INDUSTRIAL HYGIENE*

INDUSTRIAL Hygiene (I.H.) has been defined as the art and science of safeguarding and preserving the health and well-being of industrial workers. These ends it seeks to achieve through, (*i*) recognition and evaluation of environmental causes that are likely to be source of illness or injury, (*ii*) improvement of work environments and (*iii*) enforcement of the established laws, rules and procedures relating to I.H. and safety. It, therefore, attempts to anticipate adverse environmental conditions and to device engineering control measures to prevent injury to life or limb and, eventually when possible, to eliminate related occupational hazards and diseases. I.H. constantly seeks to absorb beneficial techniques and practices as they emerge. To be effective it enlists intimate collaboration between Industrial Hygienist, Safety Engineer, responsible medical authority and other allied disciplines such as Physics, Chemistry, Biology, Psychiatry and Engineering.

Mankind owes a great debt of gratitude to the martyred orphaned-child-workers in the cotton mills and mines of U.K. in the 18th century. Child-labour was a plentiful commodity then. Their deplorable state and the unconscionable manner in which they were exploited inspired the earliest Factory Act of 1802 which became the harbinger of scores of Factory Acts in U.K. and hundreds throughout the world. Labour legislation in U.K. set the pace and was later emulated in Germany, France, America and elsewhere.

In U.S.A. factory inspection was first introduced in 1877 in the State of Massachusetts. The Federal Government adopted compensation laws for civil servants in 1908. New Jersey led the States in passing a similar law for industrial workers in 1911. The first important federal act to control an occupational disease, resulting from the use of phosphorus in the manufacture of matches, was passed in 1912 by the levy of a prohibitive tax. Wisconsin made occupational disease compensable in 1919 and now similar laws are in the Statutes of the majority of States. Because labour occupies a position of dignity and is well organised, and management is alert, there has been ample opportunity to study the adverse effects of occupational environments and to take corrective steps. Besides, the worker in the U.S.A. has come to expect and, in fact, demands a safe, healthful and relatively clean and stress-free work-place and will not accept a dirty or dangerous occupation. In recent years, for example, even the foundry industry has joined the march of progress by providing clean as well as healthy work environments. Public opinion and the stringent labour and compensatory laws would suffer few employers who might treat the workers as a commodity freely purchasable on the market. These factors, coupled with rapid strides in technology, informed management, and labour fully conscious of its rights, have all led to the now axiomatic proposition that a worker is an efficient producer *only* when his working environment is congenial, co-operative, secure and satisfying—in short, friendly. Besides, or perhaps precisely because of this recognition, substantial pioneer work has been done in the field of I.H., in a systematic and organised fashion. With the passage of the latest U.S. workmen's compensation laws the responsibility of traumatic injuries and occupational diseases has shifted from the individual worker to the industry.

The recency of the development of I.H. in U.S.A., in an organised manner, may be gleaned from a few salient facts. Even though the Division of I.H. and sanitation of the U.S. Public Health Service was organised in 1915, its activities were relatively minor and till 1936 were largely confined to research of a statistical and medical nature. Up to that year there were only 5 State departments of health and 3 State departments of labour, in the entire Union of 48 States. By 1946, 41 out of 48 States had organised State agencies to advance I.H. through the enforcement of control measures against pollution of air, contamination of water as a result of draining industrial wastes, nuisance of industrial noise and, finally, to insure enforcement of factory laws relating to light, heat, sanitation, safety and other protective measures. As a further check a number of States now prescribe thorough medical examination, both pre-employment and periodic, for workers to be engaged in potentially hazardous occupations.

In the U.S.S.R., during a little over forty years of its existence, the technological and scientific advance has been phenomenal. Their scientists and technicia

contributions to all fi

and now they have

mental and physical

and working condit

attention from the te

their government.

scientific studies o

are valid to this day as

ed to characterise the import-

alytical methods of investi-

nising as the new research

be, it took a long time, and

---

* *Industrial Hygiene and Toxicology*, Vol. I—General Principles. Edited by F. A. Patty, (Interscience, New York), 1958. Pp. xxviii + 830. Price $ 17.50.

of the means of promoting industrial health through such diverse, and yet related, research organisations as the Moscow Institute of Industrial Diseases, the Pavlov Institute, the Leningrad Institute of Safety, Hygiene and Technique, the State Scientific Institute of Labour Protection and the Moscow Central Institute of Nutrition. Thus U.S.S.R. attaches special importance to improved labour conditions in order to insure high morale and maximum efficiency for their planned productivity. I.H., therefore, constitutes a *raison d'etre* of all the Soviet enterprises.

It is against such a historical background that the significance of this book, *Industrial Hygiene and Toxicology* can be best appreciated. It is the first of the three volumes, and deals with the general principles. (Volume II : *Toxicology* and Vol. III : *Industrial Environmental Analysis*). It is an all American book. It contains 21 Chapters contributed by 18 specialists. This distinguished company of authors is drawn from the U.S. Public Health Service, Bureaus of Standards and Mines, noted Research and Educational Institutions and leading Industries. It contains a comprehensive and systematic treatment of industrial hazards and their causes and of their detection, prevention, control and elimination. The original edition appeared in 1948 and this, the second edition, in 1958. During the decade phenomenal advances have been made in pure and applied sciences. Because of the development of nuclear power and the growing application of isotopes, technology has taken a dramatic leap. The position of industrial worker has potentially become more difficult and dangerous. The recognition, evaluation and control of *ionizing radiation* exposures and the inhalation of radioactive gases have aroused unprecedented concern for all organic life. Thorough mastery of these and other hazardous contaminants has therefore become an imperative to protect life. At long last, Human Engineering and I.H. which had so long and so greatly merited attention, have received up-to-date treatment in this new edition. This composite work is an eloquent expression of an integrated approach and team-spirit to achieve a common objective.

The volume is edited by Frank A. Patty, Director of I.H. Department of the General Motors Corporation. He draws from his rich experience to contribute five chapters, namely, I.H. Prospect and Retrospect, Methodology of I.H. Surveys, Action of Toxic Materials, Atmospheric Contaminants, Respirators and Respiratory Protection Devices.

The chapter on Human Engineering and Industrial Safety, written by Ross A. McFarland, Director of the Health and Safety Centre, School of Public Health at Harvard, carries the hallmark of critical comprehension and lucid exposition. He considers as indispensable the utilisation of basic data on the range of the motion of head, upper arm, forearm, hand, thigh, lower leg and foot and the forces applicable in different body positions, for control design. He elaborates on the application of anthropometric and statistical data for arriving at proper human sizings for the purposes of design. He considers instruments and controls as extensions of the nervous system and body appendages of the operators. Therefore, he advocates the designing of equipment and working areas in keeping with human capabilities and limitations and consistent with the anatomical, physiological and psychological characteristics of the operators.

The chapter on Pulmonary Dust Diseases deals with classification and properties of dust, the anatomical and physiological factors of importance in injury, and pulmonary fibrosis. Periodic check of workers is recommended since no other technique is available to prevent dust diseases. The chapter on Occupational Dermatoses covers most occupational diseases.

Of particular and timely interest to industries is the chapter on Radiant Energy. It discusses the different concepts of injury caused by radiation, penetrating ionizing radiation and protection from Gamma and X-rays, infra-red radiation, corpuscular radiation (Alpha and Beta Particles, Protons and Neutrons) and poisoning from Radioisotopes.

The chapter on Industrial Noise and the Conservation of hearing covers, in considerable detail, the fundamentals of noise and its transmission, the ear and the measurement of hearing and, finally, noise control. A valuable and concise chapter on Lighting for Seeing is contributed by two authorities from the Lamp Division, of the G. E. Co. at Cleveland. In a table they furnish an authoritative and specific recommended values of illumination for different types of work and work areas.

Air pollution is the most serious health and economic problem in modern industrial communities. There is no way of determining the cost in human life, disease and unhappiness due to this cause. As for material losses, for instance, the U.S. Geological Survey places its damage to merchandise and buildings in that country at 500 million dollars, annually. (Just a glimpse of relevant history : in the U.K. the first smoke abatement law was passed by Edward I in 1273 to protect the people's health from pollutents. As early as 1306, by Royal

Proclamation, the burning of coal was prohibited in London. An owner of industry disobeyed the proclamation, was tried, found guilty and beheaded. In early February 1959, heavy smog persisted in London for five days, caused widespread infection and unprecedented crowding of hospitals, and took an unusual toll of life and affected the health of a large percentage of Londoners. The irony of the situation is that even though coal, gas and electricity are nationalised and are administered by the same Minister, co-ordination of industries and control of smoke appears difficult since the maze of chimneys over the London houses continue to smoke, unabated. The chapter on Air Pollution traces its history through advancing industrialization and urbanisation.

Because of the adverse effects of heat on comfort, safety and health of workers and, consequently, on production, heat and allied controls have merited four chapters. They are : Air Cleaning, Air Conditioning, Ventilation and Heat Control in the Hot Industries. All these chapters are of very special interest to us in India where, for a major part of the year, the temperature and humidity ranges lie in the physiologically harmful zone. Medical authorities tell us that in this zone increasing degree of psycho-physiological disturbances are noted as the level of stress rises with heat and humidity. In such a situation human organs exert their automatic controls. A substantial part of the outgoing blood from the heart is diverted, *for cooling purposes, to all the extremities* of the body. Naturally, that results in a deficiency of supply to the brain thereby affecting its work of discrimination, integration and precision in movement, with consequent sluggishness, errors and accidents. The high correlation between accident rates and high temperatures is attributed to this factor. Therefore, the author concludes, that the advantages of air-conditioning should be seriously considered for all industrial operations carried out for any length of time, under conditions of high temperature.

This composite volume is logically conceived, psychologically developed and is handsomely got up. It makes excellent use of graphic materials to supplement the clarity of the written word. It carries a good index. Most chapters include tables furnishing vital information—both factual and technical. For the benefit of those who desire to pursue a subject in greater detail, each chapter furnishes relevant references. The inclusion of a section recounting the activities and contributions of ILO and WHO in this volume would have been pertinent and welcome. However, it is a valuable reference and should be at the elbow of every industrial hygienist, safety, sanitation and production engineer, and alert industrial manager. It is a must reference for the libraries of Engineering Colleges and Industries.

A word about the *prospects of utilising* the I.H. techniques in India. The absence, alleged or real, of the concern of health, safety, well-being and desirable working environment in a factory where the worker spends nearly 25% or more of his weekly time, can prove a *corroding factor to productivity*. This problem is particularly aggravated *in our country by the climatic conditions—high temperature* and abnormal humidity—for *nearly 7 to 8 months in the year*. Obviously, for lack of resources, we cannot possibly apply, immediately, the techniques of the I.H., so widely practiced in U.S.A. and so well elaborated *in the volume* under discussion, to our existing or developing industries. We can, however, provide in our long-range plans for the manufacture of basic air-conditioning equipment with the view of air-conditioning our industries *as and when* we become self-reliant. *Till such time it is suggested that such industries*, as are running only one or two shifts and provide quarters to their workers in the factory neighbourhood, avoid work during the hottest part of the day. This could be achieved, conveniently, by bifurcating the day shift into a morning and an evening period. Where a second shift is essential, a night shift could be introduced. A lead in these directions could be given *in a selected few of our new nationalised industries. The fertilizer-cum-heavy-water* industrial unit at Naya Nangal incorporates the latest in technology. Since it will be operated by hydroelectric power, it will provide the cleanest industrial area in India. Naturally it will also offer the best opportunity for an extensive I.H. programme and could, therefore, be used as a *model for emulation*. In our new steel plants at Bhilai, Durgapur and Rourkela, the best known I.H. techniques have *probably been incorporated* in their respective designs by the Russians, British and West Germans, to insure effective control of contaminants and to safeguard and preserve the health of the workers. These three large enterprises will provide comparable clinical data which could be studied with advantage for essential application or adaptability to other industries throughout our land.

BHOLA D. PANTH.