's choice which is, instead, governed by the necessity for speed and reproducibility in the glueing of wood joints and veneers. Mr. Merrick then described the detailed operations involved in glueing in the furniture industry. A further point which emerged in the discussion was that synthetic glue manufacturers have built up an enviable technical service to ensure that the best use is made of the properties and behaviour of their products.

D. A. SUTTON

RESEARCH BY SIXTH-FORM SCHOOLBOYS

By J. HEYWOOD

Department of Telecommunications and Electronics, Norwood Technical College, London, S.E.27

THE editorial in *Nature* (187, 883; 1960) directed attention to the need for educational research and mentioned some specific topics. My work was cited as one of the examples in that editorial¹, and I have been concerned with several projects of this nature. The first has been concerned with project work for sixth formers, a second continuing the study previously mentioned¹ and a third into the opinions of technical college students on liberal studies. In this article the investigations made on project work will be discussed and some results presented.

This work has already been mentioned in *Nature*² since it has been carried out through the auspices of the Radio-Electronics Section of the British Astronomical Association. Four sixth formers have undertaken the same form of project and two of them have worked as a pair. The object was to provide a system of work which would have a liberalizing influence on the students' scientific studies and at the same time provide insight into the basic techniques of research inquiry. As an enticement the scheme aimed at providing some useful data for the Radio-Electronics Section.

Two of the students already possessed an interest in astronomy before the project was envisaged and were members of the Section. The other two were in attendance at the Salesian College, Battersea, and had no previous interest in astronomy or radio. Part of their project which is of considerable interest is at the moment in the press³, and that of the third student will appear in the same publication⁴.

Each project is in three parts, the first two parallel and the third being the item of use to the Section. The students were informed that their results should be written up in a form suitable for presentation as a 'letter' to *Nature*—there was of course no guarantee of publication anywhere but the concept of a letter in *Nature* gives the student an idea of how much has to be done to produce a small item.

An important feature of this work is the system of 'least instruction'. The students are encouraged to get on with the jobs themselves: at the same time they are equally encouraged to seek advice from their tutors but it is left to them to make the appointments. O'Neil and Borlengi³ visited me at my home on four occasions during a three-month period and then

submitted the article noted. This article was seen once previously and modified. In the case of Murdin⁴, who already had an interest in radio astronomy and had worked with me previously, only two discussions were necessary. Murdin did, however, withdraw his article and make some additions before it was finally sent to press. These two articles summarize the scope and intentions of the first part of the project, while Sabbagh is concerned with the third part.

The fundamental units of radio astronomy provide an interesting introduction to the m.k.s. system and the relation between physical and radio units of brightness, brightness distribution and magnitude. A further comparison can be made with the unit of field strength as used in radio communications. In the first part of the project the student is given a number of references⁵ which vary in level and told to investigate the problems of radio astronomy with particular reference to its units; he is asked to note how they differ from similar units used in optics and radio communications. His reactions to the various fields of observational radio astronomy are noted, and it is expected that a written account of this work in the form of the summary will be presented when complete. It is interesting to note that all the approaches to this same task have differed widely.

Normally the second part of the test is the construction of a simple piece of radio equipment with the view of its being used for observations. A typical project might be the construction of a sudden enhancement of atmospherics (associated with solar flares) recorder similar to that described by Ellison⁶, or the construction of a simple radiometer⁷ after Sander⁸ or Osborne⁹. The third part would then consist of observing solar radiations or sudden enhancement of atmospherics (associated with solar flares) over a period of about two months. There is a number of possibilities open to simple investigation involving the analysis of such records.

At the time of writing all the students had completed the first part of the project. Sabbagh¹⁰ had, however, undertaken a statistical analysis of some records made by Hyde and Castelveccchi² as a combined part two and three.

Two items arise from this research. First, it has been said that there is a large number of sixth formers with middle of the road Advanced level passes who would make good university students but who are nevertheless not able to obtain places. Secondly, it has also been said that there is far too much specialization in the sixth form arising from the need to cram. The shortage of university places accounts for the first and the shortage of time available to investigate candidates thoroughly undoubtedly assists this shortage. It would seem that projects such as those described would not only offset specialization, but also, if run on the lines of a second degree whereby an external oral examination was given on the candidates dissertation, provide the universities with a powerful means of selection. An alternative would be to offer a general paper on science subjects in which a candidate is required to write two fairly

lengthy dissertations on any two of a variety of subjects announced during the two years preceding the examination. The former method seems to be the better since it offers the student an introduction not only to the wide aspects of scientific inquiry but to a knowledge of its tools.

¹ Heywood, J., *Nature*, **186**, 189 (1960).

² Heywood, J., *Nature*, **188**, 900 (1960).

³ O'Neil, C., and Borlengi, M., *Mem. Brit. Astro. Assoc.* on "The Design of Radio Telescopes" (in the press).

⁴ Murdin, P. G., *Mem. Brit. Astro. Assoc.* (in the press).

⁵ Pawsey, J., and Bracewell, R. N., *Radio Astronomy* (Oxford, 1960). Lovell, A. C. B., and Hanbury Brown, R., *The Exploration of Space by Radio* (Chapman and Hall, 1957). Smith, F. G., *Radio Astronomy* (Pelican, 1961). *The Services Handbook of Electronics*, vol. on "Transmission and Propagation" (H.M.S.O.).

⁶ Ellison, M. A., *J. Brit. Astro. Assoc.*, **69**, 127 (1959).

⁷ Pettifer, J., *Mem. Brit. Astro. Assoc.* (in the press).

⁸ Sander, K. F., *Proc. Inst. Elect. Eng.*, Part 3A, **93**, 1487 (1946).

⁹ Osborne, J. M., *School Sci. Rev.*, No. 142, 478 (1959).

¹⁰ Sabbagh, J., communicated to *J. Brit. Astro. Assoc.* (1961).

UNIVERSITIES COUNCIL FOR ADULT EDUCATION

DURING 1959-60, as in 1958-59, there was a small increase in the total number of adult education courses over the figure for the previous year, from 4,741 to 5,051, and *prima facie* a striking increase in residential courses, from 351 to 575*. Apart from residential courses, the most notable increase was in the number of sessional courses. At 1,647 they reached a record maximum. This upward trend has been steady over the past few years, the average rate of increase since 1955-56 being about 5 per cent per annum. Alongside this increase the downward trend of tutorial classes has continued although the fall has been at a reduced rate, from 851 to 839, a reduction of only 12 compared with 46 and 53 in the two previous years. At Manchester, where the decline in the number of tutorial classes caused concern to the Joint Committee, a leaflet outlining the advantages of tutorial class study was printed and given to every Workers' Educational Association student who was not a member of a tutorial class. From Hull comes a reminder that "in general, tutorial courses offer more obviously and more fully, opportunities for the development of classes into strenuous seminar groups". Southampton, though regretting the reduction of this type of work, wonders whether the development of tutorial work has been pushed, in recent years, beyond reasonable limits. The report of King's College, University of Durham, contains this thought-provoking paragraph:

"Part of the answer to the decline in tutorial classes is that adult education is ceasing to be the 'late night' substitute it once was. There are fewer gaps in the educational system through which the potentially highly educable boy and girl can slip out of the main stream. While it is by no means infallible, and cannot be so long as the sill of the catchment area remains at the 'eleven plus', comparatively few pupils of good standard fail to make the grade if they try hard enough. The most grievous failure of the present system is that it so easily misses those who, at the vital age, are unaware of the need to make the effort and who lack parental pressure to encourage them to do so. Alongside the elimination of much of the earlier material from which adult students

were made has gone some of the incentive to seek a higher education. The social scene of the early decades of the twentieth century has changed. The Welfare State needs a smaller quota of pioneers, dedicated to the attainment of social justice, and a much larger one of trained social workers, with qualifications, for the administration of its machinery. Moreover, progress in any occupation is now achieved through certificate, diploma or degree to a much greater extent than ever before, and the provision for those ends becomes steadily more extensive. So, the tutorial class, which in theory offered an opportunity for study for its own sake, but which in fact offered all kinds of other inducements, is less an attraction because it is less needed.

"The character of adult education is undergoing change no less than other factors of twentieth-century life and, although the tutorial class should continue to attract those who recognize its essential quality, universities may soon need to consider the introduction of incentives to it other than study 'for its own sake'."

One respect in which the character of adult education is undergoing change is the continued development of residential courses. Several departments comment on this as forming perhaps the most satisfactory side of their work. The residential course is a reflexion of changed social and economic conditions. "People are, on the whole, rather better off and at the same time they have many competing claims on their time. They prefer, wherever possible, to take their adult education in small and intensive doses, a limited commitment in a limited time, instead of spreading it over a long period of time, as in the past." Manchester is to be congratulated on the success which has deservedly crowned its persistent effort to demonstrate the importance of an extra-mural residential college.

Because of changes of classification, a strict comparison of the 1959-60 figures of subjects of study with those for previous years is not possible, but there seems not to have been any significant shift of interest. Indeed, the consistency of students' interests year after year, as revealed by the table of subjects studied, suggests either that there exists a peculiarly proper balance of subjects in extra-mural work and that it has been attained, or that students

* Universities Council for Adult Education. Report on the year 1959-1960. Pp. 28. (Bristol: W. E. Salt, Honorary Secretary and Treasurer, The University, 1961.)