

selection of elements throughout the periodic table. They measured the energy of electron-positron pairs produced by the gamma-rays. The spectra become more and more complex as the capturing material is made heavier. Lead and bismuth, however, have simple spectra. The reasons for this behaviour are at present unknown.

The neutron cross-sections of nuclei have been studied at the Argonne Laboratory, Illinois, using three different methods. Dr. D. R. Inglis described the different methods used to select neutrons of a single energy. Narrow slits in a high-speed rotor chop neutron beams emerging from slits in a similar stator into short bursts. The reflexion of a light beam by the rotor on to a photo-cell triggers a multi-channel counting system which selects neutrons by their time of flight. The small area of cross-section of the neutron beam between rotor and stator makes possible the study of small samples of separated isotopes which are inadequate for the pulsed cyclotron technique. Nuclear cross-sections at a definite neutron energy can also be studied using resonance scattering of a beam of neutrons from the pile. The sharp scattering resonance of xenon has been used to determine the absorption cross-section of boron at this energy. For higher energies the pile cannot be used to provide a source of monochromatized neutrons. Neutrons with energies between 5 keV. and 1 MeV. can be produced by bombarding lithium with protons, using very careful voltage regulation of the electrostatic accelerator. This is necessary because the reaction threshold is 1.88 MeV.

Beams of monochromatized pile neutrons can also be used for reinforcing the older technique of X-ray diffraction in the study of solids. Mr. G. E. Bacon, of the Atomic Energy Research Establishment, Harwell, described a double-crystal neutron spectrometer in use at Harwell. The first crystal, a few inches square, is used as a monochromator to select neutrons with wave-lengths lying within a narrow band from a collimated beam emerging from the thermal column of the pile. The neutrons diffracted from a second crystal are detected by a counter mounted on a rotating arm.

A comparison of the intensities of lines in the X-ray and neutron diffraction spectra of graphite confirms that anomalies in the X-ray intensities are due to the anisotropic distribution of electrons in each atom and not to any peculiarities of crystal structure. The neutrons scattered by the atomic nuclei show no anomaly.

Whereas the scattering of X-rays increases rapidly with atomic number, the scattering of neutrons is about the same for all elements. Neutron diffraction has therefore the advantage that light elements can be detected in the presence of heavy ones.

The fast neutrons in a pile can cause interesting changes in the physical properties of solids. Mr. T. M. Fry, of the Atomic Energy Research Establishment, Harwell, referred to the experiments of Lark-Horovitz, which demonstrated the production of electron-traps in germanium irradiated in the Oak Ridge pile. Siegel found that samples of  $\text{Cu}_3\text{Au}$  were disordered after prolonged irradiation at Oak Ridge. Dugdale at Harwell, on the other hand, has found that the resistivity of annealed samples of  $\text{Cu}_3\text{Au}$  falls as a result of short irradiations in the pile. This suggests that the degree of order of these samples is increased by the bombardment.

Berman, at the Clarendon Laboratory, Oxford, has observed that the thermal conductivity of a quartz

crystal is reduced by successive irradiations at Harwell until its behaviour is more nearly that of a glass. These changes can be attributed to the scattering of thermal waves by clusters of interstitial atoms and vacant lattice points.

Experiments of this type should throw light on the structure-sensitive properties of solids.

T. M. FRY

## MANAGEMENT BEHAVIOUR AND FOREMAN ATTITUDE

IN a large-scale business enterprise there are many levels of administrative work. The administrator has responsibility for the process of blending productively the economic, technical and business requirements of complex situations. Some of the most perplexing human relations problems in industry, however, are faced by foremen, supervisors, and others in middle management groups, and to observe at first hand some of these problems of human relationships, Messrs. D. R. Ulrich, D. R. Booz and P. R. Lawrence, of the Graduate School of Business Administration, Harvard University, recently spent eight months in a factory in the United States.\*

The particular plant chosen for study reflected many of the tensions and instabilities of an intensely competitive industry. It was one of many plants operated by a company with headquarters in New York. The products of the department were four models of a small, delicate instrument which had been invented and produced for only about two years. A great many technical engineering aspects in the production of this instrument were causing trouble continually.

A new general manager had called upon his immediate associates to operate as a management team. These men, all specialists in their fields, met at the manager's call to make or review all decisions concerning the plant.

Between the management team and the direct labour operators was a thin bridge of supervisors, foremen and staff specialists. At the work bench the company employed a large number of semi-skilled workers. These operators worked on production lines that were continually being revised according to the dictates of the engineering department as interpreted by the foremen.

Preoccupied with the demands made upon them by the hourly employees and the staff specialists, the supervisory personnel felt they did not themselves have adequate capacity to deal with these demands. Yet their efforts to get the help they needed from general management were not successful; instead, 'management' made the strongest demands of all.

The research group felt that a close knowledge of the personnel at each level would be necessary to understand the reasons for the gap between general management and other personnel. The team therefore spent about half its time in the plant talking with, and observing the activities of, thirty-six women who were hourly-paid employees in one department.

Although none of the women ever stated their problems in these words, it seemed to the observers that the only way the women felt they could make their factory life interesting and meaningful was

\* Management Behavior and Foreman Attitude: a Case Study. By David N. Ulrich, Donald R. Booz and Paul R. Lawrence. Pp. vii + 56. (Boston, Mass.: Graduate School of Business Administration, Harvard University, 1950.) 75 cents.

## RESIDUAL STRAINS IN PLASTICALLY DEFORMED MILD STEELS

through conversation with one another and through the development of informal groups. The frequent changes in the department kept disrupting these activities, and the women developed feelings of insecurity which manifested themselves primarily in an attitude of hostility toward management, an attitude which even the women themselves did not quite understand.

The foreman of the department formed the main link between the higher members of management and the hourly employees. Since a distinct gap existed between management and the employees, since these groups frequently misunderstood each other, and since each tried to exert various kinds of pressure on the other, the position of the foreman was at once critically important and critically difficult. Caught squarely between these opposing pressures, he faced daily confusion, doubt and conflict in trying to reconcile them.

The employees viewed the foreman as an instrument of management. But what, in fact, were the foreman's relation with management?

In the foreman's opinion, the superintendent entered the department only to criticize such matters as the way the floor had been swept. The foreman wished to see as little as possible of the superintendent and to receive as few instructions from him as possible. Critically significant to the foreman was the fact that he and his immediate supervisor were held solely responsible for the correlation of all requirements set up by staff personnel as well as 'line' superiors.

Missing from the situation was an effective method for translating special technical knowledge into terms that would be useful to the line personnel, and for translating line problems into terms that would have meaning to the specialists. The barrier that prevented this give-and-take from occurring was not in any sense a technical barrier but rather one of hostile attitudes between groups competing for greater control of the work.

The report indicates that the management of the company held in its own hands the key to many of the most critical human relationships in the plant; and that the turning of this key depended upon management's own behaviour. Yet rather than try to understand how the employees viewed management, management was preoccupied with trying to get employees to "understand things our way".

In these circumstances, it seemed imperative to the research group that management should stop worrying about getting its own message across to the employees and concentrate on finding out what the employees were trying in various ways to tell management. Only by so doing could management effectively narrow the gap existing between itself and the employees, including those at the supervisory level.

A characteristic of the pattern observed by the investigators was the self-perpetuating nature of the gap in communication between senior management and subordinate levels of the organisation. They concluded that a first step in bridging this gap would be for senior management to see more clearly what its own role in maintaining the gap had been.

In closing, the authors of this report stated that the most promising development in the company was the effort the general manager was making to increase his own understanding of the human factors in his administrative work. His efforts held the most significant kind of promise for the future.

T. H. HAWKINS

USING an accurate back-reflexion X-ray technique, residual strains in plastically deformed low-carbon steels (0.06–0.15 per cent C, 0.27–0.67 per cent Mn) were evaluated from the values of lattice spacings of planes lying parallel to the surface of previously extended plate-tensile specimens. The diffusion of the  $K\alpha$  doublet, accompanying plastic deformation of the specimens, affected the photometrically measured diameter of the diffraction rings, introducing a fictitious lattice contraction. A correction for this deviation was applied by a method described previously<sup>1</sup>. The accompanying graph shows measured and corrected lattice strains for the {211} planes of a typical sample.

All specimens were ground from larger stock materials. Preliminary heat treatment *in vacuo* or in an inert atmosphere appeared to give consistent results, and the use of different mild surface etchants seemed without effect. No significant initial preferred orientation was detected in any specimen.

Axiality of loading was found to be of extreme importance, and the recording of a very clearly defined upper yield point was adopted as a criterion for axiality<sup>2</sup>. After unloading from within the mechanically determined elastic range, no residual strain of the type observed by Garrod<sup>3</sup> was detected. Pre-yield residual strain was confined entirely to specimens in which the initial loading was sufficiently eccentric to cause the suppression of the upper yield point.

In the large tensile specimens (0.1 in.  $\times$  0.5 in. cross-section) used in this investigation, the onset of plastic deformation was marked by the formation of a Lüder line, and yielding resulted in the creation of an inconsistent body strain with superimposed Heyn strains. This inconsistency, it is suggested, may be attributed to the heterogeneous plastic deformation within the confines of the Lüder line<sup>4</sup> and to the state of non-axial loading introduced by its presence, which results in a body or 'layer' strain peculiar to the geometry of the particular band of plastically deformed material. Residual strain was, at this stage, confined within the boundaries of the Lüder

