comparison would have to be reviewed, however, if gas rates were set at a lower level reflecting gas production, transmission and distribution costs.

Regarding the western zone of East Pakistan, the report notes that a power gap of 90 MW is to be expected by 1970, which might provide an opportunity for nuclear power in view of the particularly high fossil fuel costs prevailing in the region. Much would depend, however, on whether additional transmission and distribution facilities are built to make it possible to serve a wide area from a single plant.

The most favourable opportunity for nuclear power in East Pakistan is stated to be that which would arise if the eastern and western zones are interconnected. That would provide a total demand of over 400 MW in 1970 and make possible a 100 MW nuclear unit whose economic advantages would be particularly attractive.

Moving Ahead

It is stated as "the view of the IAEA Mission that the Pakistan Atomic Energy Commission, together with the national power authorities should pursue the matter (of nuclear power) further". The report concludes by indicating some of the steps which Pakistan might take "once a decision of principle is taken to go ahead with a nuclear power plant project". It is suggested that consideration be given to forming a project group to gather information and provide continuity. Continued training of nuclear engineers and technologists, in which a research reactor now under construction in Pakistan might be useful, is also emphasized. An invitation for bids is recommended as a way of obtaining precise cost data.

Aspects of the project in which IAEA can offer assistance are then enumerated. These include preparation of the specifications, selection of a site, evaluating reactor safety, preparing health and safety regulations, evaluating bids, training personnel, obtaining fuel, and seeking outside financing.

ATOMIC ENERGY IN YUGOSLAV AGRICULTURE

With the assistance of the United Nations Special Fund, a major project for extending atomic energy applications in agriculture is to be undertaken in Yugoslavia. IAEA will act as the Executing Agency for the project, which will be carried out over a period of three years and will include a number of activities to develop nuclear research and training for the improvement of overall agricultural production, especially in respect of grain and livestock. Among the principal aims are improvement in the use of fertilizers, improved irrigation and drainage, better breeding and selection of crop plants, and better livestock management.

Improvements in these fields can be hastened through research involving the practical application of nuclear techniques. It is therefore planned to expand the research and training facilities of the Institute for Application of Nuclear Research in Agriculture, Forestry and Veterinary Sciences at Zemun, near Belgrade, which deals with practical problems in all phases of plant culture and animal husbandry. The object is to make it the central institution in the country for the application of nuclear research in the field of agriculture.

Under the Special Fund project, which was approved in May 1962, the Fund will contribute US $546 400 to cover the cost of equipment, training and expert services, while the Yugoslav Government will contribute the equivalent of $1 206 000 in the form of land, buildings, equipment, staff and other services. The execution of the project will start early next year at the Institute at Zemun, which at present has two buildings and 50 hectares of arable land. The project calls for an expansion of buildings, additional equipment and a larger scientific staff. It is anticipated that by 1965 the number of resident scientists at the Institute will increase to 90. The Special Fund will provide experts, fellowships and equipment through the Executing Agency, and the programme includes in-service training of counterpart personnel to be provided by the Yugoslav Government.

The Institute's work in connection with this project will be on the following main subjects:

(a) Soil fertility and plant nutrition, including methods for laboratory assessment of the fertility status of the soil, and methods of application of fertilizers; studies of leaching of plant nutrients; studies of soil moisture in connection with irrigation and drainage; and studies on the absorption of nutrients by plants from the soil and on nutrient translocation and accumulation within the plant;

(b) Plant breeding, using irradiation to produce mutants of agricultural crops and forest trees as a supplement to conventional breeding methods;

(c) Animal husbandry, including protein nutrition studies of poultry and animal health protection.

Soil Fertility and Plant Nutrition

Half of the soils in Yugoslavia are acid and have a low productive capacity. High yields, therefore, cannot be achieved without proper application of fertilizers, the effects of which depend on the type of soil, properties of plants and the manner of application. At present about 700 000 tons of superphosphate are

produced in Yugoslavia annually, but the fertilizer is not very well utilized in the acid soils. By developing effective methods of fertilizer application substantial savings in the amount of fertilizer used should be realized. Results of laboratory studies with radioactive or stable isotopes of phosphorus should contribute to determining proper practices for optimum fertilizer management.

Large amounts of lime are used to reclaim acid soils in Yugoslavia and the liming must be repeated every fifth or sixth year. It is therefore important to investigate the process of leaching of calcium from the soil, since the availability of different plant nutrients is closely related to soil calcium supply. This investigation will contribute to an understanding of the relationship between calcium and phosphorus in soils and the availability of other plant nutrients.

As regards soil moisture studies, it is to be noted that in the conditions of Yugoslavia water is very often a limiting factor, and large irrigation projects have to be undertaken. Different conventional methods are used to measure the moisture of soils in order to determine needs under irrigation cropping, but nuclear methods can be expected to make this procedure simpler and faster.

In the field of plant physiology, it is important to study the absorption of nutrients by plants, especially of nitrogen and phosphorus. A full understanding of crop response to those most commonly deficient elements will help in prescribing the proper time and rate required for the most effective application of fertilizers. Another subject of interest is the metabolism of nutrient elements in crops and the relationship between mineral nutrition and photosynthesis. Since the nature and amount of nutrient elements influences plant metabolism and the quality of crops, it is useful to know the proper balance between the macro- and microelements for maximal and most economic production.

Plant Breeding

So far as plant breeding is concerned, results already obtained by Yugoslav scientists are promising, especially with maize, barley, wheat and soy bean. Under the Special Fund project, this work will be further extended, and experiments will be carried out in order to breed new varieties of wheat, barley, maize, sugar beet and some important forage plants through radiation-induced mutations. The main object will be to develop such characteristics as resistance to plant disease, frost and drought.

Animal Husbandry

One of the main tasks for the improvement of livestock is to find preventive measures against parasitic diseases in farm animals. Yugoslav experts have already done some work on a vaccine against lung parasites in sheep using ionizing radiation in the preparation of the vaccine. Complete immunity has been obtained by use of this vaccine with lambs kept under laboratory conditions. The results of this work indicate that with similar proceedings it may be possible to develop protective substances against other parasitic diseases of farm animals, which constitute a major problem in animal husbandry in Yugoslavia.

Another subject to which attention will be given under the Special Fund project is poultry nutrition. Radiation and radioisotopes have already been used in studying various aspects of the subject, and the project provides for further expansion of the work. In particular, atomic tools will be applied in the investigation of the following problems:

(a) Optimal levels of protein in rations for broilers and laying hens;

(b) Optimal relations between basic and specific protein nutrients in these rations with regard to the content of amino acids;

(c) Optimal content of calcium and phosphorus in various types of these rations;

(d) The role and optimal level of the most important microelements in various types of rations for highly productive poultry; and

(e) The role of vitamin B-12 in the nutrition of broilers.

Successful implementation of this part of the project will make it possible to extend fundamental and applied research in the field of farm animal nutrition and animal sciences in general.

Training, Experts and Equipment

As already indicated, training in the uses of radiation and radioisotopes in various branches of agricultural research and practice is one of the most important parts of the project. IAEA will award 12 fellowships to Yugoslav graduate students, who will receive special training outside the country. The subjects of study will include soil fertility and plant nutrition, plant physiology, plant genetics, animal protein and mineral nutrition, animal biochemistry, immunoprophylaxis and endocrinology. About 80 post-graduate students will be trained at the Institute in the use of nuclear techniques in agriculture. In addition, short-term training will be given to a number of advanced research workers in such subjects as soil chemistry and plant physiology, biochemistry, immunology and poultry nutrition.

IAEA will also provide the services of ten experts and consultants, who will advise Yugoslav specialists on the implementation of the training and research programmes. Further, a total of $258 700 worth of nuclear equipment will be supplied through the Agency. The equipment will include a cobalt-60 source, an electron microscope, a mass spectrometer, a phytotron, a liquid scintillation counter, and radioautographic and gas-chromatographic instruments.