fluorine abundance at ~ 2 per cent of oxygen, that is that which would be expected from spallation in $3\text{--}4\text{ g/cm}^2$, so that the problem of explaining an anomalously low fluorine abundance seems to have reconciled itself.

The X-ray astronomy papers were mostly reports of new observations of the spectra of individual discrete sources. The new data reaffirm the belief that there are at least two classes of discrete X-ray emitting objects: the Crab Nebula appears to be a non-thermal (probably synchrotron) X-ray emitter, while Sco X-1 has the characteristics of a thermal source with a temperature which may vary between $\sim 50\text{--}80$ million degrees. Sco X-1 has, in addition, a non-thermal tail above $\sim 40\text{ keV}$ which fluctuates perhaps as much as an order of magnitude in a time scale less than hours, indicating some sort of impulsive behaviour superimposed on the hot continuum. New data presented on Cyg X-1 are consistent with this source being of the Crab type, although existing data indicate that this source has much larger magnitude variations than the Crab.

MATERIALS SCIENCE

Using Brittle Materials

from a Correspondent

A ONE-DAY discussion meeting on "Designing with Brittle Materials" was held in London on December 3. Sponsored by the Applied Mechanics Group of the Institution of Mechanical Engineers, the meeting was attended by 100 engineers, chemists and ceramists, who by their contributions to discussions ensured the success of the meeting.

The first session was devoted mainly to the theoretical aspects of design analysis for brittle materials when used as load carrying components. Both Mr K. W. Mitchell (Fulmer Research Institute) and Mr W. H. Dukes (Bell Aerosystems Co.) stressed the need for a new design philosophy based on the statistical analysis of load environment and material characteristics. Brittle materials exhibit no plastic deformation in their stress/strain relationship so that the stress distribution must be accurately determined by refined techniques of analysis with full allowance being made for stress concentration effects. It was said that the introduction of a failure probability concept is essential if materials are to be used at moderate stress levels. The usefulness of the Weibull series distribution function was questioned by several speakers who indicated their reluctance to use a technique which depended on a large number of test results for its accuracy. This accuracy could, however, be increased by providing good quality control and introducing proof loading, which leads to added confidence in materials which, even though they have low fracture toughness value, can exhibit high strength. Two other papers at this session dealt with design problems in ceramics and indicated the usefulness of photo-elastic techniques in the improvement of components by reducing stress concentration effects. The need to design against thermal shock by the matching of thermal expansion values in composite materials was illustrated by examples of specific components.

The practical approach to design was presented at the afternoon session in which successful components mainly developed on the "try it and see" principle were

discussed. Dr D. J. Godfrey and Mr P. G. Taylor (Admiralty Materials Laboratory) gave detailed examples of the use of silicon nitride for the manufacture of gas turbine blades, ceramic bearings, combustion chambers and rotary piston internal combustion engines. This material was of interest in that it has a negligible shrinkage on heat treatment, unlike most other ceramic materials. Complicated shapes could be obtained by flame-spray deposition with final machining to size being made in the green state. It was emphasized, however, that these materials should only be used when and where metallic materials are no longer practicable, that is, where high temperature strength and resistance to corrosive attack outweigh their disadvantage of low fracture toughness and brittleness. The requirements for successful operation of uncooled nozzles were discussed by Dr G. A. Heath (Rocket Propulsion Establishment, Westcott). In these nozzles tungsten is used either as a solid insert or as a thin shell on a graphite backing. Although tungsten at the operating temperature of the nozzle is not a brittle material, the composite structure leads to extreme thermal shock problems during the initial firing stage. Careful matching and dimensional tolerances are important to prevent buckling and separation of the tungsten shell and backing.

If a conclusion could be reached at a meeting which discusses new design concepts, it was that there exists a division of opinion as to the correct approach to the efficient utilization of ceramics. One school of thought was that design by practical testing offers the best solution, although this could lead to components of excessive weight and high safety factor. The opposing view considered the mathematical method of determining the correct fracture mechanism, designing to a finite life and use of refined test methods and stress techniques to be the best approach. Probably it will be by a combination of these two design philosophies that brittle materials in the next decade will take their place alongside ductile metallic materials, and ceramic components will be designed with added confidence.

WEEDS

Talking about Control

from a Correspondent

THE ninth British Weed Control Conference, the first to be held under the auspices of the newly formed British Crop Protection Council, took place at Brighton from November 18 to 21. In spite of its name this has become an international conference with more than 1,000 delegates, more than one-third of whom came from abroad.

The conference serves many functions, but principally it acts as a forum for the exchange of up to date technical information on all aspects of weeds and weed control. It includes sessions on the problems of weed control in every conceivable context—agricultural crops, vegetables, fruit, ornamentals, grassland, forestry, watercourses, and non-agricultural land—and on related topics from the biology of weeds to the improvement of application equipment. The conference achieves "instant" publication.

The problem of grass weeds still dominates the arable scene. The perennials, *Agropyron repens* and *Agrostis gigantea*, and the annuals *Avena* species and *Alopecurus*