This may be one of the most difficult questions to resolve, for it has so far proved impossible even to identify the ribonuclease which degrades messenger RNA. And how are the gaps filled? One candidate for this role must be DNA polymerase I, for the *E. coli* mutants lacking this enzyme appear to join their Okazaki fragments together more slowly than do wild type cells. Another enzyme involved may be DNA polymerase II, which is often found in those membrane systems which catalyse replication.

Indeed, the implications for attempts to synthesize DNA *in vitro* may be amongst the most important. The need for RNA synthesis may make it difficult, or even impossible, for purified enzyme systems to replicate DNA *in vitro*; one reason why they have often failed to do so successfully may be that, although their capacity to extend DNA chains is retained, they cannot initiate synthesis of the Okazaki fragments. Okazaki's latest discovery is almost as challenging as his original discovery that the synthesis of DNA is discontinuous.—From our Molecular Genetics Correspondent.

MULTIPLE CROPPING

Research in India

from a Correspondent

THE latest results of an extensive research programme into the whole problem of multiple cropping, which was initiated by the Indian Agricultural Research Institute in 1966, could be of tremendous significance for increasing agricultural production, especially in developing countries with high rural unemployment (*Research Bulletin*, new series, No. 8 (IARI, New Delhi, 1972)).

Effective utilization of solar energy and soil nutrients for crop production is only partially achieved even under the most advanced or intensive systems of farming. Even with a controlled supply of water and adequate solar radiation throughout the year, the life span of single crops from sowing to harvest does not usually allow land to be continuously occupied in successive or rotational cropping. Nevertheless, systems of multiple cropping are being effectively used in countries like Taiwan, China, Japan and Egypt as well as in India.

The principal objective of the Indian programme was to increase the economic yield of crops from each unit of irrigated land, largely by telescoping the production time of several complementary crops in sequence on the same land. This was made possible in two ways—the development of a relay system of cropping and by important contributions from plant breeding.

The relay system involves interplanting the next crop before the previous crop is harvested. In this way a sequence of, say, mung (a pulse crop), maize, potato (or oil seed *Brassica*) and wheat, which would normally take more than 365 days to mature, can be harvested within the year. By judicious choice of crop and variety a wide range of three and four crop relays have been successfully produced.

As the optimum yield over a short period of time is of paramount importance for multicropping, a different set of criteria for plant breeding is required. With many crops, particularly cereals, the trend is to increase the harvest index, that is weight of harvested product/total plant weight of the crop, and this is of special significance for multicropping in that an over-abundance of vegetative parts tends to delay maturity. A photosynthetically efficient but smaller type of plant would also allow for a higher number of economically productive units per area of land.

Although the chief consideration in the research programme of the Indian Agricultural Research Institute was to increase production per unit area over a shorter time scale, it was appreciated that, for the systems to be successful, minimum soil cultivation and economical use of water are important. A secondary objective was to ensure that the physical, chemical and biological properties of the soil are maintained, and if possible improved. Again, by judicious choice of crops and varieties due regard has been given to the problem of pests and diseases without resorting to protection by chemicals.

Of special significance for India is the fact that, although many of the crop relays provided significantly greater production and net profit a hectare, the intensification also implies a dramatic increase in employment potential. Thus the difference between a fallow wheat rotation and a mung–maize–potato–wheat relay amounts to an increase in production from 5 to 14 t of food grain or equivalent a hectare and an increase in manpower requirement from 85 to 432 man days a hectare a year.

Economic growth is often achieved at the expense of reduced employment of manpower, but the adoption in practice of the methods advocated by the Indian Agricultural Research Institute will, it is claimed, provide employment for an extra 17 million people to alleviate the distressing amount of unemployment in the rural areas of India. The stimulus arising from a well coordinated programme of agricultural research is contributing significantly towards providing India and other developing countries with increased production of several crops in a way that will help to alleviate both famine and rural unemployment.

SOLID STATE

Bends in TiNi

WHEN a sheet of the alloy TiNi is bent beyond its elastic limit at less than about 160° C (the martensitic transition region) the temperature of the distorted part increases, but when the sheet is straightened again heat is reabsorbed and the temperature drops by as much as 15° C. This is one of several novel properties of the alloy—its memory is already well known—that are described by Wang and Buehler in a recent issue of *Applied Physics Letters* (**21**, 105; 1972).

Wang and Buehler also point out for the first time a curious effect that takes place when a TiNi wire below its transition temperature is heated locally after it has been stretched just beyond its so-called limit of easy plastic flow. At the point where the heat is applied the wire bends so that one straight part is at an angle of about 30° to the other. What is particularly interesting is that further heating at the same place causes the wire to straighten again. If the heat source is moved along the length of the wire, however, the bend will follow it and can be made to disappear off the end. Wang and Buehler say that these and other features of TiNi support the contention that its martensitic transition is chiefly of an electronic nature.

RIBOSOMES

Roles in Ribosomes

from our Molecular Biology Correspondent

SINCE the heady triumphs of total reassembly, relatively little has occurred in the ribosome field to stir the spirit. There has been instead a long period of consolidation, or painstaking and unspectacular programmes of fractionation, sequencing and characterization, and the signs now are that the pay-off is at last at hand. In particular a start has been made in defining the structural and functional roles of individual proteins of the *E. coli* ribosome. In a brief but action-packed paper, Funatsu and Wittmann (*J. Mol. Biol.*, **68**, 547; 1972), for example, define the chemical basis of streptomycin in mutations in *E. coli*. Both streptomycin resistance and dependence are associated with a single protein of the 30S subunit, S12. This protein was isolated from nine streptomycin resistant mutants of four allele types, and examined by tryptic fingerprinting. The mutant proteins differed in each case from the wild type