MINOR INJURIES TO THE EYE IN INDUSTRY.*

BY

BERNARD CRIDLAND, F.R.C.S.ED., D.O.Oxon.,
SENIOR HONORARY SURGEON, WOLVERHAMPTON AND MIDLAND
COUNTIES EYE HOSPITAL.

EYE injuries in industry have received from time to time a good deal of attention, but it has been mainly towards the major ones involving loss of one or both eyes that interest has been chiefly directed. This is as it should be, for industrial eye injuries are by no means the least important cause of blindness. Thus in the report of the Departmental Committee on the Causes and Prevention of Blindness it is stated that 10 per cent. of the blindness in three of the largest cities in the country was due to accident; sixteen other causes were mentioned, but only three of these were responsible for a higher percentage, and only one of the three (ophthalmia neonatorum) to any appreciable extent. Moreover, from various reasons the figure 10 per cent. is, I think, rather lower than it should be.

Again, in the report of the Departmental Committee on the Welfare of the Blind, published in 1917, Professor Collis states that 5 per cent. of all accidents reported by certifying surgeons—that is, all accidents in industry—for the years 1907 to 1914 were eye accidents, and that of these at least 2.5 per cent. resulted in the loss of one or both eyes. In the departmental report of the Scottish Register of the Blind 7.2 per cent. are stated to be due to occupation.

And next, if we turn to American statistics, which cannot be far different from our own, we find that accident is responsible for 13.5 per cent. of all blindness in the United States. Furthermore, out of 250,000 eye accidents which occur annually in the United States, there was loss of, or serious impairment of, vision in one eye in 3,100 cases, whilst there are no fewer than a hundred cases of total blindness in industry every year in that country.

A very full survey of eye accidents in industry was made some years ago by the Departmental Committee appointed by the Ministry of Health to investigate the causes and prevention of blindness generally. The report was published in 1922, and you are no doubt familiar with the excellent recommendations which were made with regard to prevention. The statistics made use of by the committee were based wholly upon major accidents—that is, cases which had required admission to hospital and were in receipt of compensation—but no reference was made to the minor injuries beyond the remark in one paragraph that "there are also many minor eye accidents causing absence of less than seven days and which are not reported."

It is to these minor injuries that I wish especially to draw attention, for, so far as I am aware up to the present time, there is little information as to their economic effect in industry—as to what they mean both to employer and to employed, as to how far they are worth preventing, and, if so, what more can be done in the way of prevention. No doubt some attempts have been made, but that much still remains to be done will at once be acknowledged by all surgeons of eye hospitals and departments, especially those situated in industrial areas, where a good proportion of all the cases seen are accident cases of major or minor type.

In my own hospital of fifty beds 6,880 accidents were dealt with in 1928, as compared with 6,040 other new cases due to disease or requiring refraction—a proportion of 53 per cent. In the past twenty years there has been an increase in this proportion from 39 per cent. in 1909 to the 53 per cent. already mentioned for 1928. The vast majority of these accidents are of course minor ones, and it is fortunate that only a very small proportion involve the loss of one or both eyes. I find that the giant magnet was only used in twelve cases in 1928.

Recently the Council of British Ophthalmologists appointed a subcommittee to ascertain what effect had been given to the recommendations of the Departmental

Committee on the Causes and Prevention of Blindness in its report of 1922. In the course of its investigation the subcommittee thought that it would be of value to obtain accurate reports of minor eye injuries, involving less disablement than a week, from the casualty and out-patient records of hospitals situated in representative industrial areas. Accordingly a special case-card was designed in which the following essentials could be recorded—namely, the occurrence of the accident, its effect as regards time lost and injury (permanent or otherwise) sustained, and any details as to the adoption of prevention. These case-cards were distributed, and information on 426 cases was obtained from four surgeons—namely, Mr. J. Jameson Evans of Birmingham, Mr. A. J. Ballantyne of Glasgow, Mr. R. J. Coulter of Newport, and myself. The number obtained was not a large one, but the investigation was in the nature of a trial trip, and it was intended that if useful information was revealed the matter would be pursued further on similar lines. I am indebted to the Council of British Ophthalmologists for permission to bring forward the details of a review of this work, which are as follows.

Taking the cases first of all from the point of view of occupation, it was possible to divide them into three main groups:

A. Regular or occasional workers at grindstones or emery wheels, involving exposure to small flying particles	51%
B. Occupations involving exposure to chips of metal	26%
C. Miscellaneous	23%

In Group A the risk of serious injury is small, the lesion almost always being a foreign body on the cornea. In Group B the risk of serious injury is greater. Group C includes a variety of occupations—from miners, road workers, painters, and plasterers, to general labourers. The injury is usually an odd one—from a simple foreign body on the cornea, a burn or contusion, to lime in the eye.

Types of Injury.

	Per cent.
Foreign bodies on the cornea	90
Abrasions of the cornea	5
Miscellaneous (burns of lids, wounds of the conjunctiva, contusions of the globe)	5

Information as to Protection (406 Cases).

	Per cent.
A. Protection not used	70
B. Protection admitted available but not used	19
C. Protection made use of (chiefly goggles, otherwise machine guards)	11

Time Lost from Work owing to the Accident (three Groups).

	Cases.
A. Those who lost from 1 to 2 hours (comprising all where it is presumed the workman was able to return to work at once)	371
B. Those who lost from 2 to 8 hours	48
C. Those who lost from 8 to 24 hours	7

At a rough average estimate the time lost from work is 992 hours, or 124 working days of eight hours each, due to 426 cases of minor eye injuries—that is, seven minor eye injuries mean the loss of two days of eight hours each. This is undoubtedly a low estimate, as, from information received through welfare supervisors, many men do not return to work that day, whilst those who do frequently waste much more than two hours.

Other factors which must also be considered as causing loss of time are the covering with pad and bandage of the injured eye, which is done in many hospitals, and which, even if the man returns at once to his work, proves a great handicap. As a rule, however, a bandaged eye means no work for that day. The instillation of atropine, which is sometimes thought necessary, acts in a similar manner, and is a handicap for days, even though the eye is uncovered. And, again, a man is frequently told to attend the hospital the next day for observation.

These are factors which add materially to the loss of time away from work and which have not been taken into account in computing the foregoing figures. It would, in fact, seem a fair and reasonable estimate to say that every three minor eye injuries mean one whole day's loss

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of output. In a small percentage of cases no working time is lost, as the man struggles on with his work until closing time, attends the hospital, and recovers by the next day, to return at the usual time.

The following table shows the time which elapsed between the occurrence of the accident and the attendance at the hospital (information obtained in 234 cases).

A. Cases which attended at once	5
B. Cases which attended after 1 to 12 hours	119
C. Cases which attended after 12 to 24 hours	65
D. Cases which attended after 2 to 6 days	45

The average time which elapsed between the accident and the attendance at the hospital was sixteen hours per person. These figures are of value from the point of view of the increased liability to infection owing to delay.

Some information was also obtained from the records of a firm employing 975 hands (males 675, females 300), taken over a period of nine months. Of these, 98 cases of minor eye injuries were reported at the well-equipped first-aid station, 85 of which were dealt with by the nurse, the remaining 13 being sent to the Wolverhampton Eye Infirmary. Of these 13 cases, the amount of time lost from work averaged about two and a half hours each in 12 cases; the thirteenth, more serious, lost about twenty hours (or two and a half working days). The total loss of time due to the 13 cases of minor eye injury amounted to fifty-eight and a half hours—nearly one and a third working weeks. The injuries comprised in these 98 cases were:

Foreign bodies	48
Dust or sand in the eye	27
Blows with chips of metal	14
Burns with hot metal or acid	9
	98

The monthly incidence of the cases was as follows: January 10, February 7, March 9, April 14, May 12, June 11, July 8, August 12, September 15. The monthly incidence was taken in order to see the effect of hot weather, meaning fatigue. Apparently the figures show nothing in this respect from which to draw any conclusion. This is in contradistinction to the finding of Lafon of Périgueux, who in 1911 made elaborate statistics of 2,816 cases of foreign body on the cornea incurred in various industries, which presented themselves at the Bordeaux Clinic between 1896 and 1906. His conclusions were as follows:

1. The number of cases increases with the hours of work, the maximum being reached at the end of the day. The increase is proportional to the development of fatigue.
2. The number increases towards the end of the week in proportion after the Sunday rest.
3. The number increases with the elevation of the temperature, which diminishes the resistance to fatigue.
4. The number is inversely proportional to the age of the patients—the younger the worker the more easily is he fatigued and the greater the incidence.

Thus fatigue, both mental and physical, is the explanation of the variations shown by the statistics, and he suggests that, besides suitable protection, some rest, especially in the hot months, should be allowed.

These observations, though based on a comparatively small number of cases, are sufficient to show that from the economic point of view minor eye injuries are of considerable importance. Further, it must be remembered that from sepsis any minor injury may become a major one—as, for example, when a pneumococcal ulcer of the cornea follows an abrasion incurred in coal mining or the heavy iron trades.

As has already been shown, the large majority of minor eye injuries are caused by flying particles, and it naturally follows that there are two ways in which the prevention of such injuries can be achieved: (1) to ensure that the flying particle does not reach the eye, and (2) better still, to eliminate the flying particle altogether. It is on these two essentials that the three main principles of prevention are based. They are, as follows: (1) mechanical guarding; (2) education of workmen and foremen; (3) engineering revision.

1. Mechanical Guarding.

Mechanical guarding is the interposition of a guard between the eye and the flying particle. It comprises various forms of goggles, machine-guards, and shields, face-masks, and helmets or hoods, according to the area of the head and neck it is desired to protect. For the protection of the eyes themselves it is a question of goggles and shields, either held in the hand or fixed to the machine. Goggles, if of the right kind and properly worn and kept in order, form 100 per cent. protection, as against 90 per cent. offered by shields; but, on the other hand, it must be borne in mind that the goggle at its best is a handicap to output of work, and that the shield is more likely to be in its place than the goggle. If an ideal pair of goggles could be produced and put on the market at a reasonable price it should not be so difficult a matter to induce men to adopt the fashion of wearing them. The words "adopt the fashion" are purposely used, for fashion is the prelude to custom. The chief difficulty lies in producing the ideal goggles. Such might be visualized as being an instrument a man could wear all his working day, hardly realizing that he was doing so, and at the same time without impeding his output in any way.

Out of the many models that have been devised one of the most acceptable, referred to by the Chief Inspector of Factories and Workshops in his report for 1927, has been adopted by the Shipbuilding and Engineering Trades Mutual Assurance Association. No doubt many present are familiar with this model, which consists of a strong frame with flexible ear-catches containing lenses of fair size made of toughened glass. There are no side flanges, and ventilation can take place freely, so that the lens surfaces are not dimmed by moisture. Messrs. Hamblin's Limited have produced a model on these lines fitted either with toughened glass or "splintanil," a material which on receiving a sharp blow behaves in the manner usual to all types of safety glass.

An ingenious form of protection of quite another type is one which consists of a piece of silk gauze, and which, I understand, is very effective in stopping small flying particles from emery wheels, etc., but gives little protection in the heavier metal industries. Yet another type is one modelled (at the suggestion of Mr. Treacher Collins) on the visor invented by Sir Richard Cruise in the late war. This visor of fine chain mail attached to the steel helmet was allowed to hang in front of the eyes, and formed from experiment a good protection against splinters of all kinds, at the same time causing little interference with vision. I think, however, that it would be difficult to get men to take kindly to wearing this model.

2. Education of Workmen and Foremen.

This, the second principle of prevention, is one which naturally is directly associated with the first, and simply means making the man realize the risk he is running and teaching him how best to avoid the danger.

3. Engineering Revision.

The third principle is the most recent method of prevention, and as amongst other things it seeks to eliminate the flying particle altogether, it is the ideal. It aims at doing away with the underlying cause of accidents rather than the covering up of danger points. The term is generally understood to mean the changing of a manufacturing process, the re-designing of a machine or tool, the rearranging of the physical equipment of a plant, or the changing of the method of work to any other for the purpose of preventing accidents. The introduction of the automatic machine is an excellent example of engineering revision, since fewer men are required for the same amount of work, and therefore fewer are exposed to hazards.

One cannot help feeling that it is by engineering revision we are likely to meet with the greatest success in prevention, for we are then independent of the necessity of guards and education of workmen. The last-named method seems to be very difficult to carry out in this country—more perhaps than in others. In America, for example, a

fair amount of success has been met with by the employment of safety engineers, who, in addition to concentrating on engineering revision, make a special point of educating the workmen by propaganda and many ingenious and telling methods. If it was possible to ensure that all of the three methods could be carried out simultaneously, it could be imagined that all accidents due to flying particles would be abolished. In theory no accident ought to occur, but actually it is impossible to prevent those due to unforeseen circumstances.

The prevention of eye accidents in the great variety of occupations followed in this country is, on investigation, a much greater subject than might be thought, and it is impossible in a short paper such as this to enter into the detailed study which is necessary for each type of occupation, but it is hoped that enough evidence has been brought forward to show that minor eye injuries have an appreciable importance in industry.

The fact that *three* of such simple everyday occurrences as a foreign body on the cornea are responsible for the loss of a whole working day of eight hours should be sufficient to arouse the financial attention of every employer, quite apart from the suffering borne by the employee. Furthermore, when, in addition, the burden on the hospitals is taken into account, it must be conceded that the time is ripe for some great effort to be undertaken towards the reduction of these apparently trivial accidents. The word elimination would, of course, be preferable to reduction, but this would involve superhuman efforts.

The difficulties in the way are great, and not the least among them is the psychology of the employee, especially when of British nationality. No disparagement of my countryman is here insinuated, but merely a reference to the wonderful spirit of indifference to danger so characteristic of our race, to which may perhaps be added some ignorance of risks run.

THE RESULTS OF INDUCTION OF LABOUR WITH ANIMAL BLADDERS.

BY

G. F. GIBBERD, M.S., F.R.C.S.,
OBSTETRIC REGISTRAR, GUY'S HOSPITAL.

IN 1901 Baumm¹ described the method of induction of labour in which a sterile animal bladder is introduced through the cervical canal, and then partially filled with glycerin. As a semi-permeable membrane the bladder allows water to pass from the surrounding tissues into its cavity, so that its contents gradually increase and the bladder becomes progressively more distended. At the same time a small proportion of the glycerin passes out into direct contact with the uterine wall.

Although the method seems to have been fairly widely used on the Continent, it has attracted little attention in this country, and the figures published here represent the results obtained in the first thirty cases in which the method was tried at Guy's Hospital. I am indebted to the obstetric surgeons at that hospital for permission to publish these results.

The technique used has been modified slightly from that suggested by Baumm. The apparatus that has been found most satisfactory consists of a short piece of metal tube about one inch long to which is attached a piece of rubber tubing about six inches in length. Through this a long metal stylet is passed so that its point projects about five inches beyond the end of the metal tube. The end of the stylet is flexible, and protected at the tip by a smooth knob. The animal bladders, which are obtainable ready sterilized in sealed glass tubes, are of two sizes—a large (pig's) bladder with a capacity of about 500 c.cm., and a small (sheep's) bladder with a capacity of about 200 c.cm. The bladder is tied to the metal tube by means of a silk ligature, and stretched by means of the stylet. It can thus be introduced through the cervical canal in the same way as a Krause's bougie, and when it is completely within the uterine cavity the stylet is withdrawn, and (in the case

of a large bladder) about 200 c.cm. of pure sterile glycerin is injected into the bladder by means of a syringe. The rubber tubing is then clamped. The flexible stylet ensures deflection of the bladder, should it hit against the presenting part, and thus renders the introduction a simple and safe procedure. With care the bladder can be introduced without coming into contact with the skin of the vulva or vagina, and without any undue handling on the part of the operator, but the aseptic technique practically always makes an anaesthetic necessary.

After introduction into the uterus the contents of the bladder gradually increase in amount; at the same time a small amount of glycerin passes out into direct contact with the uterine wall. The uterus is thus subjected to the double stimulus of the mildly irritating glycerin and of the gradually increasing size of the bladder. In the later months of pregnancy a large bladder has been used in the majority of cases. The smaller bladder is more suitable for the induction of abortion in the early months.

In the majority of the cases previous unsuccessful attempts to induce labour with quinine and pituitary extract had been made. Several cases in which abortion was successfully induced in the early months of pregnancy have been excluded. Only cases in which pregnancy had progressed past the twenty-eighth week are considered here. The indications for induction in these cases were either disproportion between the size of the head and the pelvis, or maternal toxæmia. It is not suggested that the results obtained are to be regarded as entirely satisfactory, but for the purpose of comparison they are considered side by side with the results of twenty-three consecutive inductions with bougies or stomach tube, undertaken at Guy's Hospital during the same period and under similar conditions.

Results.

	Animal Bladder.	Stomach Tube or Bougie.
Failures ...	3 (16%)	2 (9%)
Successes ...	27 (93%)	21 (91%)
Induction interval:		
Longest ...	72 hours	96 hours
Shortest ...	2 hours	2 hours
Average ...	13 hours	35 hours
Less than 24 hours ...	23 (85%)	8 (40%)
Less than 12 hours ...	17 (63%)	4 (20%)
Less than 6 hours ...	11 (41%)	2 (10%)
Puerperal morbidity ...	4 (15%)	3 (14%)
Complications:		
Separation of placenta ...	1	1
Malpresentation ...	1	Nil

The three cases in which the method failed may be considered separately. In the first, a patient with albuminuria of pregnancy, since no pains had occurred eighty-eight hours after the bladder had been introduced, this was removed and a stomach tube was inserted instead, after which a further thirty-eight hours elapsed before the onset of labour. The puerperium was morbid on account of pyelitis. In the second, a patient with a contracted pelvis, labour pains started and the bladder was expelled after forty-eight hours. After this the pains ceased entirely, and pregnancy then ran a normal course until it was terminated by Caesarean section ten days later. In the third patient the bladder was expelled with a few pains, which ceased almost immediately afterwards. The patient refused any further intervention and was discharged from hospital. She was admitted in labour four weeks later, and delivered with difficulty, by the forceps, of a dead foetus, death being due to intracranial haemorrhage. A normal puerperium followed.

Although all three cases must be regarded as complete failures in that the object of the operation was not attained, yet it is satisfactory that the attempt did not