residues are clustered in one half of the chain and the A and T residues in the other. These features may serve as signals to the enzymes which generate sticky ends. There are two obvious candidates—either a sequence specific exonuclease which removes twenty bases from each 3′-end of a double stranded molecule, and so leaves the complementary 5′ strands protruding, or a specific endonuclease which attacks a circular DNA molecule internally at one site on each chain.

METALLURGY

Memory in a Metallic Compound

from our Materials Science Correspondent

THERE has been a flurry of investigation recently of an extraordinary intermetallic compound—TiNi. TiNi undergoes three allotropic transitions, one of which at least, slightly above room temperature, is martensitic. Unlike most intermetallic compounds it is capable of plastic deformation; this happens partly by dislocation motion and partly by martensitic shear. TiNi has a "mechanical memory": if deformed at a temperature below the martensitic transition range and then heated through this range, the material springs back to its original form.

A group of eight papers published in the April 1968 issue of the *Journal of Applied Physics* deals with various basic features of this compound and of a number of crystallographically similar materials. This month a valuable paper has appeared which concentrates on the practical aspects of TiNi. It is by W. T. Buehler and F. E. Wang (two of the leading investigators in this field, and both associated with the US Naval Ordnance Laboratory) and appears in the first issue of a new Pergamon periodical, *Ocean Engineering* (**1**, 105; 1968). It seems that two useful alloys exist in the TiNi system: one has a composition near TiNi—the precise composition can be altered slightly, with or without small additions of cobalt, so as to change the martensitic transition range—and the other contains excess nickel and is age-hardening. The second composition has no mechanical memory. Between them the alloys offer good ductility for fabrication, very high damping over limited temperature ranges, non-magnetic properties, high ability to harden according to the Jominy test, remarkable corrosion and erosion resistance and high strength. The most useful property, however, appears to be the mechanical memory of the TiNi composition (christened Nitinol-55 by the authors). One American company has shown how this property can be used to hot-form an elaborate radio aerial assembly from a pattern of TiNi wire, crumple this into a compact ball and then return it to its original shape by warming through the martensitic range: this technique can be applied to satellite aerials.

The very high damping should also have applications in submarine design and noisy machines, for example. The damping is as high as in the new Cu-Mn alloy recently developed in Britain (R. J. Goodwin, *Metal Sci. J.*, **2**, 121; 1968) and the other mechanical properties are probably better for uses requiring high strength.

The mechanism of the mechanical memory is still uncertain. R. de Lange and J. A. Zijderveld, in an intriguing paper (*J. Appl. Physics*, **39**, 2195; 1968), offer some X-ray texture measurements in connexion with the martensitic transformation, and suggest that the predominant orientation of individual martensite plates is altered by an applied stress, and that the amount and sign of shape restoration on reheating will depend on the degree of such preferred martensite orientation. The matter can hardly be so simple, however, because a study of electrical resistivity by F. E. Wang (*J. Appl. Physics*, **39**, 2166; 1968) shows that the physical characteristics of the transformation are substantially altered by the application of stress, and the Dutch workers themselves showed that the amount of transformation is altered by applying a stress. Whatever the transformation mechanism, there is no doubt that the memory effect, by permitting the design of self-erectile structures, as the Americans term them, will be of great value. TiNi is the only alloy which behaves like this in polycrystalline form, though some other alloys (InTl, AuCd) have mechanical memory when in single crystal form.

Buehler and Wang's recent paper appears in *Ocean Engineering* because they believe that self-erectile structures have a range of applications in underwater operations, and a page of their paper is devoted to a discussion of this. The editor-in-chief of the new journal, Dr A. A. Johnson, is a metallurgist, and it is evident from the editorial that a good deal of the periodical will be devoted to materials of importance in underwater engineering.

Investigation of Magnetic Structure and Dynamics in Solids with Neutron Beams

by

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Techniques involving neutron scattering allow the internal structure and dynamics of magnetic materials to be examined with a degree of experimental definition unobtainable by other methods.

DURING the past 20 years, the building of powerful nuclear reactors has provided physicists and chemists with an extremely important tool for investigating aggregated matter. The scattering of a beam of thermal neutrons from a solid or liquid sample can give unambiguous and detailed knowledge of the structural and dynamical properties of the specimen material. The use of neutrons in this way depends, of course, on their wave-