and the neonatal lamb lungs. In any further comparative studies the possibility of reducing time and processes of handling before injection could be worth investigating. Indeed, and to avoid artifacts, the lungs and especially the vessels are to be left untouched before injection, not even washed out after necropsy to remove postmortem thrombi.

On the other hand, the selection of normal, 4-day-old lambs as a control group was based on the fact that in neonatal physiological studies the lamb is commonly used as a substitute for the human newborn, and on the assumption that both species have a morphologically similar pulmonary vasculature. As a matter of fact, no differences have been observed either on histological examination of the lung sections or on histometrical study of the arterial wall diameters in both groups. The use, as controls, of lungs of human newborns who died of nonrespiratory disease was my original plan, but it was discarded because such lungs nearly always show some pulmonary disturbance, either as a complication, an agonal manifestation, or an association (as in cardiac malformations) with the primary disease in our autopsy cases dealing with premature births. In larger hospitals handling numerous emergencies, it should perhaps be possible and extremely interesting to study a series of lungs from infants who died suddenly from accidents.

To summarize, even if much information is still lacking about the precise nature of this filling defect in HMD, my reported observation nevertheless argues strongly in favor of a disturbance of the pulmonary perfusion, localized largely at the level of the small muscular pulmonary arteries (50 to 30 μ) and even more at the level of the pulmonary arterioles ($< 30\ \mu$) in this disease. This phenomenon is in accordance with our previous findings (*3*) and with the recent findings of Chu *et al.* (*2*), which have shown that pulmonary hypoperfusion is the prominent characteristic of the respiratory distress syndrome of the newborn. Its description and localization seem to be of more than academic interest: the therapy of HMD could be greatly influenced by additional data on the lung vasculature of the human fetus and newborn.

J. M. LAUWERYNS

Experimental Laboratory of Cardiopulmonary and Genital Pathology, University of Louvain, Louvain, Belgium

References and Notes

1. G. Dawes and J. Mott, *J. Physiol. London* **164**, 465 (1962); C. D. Cook, P. Drinker, H. Jacobson, H. Levison, L. Strang, *ibid.* **169**, 10 (1963).
2. J. Chu, J. A. Clements, E. Cotton, M. H. Klaus, A. Y. Sweet, M. A. Thomas, W. H. Tooley, *Pediatrics* **35**, 733 (1965).
3. J. M. Lauweryns, *Acta Anat.* **46**, 142 (1961).
4. V. L. Van Breemen, H. B. Neustein, P. D. Bruns, *Am. J. Pathol.* **33**, 769 (1957); M. Campiche, M. Jaccottet, E. Julliard, *Ann. Paediat.* **199**, 74 (1962).
5. J. M. Lauweryns, E. Eggermont, A. Van den Driessche, P. Denys, *Arch. Franc. Pédiat.* **22**, 5 (1965); J. M. Lauweryns, *Arch. Disease Childhood* **40**, 618 (1965).
6. M. E. Avery and J. Mead, *Am. J. Diseases Children* **97**, 517 (1959).
7. D. R. Shanklin, *Am. J. Pathol.* **44**, 823 (1964).
8. D. Gitlin and J. M. Craig, *Pediatrics* **17**, 64 (1956).
9. L. Rosen, D. H. Bowden, I. Uchida, *Arch. Pathol.* **63**, 316 (1957).
10. R. M. O'Neal, R. C. Ahlvin, W. C. Bauer, W. A. Thomas, *ibid.*, p. 309; R. L. Naeye, *ibid.* **71**, 121 (1961); W. H. Civin and J. E. Edwards, *ibid.* **51**, 192 (1951).
11. C. E. Tobin, *Surg. Gynecol. Obstet.* **95**, 741 (1952).
12. I thank M. Klaus, Stanford University, for his interest and advice, M. De Bruyne, T. Lerut, and M. Kestens for their excellent technical assistance, and Prof. J. A. Schockaert and Prof. M. Renaer for giving me the opportunities for the postmortem studies.
13. Supported by PHS grant 1-R01-HE08998-02, from the National Heart Institute.

18 April 1966

■

Polymorphism of Shock Loaded Fe-Mn and Fe-Ni Alloys

Abstract. *Addition of nickel or manganese to iron lowers the pressure of the "130-kb" dynamic polymorphic transition to about 55 kilobars at the limits of the body-centered cubic alloy phase.*

Since the initial discovery of the "130-kb" polymorphic transformation of iron (*1*) from body-centered cubic to a hexagonal structure (*2*), we have studied the polymorphic behavior of a number of binary iron alloys under explosive pressure loading (*3*). In general, the transformation pressures of these alloys increase as the amount of solute is increased. A mild violation of this rule in Fe-Ni alloys has been reported (*3*). We now report the more-dramatic transition-pressure lowering found in the Fe-Mn alloy system, and extend the range of the previous Fe-Ni investigation.

As in our earlier studies, our alloy samples were made by arc melting the constitutents together; then followed the heat treatments necessary to obtain uniform solid solutions. The requirement that all samples be entirely body-centered cubic limited the maximum solute concentrations.

Behavior of the alloys under explosive loading was studied by use of the pin technique (*3, 4*), the object of which is to determine the successive velocities of the unconfined or "free" surface of the sample. Each free-surface velocity is induced by one of the three shock waves traveling through the sample; from these velocities the properties of the shock waves themselves may be calculated. The three shock waves are: the elastic wave, having the pressure of the dynamic elastic yield point of the material (typically less than 20 kb); the plastic-I wave, which has the characteristics of the onset of the polymorphic transition; and the plastic-II wave, which carries the balance of the initial shock pressure. Thus we are interested in determining the properties of the plastic-I wave, these being the conditions under which the polymorphic transformation begins.

We slightly modified the traditional calculation (*1*) of the shock characteristics, in which it is assumed that the interaction of the elastic wave with the free surface produces a rarefaction shock traveling back into the sample with the speed of the elastic wave (relative to the free surface). This assumption is used to find the point of intersection between the plastic-I wave and the rarefaction, from which the plastic-I shock velocity is determined (*5*). However, it is known that this treatment of the rarefaction is to some degree incorrect (*6*). The other extreme is to ignore the interaction between the rarefaction and the plastic-I wave, and to calculate the plastic-I velocity from the coordinates of the point at which the plastic-I wave arrives at the free surface (*7*). We have used this simplifying assumption in the calculations for this report. The two extreme methods of calculation result in transition-pressure values differing typically by 1 percent and bracketing the unknown true value. As the experimental errors are somewhat larger than this difference, improvement of the calculation is of little value.

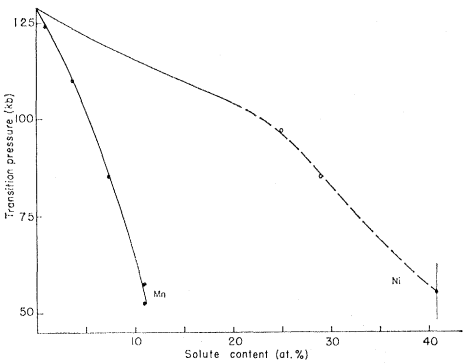

Fig. 1. Transition pressures for the Fe-Mn and Fe-Ni alloy systems. The dashed line indicates the range of the new Fe-Ni data; vertical bar shows an estimated error for the lowest Fe-Ni pressure.

Transition pressures for the two alloy systems appear in Fig. 1; the data for the solid portion of the Fe-Ni curve have been reported (*8*), and the dashed portion is a hand-fit to the new experimental points shown. The behavior of the Fe-Mn system is more dramatic, as the manganese solute is less dilatory than the nickel in lowering the transition pressure. Confidence in this result has been reinforced by the results of an associated study of the Fe-Mn system by the interaction-zone technique. This technique (*8*) is less precise than pin measurements, but, with constant initial pressure, the interaction-zone thickness (and thus the transition pressure) decreases with roughly the same dependence on solute content as Fig. 1 shows.

The solute concentrations were limited to the indicated ranges by the need for keeping the alloys entirely in the *bcc* phase. It is interesting that the transition pressures at the limiting compositions for both these systems are about 55 kb.

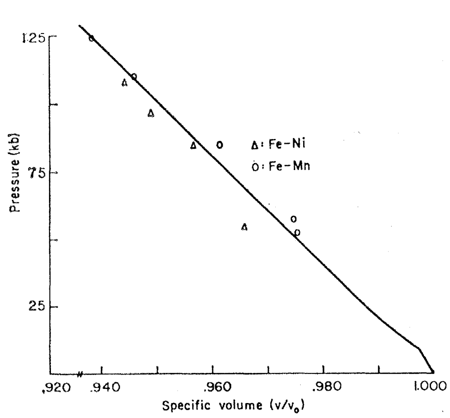

Fig. 2. Pressure-volume states for the onset of the polymorphic transition for the Fe-Mn system, and for Fe-Ni alloys containing more than 20 percent Ni by weight. The Hugoniot of pure iron (solid line) is included for comparison.

With the normal explosive lens systems available, it is difficult to obtain shock waves with acceptable planarity at pressures less than about 150 kb (in iron, or in materials with shock impedances close to that of iron); thus the initial pressure in all these experiments was some 150 kb. With such a relatively high input pressure, the effects of the plastic-I wave on the free surface can be seen only briefly before the arrival of the plastic-II wave at the surface. Few pins are contacted in that short time, and the relevant velocity is poorly determined. An estimate of the transition-pressure error caused by the uncertainty in free-surface velocity is shown in Fig. 1 for the lowest Fe-Ni transition pressure; data above 100 kb are attended by more-normal errors of 2 to 3 percent.

A pressure-volume plot of the transition points appears in Fig. 2. The solid line is the Hugoniot (the locus of dynamic *P-V* states) for pure iron up to the transition. All the Fe-Mn data are shown, but for clarity only data for Fe-Ni alloys containing more than 20 percent Ni by weight are included in the plot. The data suggest that, as the amount of solute is increased, the Fe-Ni alloys become more compressible and the Fe-Mn alloys become slightly less compressible than iron. For both alloy systems these trends must reverse at some point because the Hugoniot of nickel is known to lie somewhat above the iron curve (nickel is less compressible) (*9*), and static-pressure results indicate that manganese is considerably more compressible than iron (*10*). These facts are not surprising, as neither element has a *bcc* structure.

This report is the last on our pin-technique investigations of polymorphism in binary iron alloys. When previous results (*3*) are combined with these data, it is clear that by selecting the proper binary iron alloy one may obtain transition pressures in a continuous range from 55 to about 600 kb.

T. R. Loree
R. H. Warnes
E. G. Zukas
C. M. Fowler

Los Alamos Scientific Laboratory, Los Alamos, New Mexico

References and Notes

1. D. Bancroft, E. L. Peterson, F. S. Minshall, *J. Appl. Phys.* **27**, 291 (1956).
2. R. L. Clendenen and H. G. Drickamer, *J. Phys. Chem. Solids* **25**, 865 (1964); T. Takahashi and W. A. Bassett, *Science* **145**, 483 (1964).
3. T. R. Loree, C. M. Fowler, E. G. Zukas, F. S. Minshall, *J. Appl. Phys.* **37**, 1918 (1966).
4. F. S. Minshall, *ibid.* **26**, 463 (1955).
5. This is point 2 in (*3*, fig. 1).
6. M. H. Rice, J. M. Walsh, R. G. McQueen, in *Solid State Physics*, F. Seitz and D. Turnbull, Eds. (Academic Press, New York, 1958), vol. 6, p. 1.
7. This is point 3 in (*3*, fig. 1).
8. C. M. Fowler, F. S. Minshall, E. G. Zukas, in *Response of Metals to High Velocity Deformation* (Proc. A.I.M.E. conf. 9, 275). (Interscience, New York, 1960).
9. J. M. Walsh, M. H. Rice, R. G. McQueen, F. L. Yarger, *Phys. Rev.* **108**, 196 (1957).
10. P. W. Bridgman, *Proc. Amer. Acad. Arts Sci.* **76**, 55 (1948).
11. Work performed under AEC auspices.

5 July 1966

Malathion Degradation by Trichoderma viride and a Pseudomonas Species

Abstract. *Malathion was found to be metabolized quickly by a soil fungus,* Trichoderma viride, *and a bacterium,* Pseudomonas *sp., which were originally found in soils from northern Ohio that had been sprayed heavily with insecticides. Results of a survey of the breakdown capabilities of 16 variants of* T. viride *revealed that certain colonies from this species had a very marked ability to breakdown malathion through the action of a carboxylesterase(s). The enzymes can be made soluble by preparing the acetone powder suspension.*

Malathion is an important selective insecticide in the control of various pest insects. The pattern of its degradation has been extensively studied in insects and mammals (*1*). In brief, mammals are more resistant to this insecticide than most insects are because they have a superior ability to break the malathion molecule at the carboxylester sites. This point became even more evident when insects highly resistant to malathion were found to possess additional enzymes that can hydrolyze the carboxylester bonds of malathion (*2*). Studies of microbial degradation of organophosphorus insecticides by Ahmed and Casida (*3*) revealed that phorate and other dialkyl phenylphosphates and phosphorothioates could be degraded through the action of both *Pseudomonas fluorescens* and *Thiobacillus thiooxidans*. From a comparison of autoclaved and nonauto-