Members at Large—

Cyril Ainsworth, American Standards Association, New York, N. Y.
C. B. Auel, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.
J. I. Banash, Consulting Engineer, Chicago, Ill.
E. W. Beck, United States Rubber Products, Inc., New York, N. Y.
H. R. Bixler, Union Carbide and Carbon Corp., New York, N. Y. (Metropolitan Chapter)
E. W. Bullard, E. D. Bullard Co., San Francisco, Calif. (San Francisco Chapter)
H. F. Gilbert, American Cyanamid Co., Linden, N. J. (New Jersey Chapter)
Roy M. Goodwin, Philadelphia Electric Co., Philadelphia, Pa. (Philadelphia Chapter)
W. M. Graff, National Bureau of Casualty & Surety Underwriters, New York, N. Y.
H. J. Griffith, Jones & Laughlin Steel Corp., Pittsburgh, Pa. (Western Pennsylvania Safety Council Chapter)
R. McA. Keown, Industrial Commission of Wisconsin, Madison, Wis.
J. M. Kerrigan, United States Rubber Reclaiming Co., Inc., Buffalo, N. Y. (Niagara Frontier Chapter)
Everett F. King, Lever Brothers Co., Cambridge, Mass. (Boston Chapter)
Thomas E. Lightfoot, The Koppers Coal Co., Pittsburgh, Pa.
M. G. Lloyd, National Bureau of Standards, Washington, D. C.
H. L. Miner, E. I. du Pont de Nemours & Co., Wilmington, Del.
W. S. Paine, Aetna Casualty & Insurance Co., Hartford, Conn.
Geo. F. Prussing, Union Oil Company of California, Los Angeles, Calif.
C. E. Ralston, Pittsburgh Plate Glass Co., Pittsburgh, Pa.
A. S. Regula, Industrial Relations Counselors, Inc., New York, N. Y.
G. E. Sanford, General Electric Co., Schenectady, N. Y.
C. W. Smith, Standard Oil Co. (Ind.), Chicago, Ill.
H. S. Smith, Union Carbide and Carbon Corp., New York, N. Y.
R. C. Stratton, The Travelers Insurance Co., Hartford, Conn.
R. F. Thalner, Buick Motor Company, Flint, Mich.
S. E. Whiting, Liberty Mutual Insurance Co., Boston, Mass.
William P. Yant, Mine Safety Appliances Co., Pittsburgh, Pa.

WEDNESDAY NOON SESSION

October 7, 1936

The annual meeting of the ASSE-Engineering Section of the National Safety Council followed a luncheon and convened with C. W. Smith, Standard Oil Co. (Ind.), Chicago, general chairman, presiding. All reports had been mimeographed, and copies were distributed at the luncheon.

Dr. Francis F. Lucas, Member, Technical Staff, Bell Telephone Laboratories, New York City, and international authority on microscopy and photomicrography, spoke on "Late Developments in High Power and Ultra Violet Microscopy."

The report of the nominating committee was presented by A. S. Regula, chairman. Other members of the committee were S. E. Whiting, R. F. Thalner, C. B. Auel, and Dr. M. G. Lloyd. The committee's *list of officers, as elected, will be* found elsewhere in this sectional record.

Other sessions sponsored by the ASSE-Engineering Section included those on "Safety Belts," "Safety Training," "Exhaust Systems," "Safety Exchange Round Table," and "Occupational Diseases." Reports of these sessions will be found elsewhere in the Transactions.

Late Developments in High Power and Ultra Violet Microscopy —Their Value from an Accident Prevention Viewpoint for Detecting Flaws in Metal Structures

By DR. FRANCIS F. LUCAS

Member Technical Staff and Head of Microscopic Laboratories, Bell Telephone Laboratories, Inc., New York City

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Dr. Lucas used about 30 lantern slides and discussed each briefly. The high power and ultra-violet microscopes were first illustrated and described. Following this was a group of four slides showing the development of high power metallography. The first photograph showed a specimen of chrome iron (stainless iron) at 200 diameters magnification. The structure was so fine that at this magnification little could be seen. The next photograph, at 1000-X, began to show some structure. Ordinarily this would be regarded as a high power micrograph. Next the structure was shown at 4000-X with the best apochromatic system the world affords. The structure was then resolved to better advantage, but not fully. The final micrograph was of the same specimen but photographed with the new mono-brom-naphthalene immersion system of N. A. 1.60 and showed the structure completely resolved. Details of structure—minute carbides of iron and chromium—measuring about 150 atom diameters in size were very distinctly resolved.

Dr. Lucas showed how this high resolving power system could be applied to a study of fatigue cracks, which vary in width from about 150 atom diameters upward.

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Cracks in metal bring to mind fatigue phenomena as the cause. If one arrived at this possible conclusion, he would not be far wrong. I shall not be concerned particularly with methods of test, test data and the outward characteristic appearance of fatigue fractures. To review very briefly some of the ideas now commonly held on the subject by metallurgists and engineers may refresh the memory. It may be an aid to a better understanding of the new subject of internal stress raisers and their influence on the propagation and trend of fatigue cracks.

It is asserted by competent authorities that a very high percentage of metal failures occurring in service are of the type denoted as fatigue failures. All fast moving mechanisms whose loads are either intermittent or reversed cycles of stress may develop fatigue type failures.

Literally thousands of things in every day use, from a giant ocean liner to the hair spring of a delicate watch, may be subject to fatigue type failures.

The advent of the railroad seems to have been responsible for stimulating thought on the subject of the fatigue of metals under repeated stress. A German engineer prevailed upon Prussian State Railways to undertake such an investigation, and his results have become a classic. His repeated stress tests were reported in the London publication "Engineering" for 1871.

The fracture resulting from repeated stress is a brittle, jagged-appearing one, so that at first engineers and investigators concluded that the fibre of the metal underwent some change. Oftentimes the fractured surface appears bright and shining as though composed of large crystals. Observers of these fractures inferred that a change had occurred in the metal and from the appearance to the eye the theory seems to have developed that the metal had crystallized and hence had failed. No one seems to have advanced any good reason why a crystallized metal should be weaker and more susceptible to cracking than a non-crystalline one, assuming such existed. But at any rate the crystallization theory persisted, and it took almost two decades and much microscopy to dispel the delusion. Even today echoes of this old crystallization theory may be heard from engineers.

As a matter of fact, metals are inherently crystalline. The crystals at times may be large and equi-axed or they may