Accidents and their Prevention

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ACCORDING to the dictionary the word 'accident' means 'a mishap', 'an unexpected event proceeding from an unknown cause', 'a chance event', 'event without apparent cause', 'unexpected act,' 'unintentional act', etc. If we accept any of these connotations it would not only make an objective approach to the problem of accidents impossible but render us indifferent to preventive measures that may have to be adopted to ward them off. Such an attitude betrays a lack of elementary scientific training of the mind; what is still worse, it reveals lamentable ignorance of the etiology of accidents. No doubt, accidents cannot be often studied under strictly prescribed laboratory conditions ; neither is it conceivable to bring the conditions of causation of each and every accident under control so much so that a particular accident can be repeated, as is possible in the case of some physical phenomena in the domain of Physics, Chemistry, and such other basic sciences. But that should not be considered as a sufficient evidence to prove that the problem of accident causation is beyond the purview of scientific investigation. The correct method of dealing with such phenomena would be to find out the limitations under which they are to be investigated and proceeded with. Unfortunately the subject did not receive adequate consideration till psychologists recently brought their heads together for a scientific study of this problem and suggested possible remedial measures. Soon after the beginning of the present century, some scientists, mostly psychologists, refused to be guided by the popular meaning of the word and started studying carefully the so-called unexpected event, accident, and tracing all relevant facts about its causation. After years of fruitful research these investigators discovered many pertinent facts concerning what was heretofore considered as more or less a gift of chance and they thus paved the way for future workers in this field. The facts they discovered have since been recognised as the fundamental facts about accident causation. Once the diagnosis was correctly made it did not take the investigators long to suggest proper preventive and curative measures. The real difficulty lay in the task of successfully analysing the so-called elusive event, accident and once that was done prevention followed as a matter of course.

It may not be out of place to mention here that theoretically speaking even such an abstract factor as 'chance' has not been left out of scientific study and analysis on the ground that it is apparently unanalysable or uncontrollable or beyond the scope of laboratory experimentation. On the other hand, mathematics has adequately solved the problem by logically analysing the so-called chance and its effects on matter and mind. It has also formulated some well defined laws governing the apparently fortuitous behaviour of chance. We shall discuss in the course of this article the findings, including the recent ones, of the investigators in this field and examine the problem of accident prevention in the light of their discoveries and recommendations.

Problem Stated.—For a scientific study of the problem of accident causation it is important to keep in mind the two types of accidents usually met with in nature :

(1) The first type relates to street accidents, i.e., those caused by motor, tram, train, etc., and are taken to be the inevitable consequences of the march of civilization. Within this class are included by far the largest number of accidents occurring in any modern city or town and also cases arising out of a sudden fall, sudden collapse of a building, or, as happened recently in

Bombay, and still more recently in the port of Chicago in U.S.A., sudden severe explosion accompanied by monstrous fire. Such accidents receive little attention of people except some lip sympathy because, by circumstances and by accident, they are made helpless witnesses of such tragic happenings. In this connection it would be somewhat interesting to note the legal view of the problem. Almost everyday in the morning on opening the daily newspaper we find some inquest reports of the city coroner on the body of one or more accident victims. These reports, almost in all cases, are expressed in a traditional form, namely, that an inquest was held on the body of such and such a person and that the death was found to have been due to accidental causes. In such investigations, what receives more attention is the apparent cause of the death rather than the circumstances which brought it about ; and therefore these people do not pursue the matter any further, little imagining that their analysis is not very sound. This unscientific attitude is somewhat responsible for allaying peoples' curiosity in the matter. Most people seem to believe that such reports are final and that no useful purpose would be served by further dragging the matter. The death, according to them, brings to a close the whole event. Speaking from one's sentiments there may be some sort of justification for such an attitude; but looking at the problem in its proper perspective such attitudes cannot be defended and they are highly detrimental to the progress of science. A scientist can never be satisfied with such meagre description of the cause and effect. A concrete illustration will bring home the point at issue. Supposing at one time some eight people crossed successfully the Hornby Road at the point opposite the V. T. station clock tower, while the ninth pedestrian met with an accident, though all of them crossed under the same objective circumstances, in the face of some external dangers. Why is it that only the ninth person met with accident while the remaining eight, though threatened with presumably the same danger from outside, were able to cross and go to the other side ? Or let us again consider the cases of accidents which are of late occurring in the suburban section of the B. B. & C. I. and *G*. I. P. railways in Bombay due to what has since been found to be overcrowding in the local trains. Those who have recently taken a trip in any of these suburban trains know how many people usually travel on the foot-boards clinging to the iron bars at the doorways to the absolute discomfort of other passengers. But contrary to our expectation not all the persons travelling in that way at a particular moment drop down ; and not from all the doorways. Only one or two such persons out of the lot have been found to slip off and fall down, meeting with severe injuries which usually prove fatal.

Instances of this sort can be multiplied without in any way improving the prospect of finding a way out of such situations. How can we account for such strange happenings? The usual explanations offered in such cases take one of the following forms:—the unfortunate man, of the first example, was absent-minded ; he was probably having a sensory defect and so could not see or hear the obvious danger signal; he was careless; he was slow in his strides and movements, etc. Some people who seem to be wiser refuse *to* offer any plausible explanation whatsoever since, according to them, the word itself is self-explanatory. If there can at all be any reasonable cause for it, why should the occurrence be called an accident? Yet there is another type of explanation which is even more ingenious than others of the kind and can only be regarded as a fertile product of imagination. This type of explanation virtually rings down the curtain over the incident by suggesting that the man was destined to meet with that accident, or that it was long before written on his forehead that on such and such a date and at a specified time the man in question would meet

with an accident of the sort he has actually suffered. The conjectures do not seem to stop there but take us a step further by suggesting that nothing could have been done by way of preventing what was more or less pre-ordained and therefore inevitable. According to the advocates of this view some superhuman power arranges such events for some of us occasionally and it would be almost sinful on our part to try to undo what is written there, meaning the forehead region. Such sterile explanations do not lead us anywhere; nor do the attitudes revealed therein suggest any fresh clue to a scientific explanation of accidents. While appreciating the originality of these explanations one cannot but be surprised to find the amount of fantastic element unnecessarily, and perhaps unknowingly too, introduced into the concept and for which there can be very little justification.

(2) The second type of accidents refers to those that occur in industries and industrial concerns and are denoted by the name 'Industrial Accidents'. In this group of accidents the external causes, besides being somewhat limited in number and unlike those discussed under (1) above, are more or less well-defined so far as their applicability in a particular situation is concerned. Industrial accidents may be generally said to result from three sources : firstly from lack of adequate safegards about the machines (the nature of these safeguards has been discussed in detail under 'Preventive Measures' below); secondly from a large number of external factors, such as, bad ventilation, bad illumination, unusual atmospheric temperature, etc., over which the worker has practically no control; and thirdly from those factors that are to be found in the worker himself, i.e., the individual factors as a direct consequence to the existence of individual differences which have their origin in the constitution of the germ plasm of the human organism. The last source is the most important from psychological view point since here we find certain peculiarities and characteristics of human beings, the existence of which in individual cases predisposes the organism to accidents or tends to make him 'accident prone'—a term generally used by industrial psychologists to describe such people. That some of the causes in an accident situation are inherent in the very nature of the tasks or instruments and tools handled by the workers needs no elaboration; that certain tasks, more than others, involve risk and danger to the individuals can also be readily conceded to; but what is really difficult to comprehend in the absence of the 'human factor hypothesis' is that even after a careful elimination of all possible external sources of danger that might theoretically follow, cases of accidents though not to the extent and rate obtaining before still occur. To an untrained eye the human factor or personal element involved in an accident may not be quite apparent but one cannot go a long way in the study of accident causation and ignore these. Merely pointing out that a particular work involved risk and danger, or that certain working conditions induce accidents or increase the incidence rate is to say the least about them.

Psychologists came into the field when the whole atmosphere relating to accident causation was practically saturated with such beliefs and superstitions. They had, therefore, to break considerable new ground before they could treat the problem scientifically. Carelessness which has much to recommend it as a plausible explanation, and which even now is held in certain quarters as one of the main causes of accidents, was found to be no better than a smoke screen interfering with the progres of the scientific study of the problem. The psychologists next examined the claim of 'chance hypothesis' to explain the accident cases, but concluded that it cannot be regarded either adequate or appropriate; since the distribution curves of accident rates do not possess all the important characteristics of the well known 'Gussian

Curve'. Leaving aside its mathematical connotation of possibility or probability, the word 'chance' stands for some given unknown or unanalysed forces. Even in so called typical chance experiments, e.g., throwing of the dice or coins, it has been shown that the faces or sides lying upward in a particular throw are the result of the various complex forces acting upon them. However, from the mass of materials available in the form of popular explanations which have been offered from time to time in this field to cover up new cases of accidents occurring frequently as a sequel to the changed transport and other conditions, as well as from the results of their further enquiry into the phenomenon, these investigators discerned that there is a personal element in all these occurrences, and the amount of that element varied from individual to individual and also in the same individual for the different periods of time and life. They further contended that the objective situation also not infrequently determines the amount and quality of this personal element to be called into play in a particular setting. This is a significant discovery leading up as it did to a further study and understanding of the problem in different settings. Little did the people who naively offered some make-believe explanations of accident causation know that some day these very explanations would be construed to mean such things as human factor, personal element, etc. There is no hesitation in admitting that the germ of future scientific solution of the problem lay in those explanations ; for it has now been conclusively proved that a human element—however apparently insignificant—can almost always be traced in practically all cases of accidents and the two illustrations cited in (1) above are no doubt cases in point.

Industrial Accidents.—The so-called objective causes and prevention (if possible) of industrial accidents formed a subject of considerable interest and attention even in earlier days, but the scientific study of the problem in its many settings was begun only in the beginning of the present century. The problem at first was tackled, though not to one's absolute satisfaction, by those who were closely connected with industrial organisations and national welfare of a country. The search for appropriate measures to prevent accidents was begun when responsible persons realised that industries in general have a direct bearing and influence on the economic condition of the worker and his family. But their efforts, without bringing about the much needed orientation in the general outlook, were confined in most cases to the finding of some rough and ready, easy and cheap method for the prevention of accidents. Cases are not infrequent where the accident met by a particular man has resulted in the ultimate economic ruin of his whole family by bringing untimely death and destitution to his dependants. There are instances of a more pathetic nature; and it may be said without any hesitation that the ultimate responsibility for such upsetting of the economic and social structures automatically falls on the employers who do not perhaps adequately realize the consequences of their indifference in the matter. Hence it is but natural that such people would be genuinely interested in the successful solution of the problem. Happily for the workers the entire outlook has in recent years been considerably changed and the pendulum of popular opinion has swung too far in their favour. Industrialists and employers of industrial concerns need no longer be told that nothing but good will come out of a movement for the control and prevention of accidents. But the seriousness of the problem, which in almost all countries has been sought to be solved, if not wholly at least partially, by counteracting the evil effects of accidents with compensatory laws, is not always correctly appraised. These compensatory laws, a brief description of which will be given later have been enacted and enforced by the State or the Government of the land as a part of

their duty in the matter.

Apart from the fact that an almost criminal loss of human life and material results from such accidents which cannot be compensated even with the best of laws enacted for the purpose, the loss sustained by the members of the victim's family as well as the loss to the industry and State amounts, in terms of money, to a colossal sum. An approximate idea of this loss may be had from the following roughly estimated figures available :—the number of accidents reported to the Home Office in Great Britain, in 1929, was 161,269—the corresponding figure for the previous year being 154,319 (Annual Report of the Chief Inspector of Factories and Workshops for the year 1929—H. M. Stationery Office). According to a report of the National Safety Council (Accident Facts, National Safety Council, Chicago, 1931, p. 5), approximately 99,000 people were killed by accidents in the United States during 1930. This number represented a death rate from accidents alone of 80'4 per 100,000 population. In 1929, it was revealed that in the United States the accident rate was second in rank in a list of leading causes of death among men, and eighth in rank in a similar list prepared for women. Thus in these cases accidents got a prominent place in Vital Statistics by considerably increasing the corresponding mortality ratio. One common feature in these figures is that the incidence rate is much higher among men than women, which is as it should be, since in usual peace time the number of men employed in different industries is considerably higher than the percentage of women. Such difference in the incidence rate of accidents among the two sexes prevails in almost every country.

The figures cited above are all in terms of human lives but to further estimate them in existing exchange values, to arrive at a reasonable cost debitable to the exchequer, is a difficult task; and the calculations of such costs are further complicated by the existence of various costs other than the direct ones, such as payment for adequate medical treatment and insurance, expense of selecting and training new men to take the place of those who have suffered accidents, cost of maintaining safety and welfare departments which function with the object of preventing accidents and caring for the injured employees and their families. Coupled with these, of course, is a possible lowering of the output which adds further to the cost of production. However the total of all such costs and charges, computed roughly as they are, has been found, as reported by Heinrich, to be well over $5,000,000,000 in the United States for one calendar year. Corresponding costs for other countries when computed on the above basis would no doubt reveal similar staggering figures.

Huge as these figures are, it must be remembered that they refer only to accidents of sufficient gravity to make them reportable to the proper quarter according to the terms of the existing laws in this field. In the absence of such laws it is doubtful if the subject would ever have received any serious attention whatsoever. Even then cases are traceable where the employer has successfully evaded the vigilance of the relevant laws by his tact and cleverness, thereby earning the appreciation of the management who would otherwise have had to pay some compensation. Apart from such cases the factory administration reports do not take account of a type of accidents, the number of which is in all probability still larger, but which are not sufficiently severe in nature from the legal point of view but which nevertheless cause untold suffering to the worker concerned and his family, as also much waste of work-time for the management. One investigator in this field reports that the non-notifiable accidents, meaning thereby those that are of a less severe nature, are as much as 30 per cent more than the notifiable ones. According to this same authority, to arrive at a reasonably depend-

able estimate of the total number of accidents caused in a particular industry, it is necessary to multiply the reported figure by anything between 10 and 50, the actual figure in a particular case being dependant upon the nature of the trade in question, since the ratio between notifiable and non-notifiable accidents has always been found to vary in different trades and occupations. It may thus be concluded that the number of minor accidents in any industry is also enormous and that such accidents, almost in all cases, entail severe suffering and cause temporary decline in the output and efficiency of the worker.

In India it is somewhat surprising to note that regular statistics about the incidence rate of accidents in different industries in various localities were not available until recently. Even the bitterest critics would doubtless agree that statistics, when timely computed and published—whatever may be the intrinsic value of the figure it sums up—facilitates enormously further discussion on a subject, and leads to the formulation of ideas and policies and measures that might be necessary to counter-effect certain tendencies manifest in the tabulated data. But the authorities here have so far failed in their duties in this matter. The Annual Report of the working of the Indian Factories Act in India during the year 1942, has been available to the public toward the second half of the current year, 1944, i.e., after more than one year and a half, which is rather amazing. Whatever might be the cause for this inordinate delay, one cannot fail to observe that such publications defeat the very purpose for which they are meant and tend to bring down the importance of these reports to a ridiculously low level. Dereliction of duties like this cannot be defended during any period of time much less in war time when a vast labour force has been employed to cope with the ever increasing demands on the different industries of the country. So far as the forms of these reports are concerned it may be pointed out that the figures sampled therein should be computed on an all-India basis and for different industries so as to facilitate the task of comparison of the results. The reliability of such figures, however, as a sort of dependable index for calculating the total number of accidents, shall be more or less limited, as will appear from a perusal of what has been said in an earlier section. The following are the chief findings of the report so far as it relates to industrial accidents:—

"Increased employment of workers, longer working hours, and employment of semitrained and sometimes untrained personnel, are some of the factors responsible for an increase in the total number of accidents in factories in British India from 48,736 in 1941 to 54,174 in 1942. The fatal and serious accidents increased respectively from 271 to 323 and from 8,374 to 9,111, and the average per 100,000 operatives was 2,374 as against 2,260 during the previous year".

Methods of Prevention.—The suggestion about appropriate measure or measures, that can be adopted with advantage for the prevention of accidents of a particular type natuarlly pre-supposes a successful analysis of the internal and external situations which give rise to accidents; and it is this part of the task which earlier investigators could not solve. The position here is analogous to that of the general practitioners in medicine. A physician, for instance, is required to prescribe remedies for his patients' ailments for which he has quite a large number of measures at his disposal. In any particular case he may prescribe one or more of these measures according to the need. But a suitable prescription is always preceded by a correct diagnosis. This diagnosis forms an integral part of the treatment which he may subsequently adopt and almost always involves a very careful consideration of the nature of the disease or ailment and the possible cause thereof. After he has successfully determined these

two things he would apply his mind and energies to finding out a suitable and most effective remedy for the purpose. Thus the success of a physician in his treatment is very much conditioned by the reliability and validity of his diagnosis. Similarly in the case of accident prevention, it is the cause of the accident that has to be properly and carefully analysed before arriving at any specific remedy. Only when a clear and objective picture of the occurrence has been obtained can effective recommendations to prevent a recurrence of such conditions be made.

So far there are two different approaches to the problem of finding out suitable remedial measures. One of these concerns itself with the study of accidents with reference to external factors influencing persons in general, irrespective of their personal qualities and traits ; and the remedial measures according to it imply, in some cases at least, voluntary or conscious control of such extraneous factors and conditions by the individuals themselves. The practical application of the foregoing principle has taken the form of enforcement of certain regulations or adoption of some safety devices, or both, the precise nature of these having to be determined carefully according to the needs of the situation. In the second approach accidents are studied to find out how far they are affected by factors affecting the same group of individuals differently though these individuals are presumably subjected to the same physical environment at the time of the accident. The remedies according to this view are based on the principle that they lie virtually outside the domain of activities usually regarded as consciously or voluntarily controllable by human organisms. This lime of approach has resulted in more success as it has finally led to the formulation of the now famous 'Human Factor Hypothesis' in the explanation of accident causation. The techniques and measures that are followed according to it, have been carefully evolved and scientifically proved by the psychologists during the second quarter of the present century. The first approach failed to discover this important human factor in the accident causation and as a result, the remedies suggested by it have more or less proved to be of limited value and application as will be evident from the following section.

In accordance with the first method of tackling with the problem the remedies are embodied in the factory regulations. Almost every civilized State has laid down certain statutory requirements with regard to its industries for the purpose of protecting the lives of its workers. These requirements have since been called Factory Acts and Regulations and generally include among others, The Workmen's Compensation Act and Rules, The Industrial Disputes Acts and Rules, The Payment of Wages Act and Rules, The Maternity Benefit Act and Rules, etc. Though these regulations individually fall much short of the actual needs in the matter, they have on the whole really reduced the number of Industrial accidents by compelling the employers, amongst other things, to conform to some set standards for the working of the different plants and machineries so as to ensure adequate safety to the lives of the workers. Little doubt is entertained now-a-days about the efficacy of such rules and regulations ; and if the measures are strictly enforced they would be able to reduce the workers' liability to accidents in general to the level of an absolute minimum. The provisions under these laws and regulations have been found to differ somewhat in different countries; but this can be explained as due to the conditions of work and industry being not identical in all places. Furthermore these laws enacted, as they must be, during a certain period of a country's industrial development may not be considered adequate or even appropriate at a later stage because of the widely changed industrial atmosphere that might be prevailing afterwards. Hence arises the necessity of periodically re*