received a good deal of support, both at the symposia and at the closing plenary session where Professor J. S. Kennedy (Imperial College) spoke on the emergence of the study of behaviour as an independent discipline with an important contribution to make to applied ecology and pest control generally.

MATHEMATICS

Trends in Education

from a Correspondent

THREE years ago, at the first International Congress on Mathematical Education in Lyons, France, there were 600 participants. This past week (August 29 to September 2) at the second congress at Exeter University, there were 1,700 from seventy countries, and many were turned away for lack of accommodation. This is a measure of the extent to which interest in the subject has grown.

The advance that is most apparent is in the emphasis placed on those aspects of mathematical education concerned with communicating a working knowledge of how mathematics interacts with other subjects and on the external world: that is, a knowledge of how mathematics is applied. The congress programme was designed to view mathematical education within the context of the total education of the individual. Thus the plenary sessions were concerned not with specialized matters, but to place the subject within wider contexts, including the historical, sociological, and psychological, and also that of its relationship to the development of mathematics itself. A typical paper was by the anthropologist Dr Edmund Leach (University of Cambridge).

In his opening address, the chairman, Professor Sir James Lighthill (University of Cambridge), stressed that a specific characteristic of the British approach to mathematical education has been a close association between pure and applied mathematics, and a general predilection for teaching mathematics in a way that emphasized some of its applications. Sir James is much concerned with the contribution of mathematics to help in solving the world's problems. In some ways his attitude contrasts strongly with those mathematical educators concerned with more abstraction than ever before. No one denies the attractiveness of an appreciation of the beauty of mathematical structures and deductions, but the prevailing attitude at Exeter was for a deeper integration of mathematics into the total education of the individual.

Sir James suggested that educators might have most benefited their pupils when they had succeeded in giving a feel for what was involved in the process of applying mathematics. This, he said, is the process of building a bridge between the abstract ideas and inferences of mathematics and the concrete problems arising in some field of application; and, he went on, it seems to be increasingly recognized that there may be more skill, more art, in that bridge building process than in the associated mathematical problem solving. This approach was taken up in two chief ways at the congress: in the thirty-eight working groups and in the national presentations by eighteen countries, at which there were classrooms of children being taught.

The working groups covered a vast range of topics, but, significantly, that most widely attended was concerned with the psychology of learning. Discussion here was much influenced by the work of the Swiss psychologist, Jean Piaget, whose former student, Joan Bliss, was group liasing secretary. For some who attended, the hope was that this might lead to the beginnings of a science of learning. The group on mathematics in developing countries considered such basic questions as the social relevance of the teaching of mathematics, and whether the traditional university institution was necessary in their countries.

During the past decade there has been a growth in the number of mathematical competitions, national and international. The best known is the annual International Mathematical Olympiad organized at inter-governmental level, and held each year in one of the socialist countries, with some limited Western participation. The working group concerned with this discussed the use of competitions in the classroom, whether they could be fair, and what contribution they made at an international level. It was agreed to set up a working party to report on how maths competitions might be fostered, nationally and internationally; and an offer was made by the Awards Committee of the British Mathematical Association to act as an information clearing house.

ELEMENTARY PARTICLES

Still no Quarks

THE first results of yet another experiment to look for quarks, at the Intersecting Storage Rings at CERN, reveal no particle showing the characteristic features of a large mass and a charge of $\frac{1}{3}$ or $\frac{2}{3}$ of the electronic charge. So far, 0.6×10^9 secondary particles produced in proton-proton collisions have been examined (Bott-Bodenhausen *et al.*, *Phys. Lett.*, **40B**, 693; 1972).

The CERN experiment shows that the cross-section for production of quarks with charge $\frac{2}{3}e$ and mass up to 13 GeV is less than 6×10^{-34} cm^2, and that the upper limit for $\frac{1}{3}e$ particles up to 22 GeV is 3×10^{-34} cm^2.

In vitro Initiation of HeLa DNA Synthesis

ELUCIDATING the biochemistry of DNA replication is not a task for the faint-hearted; after almost two decades of research, precious little can be said about the way DNA is replicated even in organisms as simple as bacteria, and next to nothing is known about the process in eukaryotes. There are at last, however, encouraging signs of progress. As Kumar and Friedman, for example, report in *Nature New Biology* next week (September 20), they may well have detected a factor(s) which specifically promotes the initiation of DNA synthesis in preparations of isolated HeLa cell nuclei.

Experiments involving the fusion of HeLa cells that are at different stages of the cell cycle have led to the conclusion that the cytoplasm of HeLa cells, which are in the S phase and replicating their DNA, contains a factor which causes nuclei in the G1 phase of a cell cycle to enter into S and begin DNA replication. Kumar and Friedman have apparently reconstructed this system *in vitro*; they isolated nuclei from early and late G1 phase HeLa cells and then incubated them with the appropriate precursors and labels, together with cytoplasm from one of several sources, namely early G1 cells, G2 cells, S phase cells or, as a control, buffered albumin. The only combination of nuclei and cytoplasm which led to a significant increase in the proportion of labelled nuclei making DNA was the late G1 phase nuclei-S phase cytoplasm combination. Cytoplasm from cells at other phases of the cycle did not promote DNA synthesis in late G1 phase nuclei, while nuclei from cells at stages other than late G1 did not respond to any of the cytoplasmic extracts.

The factor or factors in S phase cytoplasm that promote initiation of DNA synthesis in late G1 phase nuclei, assuming of course that the effect has nothing to do with changed DNA precursor pool sizes, is heat labile, resistant to pancreatic ribonuclease and withstands freezing and lyophilization. The hope is, of course, that S phase cytoplasm will prove to contain a specific initiator of DNA replication in receptive late G1 phase nuclei of HeLa cells, but it is as well to remember that as yet other less interesting interpretations of these data have not been rigorously excluded.