

abuse of the word 'science'. This word is too loosely used in the social sciences, where many of those concerned have not been trained in scientific method but on philosophical lines, so that they too easily accept decimal points as objective data.

Mr. Harrison urged that we need less partisanship in social science, which is still embryonic. Every method, every study at this stage should be encouraged. But the primary and vital acts of empirical social study must always be qualitative. Mr. Harrison welcomes the increase in quantitative methods, but deplors the growth of the idea that *only* such methods are socially scientific, an idea which is reflected in the wording of Mr. Durant's submission on this occasion.

In the discussion that followed, a wide divergence of view was expressed.

Dr. Certrude Wagner spoke of the combined qualitative and quantitative method, and the need for social scientists to observe their own problems, to think them out qualitatively, then confirm their hypotheses by means of the quantitative method. She expressed the view that the only difference between Mr. Durant and Mr. Harrison was as to whether there should be two hundred or two thousand interviews. Mr. Harrison did not agree with Dr. Wagner on this, stating that there are sides of social science where no interviews are required, and current engrossment in the interview method was one of the things he was criticizing.

Dr. L. P. Richardson pointed out that the qualitative process is an essential initial step even in elaborate quantitative studies, as in the minutely accurate measurement work he had done in earlier days at the National Physical Laboratory. In comparing the weight of two bars of metal with the exactness required, it is still necessary to select the right bars for comparison by a qualitative act.

Dr. P. Senft discussed, in some detail, the philosophical relationship between quantitative and qualitative methods. Novelists like Proust and Stendhal have generally shown a far greater insight into human nature than psychologists and others approaching the same phenomena by quantitative methods.

Dr. Millais Culpin outlined some of his experiences during the work of the Industrial Health Research Board; he found the debate very like those he had heard long ago in medicine. It all boiled down to the old argument between those who were content to ask: What? and those who were also concerned to know: Why? The quantitative method is likely, if handled thoughtlessly, to lead into an interminable pursuit of the What, though the social sciences must be concerned very much with the Why.

Prof. M. Ginsberg expressed himself in favour of Mr. Harrison's views. The idea that social research methods could be predominately quantitative, and that qualitative methods must merge into quantitative, is absurd. The suggestion that there is no real distinction between the two approaches is unsound. Quality does not pass imperceptibly into quantity. The two are distinct, and there are, in addition, many sorts of quality. The quantitative and qualitative approaches in themselves involve different concepts.

Dr. G. H. Miles's experiences in the field of market research have disillusioned him about crude quantitative methods in social study. He has seen elaborate statistical investigations which were built up on unsound methodological assumptions, such as a

survey in which people were interviewed on certain food habits. They claimed to eat more butter than they could conceivably have consumed. For people often do not know what they really do, and more often give answers which show them as respectable citizens; people always want 'to show up well' in the interview.

Mr. Harrison said that the discussion had cleared the air in a useful way. So long as social scientists were ready to interchange views and argue things out in a friendly atmosphere, so long would this be a vital and growing subject. There has been too much sociological over-sensitiveness to criticism in the past. Elasticity of outlook is necessary for the advance of any science; the development of science is largely the process of correcting somebody else's error.

Mr. Durant expressed the view that there had been a substantial body of agreement, and for his part he could not see any real difference of opinion, for he felt that in the end everything became quantitative.

PRODUCTION OF OPTICAL GLASS IN AUSTRALIA

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THE manufacture of optical instruments of many kinds for the Armed Forces has become an important section of the extensive programme of munitions production undertaken by Australia in the present emergency. Of necessity, a new and complex industry of this type had to cope with many initial problems, among which the supply of suitable optical glass soon began to cause anxiety. Some glass was obtained from Great Britain and the United States, but in the dark months following the capitulation of France optical glass of good quality and in sufficient quantity was not obtainable. In certain directions, the need became so great that spectacle lenses were used, and blocks of glass for the prisms of tank periscopes had to be made by welding together many sheets of plate glass.

The decision to undertake the production of optical glass in Australia was made in the latter half of 1940, and subsequent events have shown most thoroughly the wisdom of this policy. About fourteen months after the first experimental work was initiated, full-scale production of glass of admirable quality commenced and has continued uninterruptedly, so that Australia is now not only completely independent of external supplies but is even exporting optical glass to other countries. This achievement has been due to close co-operation between the Chemistry Department of the University of Melbourne and the technical staff and facilities of Messrs. Australian Consolidated Industries Ltd., to which organization the actual production of the glass was entrusted. It is also a pleasure to record the very willing assistance received from the staff of the National Bureau of Standards, Washington, who placed freely at our disposal their extensive knowledge of technical details, thereby saving us much valuable time.

The original programme called for the production of six standard types of optical glass; this number was afterwards reduced to four which are now in production, but all six were made successfully in the

laboratory. There were two main problems: (a) suitable raw materials for the glasses; and (b) suitable fire-clays for the pots. Fortunately, excellent sand was available in quantity, being in regular use for making flint glass for table ware. This sand contains less than 0.01 per cent iron oxides and the optical glasses made from it have proved to be almost ideal in regard to freedom from colour and turbidity. Other raw materials of high purity were soon located and removed further anxiety in this respect. The main experimental investigation was therefore directed to the selection of suitable pot-clays. About eighty specimens from various parts of Australia were examined as to refractoriness under load, shrinkage, chemical composition, especially iron and titanium content, texture and workability. From these about ten clays were selected for further trial; these were suitably blended and fashioned into small open pots holding about 2 lb. of glass each. These pots were fired in a small gas furnace and the glass batch introduced through a silica tube into the pot at 1,400° C. until the glass was in quiet fusion. After stirring with a silica rod, the pot was heated at a steady temperature (usually 1,450° C.) for 12 hours, cooled down, cracked open and the glass examined for pot contamination.

In such small pots, it was, of course, impossible to make optically homogeneous glass, but the resistance of the clays to glass attack and their general quality under the severe test conditions could be readily ascertained. It was felt that the results of these tests could be applied to the construction of suitable large pots with safety, owing to the better volume-surface ratio in the latter and the lower and more controllable temperature to which they would be exposed. These expectations were realized, and it was also found possible to slip-cast the large pots and dry them ready for the pot arch in about six weeks. As these pots can be raised to the temperature of the melting furnace in 4½ days, a great saving in time is thereby accomplished.

The pot-making and optical glass annexes have been very simply constructed to facilitate handling and reduce labour to a minimum. The capacity of the former is amply sufficient to maintain a supply of pots for a one-day melting schedule for the glass, which in turn reduces shift problems and operating costs, while the pot-handling and the stirring equipment is simple and efficient. After inspection of the chunks of glass from the pot, they are softened and moulded into the required blanks in special steel moulds which produce a very clean product, thus requiring only small tolerances. These blanks are then annealed in electric annealers before being finally inspected.

A most satisfactory feature of the production has been the high yield per pot (55–60 per cent) of usable glass, most of it of very high quality. For example, measurements by the National Standards Laboratory of Australia have shown quite remarkable constancy in optical properties of the glass from various parts of an individual pot, combined with very satisfactory freedom from striation or other blemish. Tests on eight consecutive melts of borosilicate crown yielded a mean refractive index (Na) of 1.5100 ± 0.00023 and barely detectable differences in dispersion. Indeed, the glasses now being produced fall in properties well within the tolerances set by the Australian Optical Munitions Panel, and ensure, therefore, an abundant supply of excellent material for munitions purposes.

OBITUARIES

The Very Rev. Sir George Adam Smith, F.B.A.

THE VERY REV. SIR GEORGE ADAM SMITH died on March 3 at his residence, Sweethillocks, Balerno, Midlothian, in his eighty-sixth year. A native of Calcutta, he was son of George Smith, who had a high reputation not only as a journalist but also as a biographer of missionaries. The young George was brought to Edinburgh, where he was educated at the Royal High School and the University. His university period does not seem to have been marked by any special distinction in examinations, though I fancy he must have taken a high place in the English class, if we are to judge by his writings. But he made valuable friendships there with such men as Henry Drummond, R. W. Barbour, Thomas Shaw (afterwards Lord Craigmyle) and R. B. Haldane, the great philosopher and war minister. His attachment to Edinburgh remained deep to the last. As a member of the Free Church of Scotland, he naturally proceeded to New College for his divinity course, when he had decided on the ministry as his life's work.

These were days of high tension in ecclesiastical circles. Smith must long have felt a strong attraction to the Old Testament, which contact with the celebrated teacher, 'Rabbi' A. B. Davidson, could only tend to accentuate. At that time the name of William Robertson Smith was on every lip in Scotland. He had imbibed in Germany what were then advanced views on the sources of the Pentateuch and on other Old Testament problems, and had set them forth in notable articles in the *Encyclopædia Britannica*. As a result he was tried for heresy by the General Assembly, and was ejected from his chair at the Aberdeen College.

George Smith, who had studied at two German universities after his Edinburgh courses were finished, and had afterwards travelled in Egypt and Syria, became an assistant minister at Brechin, but was soon appointed to carry on the work of Robertson Smith's chair, and thus had his introduction to Aberdeen, where he was destined to spend a large portion of his life. The extension of the city westwards had led to the erection of a very handsome church at the point known as Queen's Cross. The Aberdonians of those days were famous as church-goers and sermon tasters, and the members of this church were early convinced that Smith, who had been heard in various pulpits, must become their minister. He remained in this position for ten years, 1882–92, and built up a lasting reputation as a brilliant preacher and faithful minister.

Smith was able in the course of that period again to travel in Syria and east of Jordan, and subsequent visits served to confirm a knowledge of that region such as very few Hebraists in our time have attained. Not only was he the best interpreter of the Old Testament prophets to his generation, but also he had a very keen eye for the influence of geography on history. His "The Book of Isaiah" (1888–90), which grew in part out of his sermons at Aberdeen, made him known throughout English-speaking lands. The year 1896 was marked by the first of a number of visits to the United States, where as lecturer, preacher and public speaker he gained a high reputation. Perhaps the most notable of his works is his "Historical Geography of the Holy Land" which, originally published in 1894, reached a twenty-sixth edition in 1935. He set an example to other scholars by issuing