tabulated by area, and the possibility of spotting regularities or correlations—say the incidence of pellagra, family expenditure on food, and the provision of medical services in the eastern United States—is very remote indeed. Such interesting relations as have been found are the result of years of searching, and merely increase the sense of frustration that there is no better way of doing it. Other speakers, from the General Register Office, the Ordnance Survey, and the Meteorological Office, discussed their own approaches to the problem. As Mr. Bickmore sadly admitted, nothing so far qualifying as a real map has been produced automatically in Britain or in the United States. He was hopeful, though, that something would be done before the end of this year.

Reactors at Sea

THE economics of marine propulsion by nuclear reactor have been derided so often—most recently by Sir William Penney, Chairman of the Atomic Energy Authority—that believers need either considerable courage or blind optimism. Despite the figures recently issued for the U.S.S. *Savannah*, the United States nuclear ship, which requires an operating subsidy of close on a million dollars a year, and will cease to operate when the subsidy runs out, Mr. J. A. Teasdale, lecturer in Naval Architecture and Shipbuilding at the University of Newcastle upon Tyne, believes that a competitive nuclear powered nuclear ship could be built. In a paper read before the Royal Institution of Naval Architects on March 22, he described his design.

The ship would be in two parts, one containing the motive power and the other the cargo holds. The chief advantage would be to make full use of the expensive machinery in the motive part of the ship by doing away with long periods of idleness during loading and unloading. On delivery of a cargo, the pusher section would separate itself and depart almost immediately with another cargo unit which had been loaded in readiness. For the same power source, Mr. Teasdale claims that this concept would have both lower capital and running costs than an equivalent number of conventional ships. The design could of course be used with normal power sources, but since nuclear power plant would not require large oil storage tanks some of the difficulties in matching draught and trims would be removed.

The joint between the two sections should be either flexible or completely rigid. The flexible design would have to accommodate large forces in several degrees of freedom, and it is probable that the rigid design would be preferable. For the actual link, Mr. Teasdale visualizes a ratchet arrangement with a V-shaped bow for the pusher unit and a corresponding recess in the cargo unit. After positioning the pusher unit correctly, water ballast would be taken on to engage the ratchet. To get the best advantage from the design, the voyage time should be equal to half of the loading or discharging time of the cargo. A suitable route, Mr. Teasdale suggests, would be Liverpool–New York, at a service speed of 21 knots. One pusher unit and three cargo units, he says, would be equivalent in handling capacity to 2·43 conventional ships. After what he admits to be an elementary cost comparison, he concludes that a nuclear composite ship could be competitive with existing vessels. Using the design with a diesel main engine would, he thinks, lead to "considerable savings in cost".

High Powered Co-operation

THE Cavendish Laboratory at Cambridge, the Ministry of Technology and Associated Electrical Industries, Ltd., are all agreed that there are substantial scientific and economic gains to be had from the development of high voltage electron microscopes. Dr. V. E. Cosslett at the Cavendish has designed and built a microscope operating at 750,000 volts, and AEI has decided to build the microscope, scaled up to 1 million volts and with minor design modifications, and to sell it commercially for a price in the region of £180,000. Where the ministry comes in nobody is quite sure, but it is on the scene and beside itself with pleasure at this example of collaboration between industry and the university.

In order to build the microscope at Cambridge, some structural alterations were necessary at the Cavendish; a students' laboratory was annexed for the electron accelerator, a large hole made in the floor, and the actual microscope sited in the cellar below, previously a battery room. The microscope is beautifully engineered, about twice as large as conventional ones, and has been in use for a year. Results have been very encouraging, and it seems that some of the doubts expressed about high voltage microscopes were unjustified. Apart from the opportunity to use much thicker specimens in transmission, there has been a considerable improvement in clarity, and fine detail invisible at 250 kV can be seen at 750 kV. For biological specimens damage is less than at 100 kV, perhaps surprisingly, and for metallurgical work the interpretation of the electron micrographs is not unduly complicated by the increase in thickness; the use of stereo pictures can help. The microscope has the advantage of operating over the whole range from 100 kV to 750 kV, and AEI intends to preserve this feature when it puts the design into production.

So far, the microscope has been used, among other things, for the examination of wool fibres, porcupine quills and membranes for artificial kidney machines, but the obvious application is in metallurgy. Foils

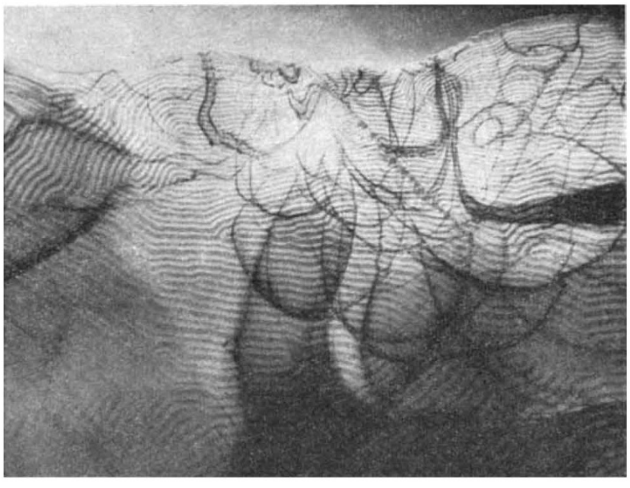

Fig. 1. Domains in a wedge-shaped cobalt foil, photographed by Lorentz microscopy in the Cavendish Laboratory microscope. Voltage 700 kV, magnification about 5,000. (P. J. Grundy and J. P. Jakubovics, Cavendish Laboratory.)