

DISCUSSION

Underground lighting in the gold mining industry

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M J Martinson (Fellow) There is everywhere a lamentable dearth of quantitative information on occupational factors affecting the health and safety of mineworkers, and as the authors point out in their introduction underground lighting is one of the factors which has received little attention in South Africa prior to this welcome paper. Since the authors are to some extent pioneering, it is perhaps inevitable that the paper should raise more questions than it answers, but nevertheless it provides a provisional yardstick against which the need for, and success of, remedial action may be judged.

Before commenting in detail on a few aspects of the paper it may be worthwhile to summarize the statutory provisions relating to underground lighting, contained in Chapter 15 of the Regulations promulgated in terms of the Mines and Works Act 27 of 1956. Chapter 15 is entitled 'Lighting, Safety Lamps and Contraband', but in the context of the present paper only four simple regulations need be noted: firstly, no person shall work or travel in an unilluminated part of a mine unless he carries a light; secondly, adequate stationary lights shall be provided at stations and certain other localities in shafts, winzes and places used for winding; thirdly, mechanically propelled conveyances shall be provided with an effective bright light shining in the direction of travel; and fourthly, moving machinery to which personnel have access shall be illuminated so as to be clearly visible.

In all four regulations the standard of lighting to be provided is wholly subjective, and under these circumstances the wide inter- and intra-mine variations in light intensity disclosed by the study are hardly unexpected. Nevertheless the data presented in the authors' Table I raise three points:

- (1) Is there any evidence that the 19 mines visited during the survey are representative of the 45-50 large gold mines in South Africa, or that the shafts selected are representative of the respective mines? Mine managers would scarcely be human were they not to offer better lit working places for the survey; perhaps the use of a scaling factor (e.g. tonnes or transit mineworkers per shift, kilowatts, etc.) for each working place might have helped to put the figures in perspective.
- (2) Looking at two of the more numerous — and probably important — of the ten working places included in the survey, i.e. stations and tips, one is struck by the marked skewness of both intensity distributions (with higher frequencies at the lower intensities) and the abrupt cut-off in both cases just short of pitch darkness. Thus, of the 45 mean readings recorded at 26 tips no less than 19 fall in the lowest range of 0,1-0,9 lm/ft², with but one tip in total darkness; of 46 readings on 26 stations, 7 fall in the lowest range and none is in total dark-

ness. Although a light with an intensity in the range 0,1-0,9 lm/ft² may satisfy the regulations, it is certainly arguable that in some situations it may be safer to have no light at all.

- (3) In view of the skewness referred to above, one wonders how meaningful are the 'total average light intensities for (the gold mining) industry' quoted in Table I, which the authors compare with illumination levels found in other countries. Looking at tips again, one notes that 34 out of 45 mean intensity readings fall below the 'total average' for tips, and only 10 exceed it. From this it may be concluded that a few well-lit working places included in a 'total average' may conceal a plethora in Stygian gloom.

In their discussion the authors make fleeting reference to the effect of underground lighting on productivity and accident rates, without however quoting any South African experience in this regard. Intuitively it seems highly likely that better lighting (in the widest sense) would improve productivity and reduce accidents, and of course it is in these areas that the mining industry might seek economic justification for providing better lighting. It is all the more regrettable therefore that these factors were not studied simultaneously with the present investigation, especially at the Psychological Division of the Human Sciences Laboratory has recently published a study on underground accidents in the gold mining industry without making any reference whatsoever to lighting as a causal factor. In the event neither of the two studies enables us to make an economic appreciation of the situation, and this seems to be a classic example of a situation where some dovetailing of research effort would have greatly increased the useful return.

On the effect of lighting on accidents, it may be noted that in 1939 Mickel presented some very interesting statistics to the Mine Managers Association of the Transvaal², on the improvement in accident rates which followed the random issue of electric cap lamps to native mineworkers in the Hercules Section of E.R.P.M. the previous year. Based on a 12 month trial period in which 250 000 shifts were worked with carbide lamps and (contemporaneously) 307 000 shifts with cap lamps, the incidence of major accidents (at least one day in hospital among men using carbide lamps was 1,15 accidents per 1 000 shifts, while the incidence of minor accidents (requiring dressing only) was 11,52 per 1 000 shifts. The corresponding figures for men using cap lamps were 0,79 and 7,31 accidents per 1 000 shifts respectively, representing a reduction of over 30 per cent in both major and minor accidents. While these figures are obviously dated — only men using cap lamps were issued with hard hats, for instance — they do indicate a need for similar research today.

While on the subject of lighting in stopes, it seems an oversimplification to state that 'The available light in a stope at any one time is the light output of the individual cap lamps multiplied by the total number of lamps in that particular area', nor does the statement appear to agree with the mean intensity of 2.4 lux quoted for stopes under "Results". It is not clear how lighting in areas lit by cap lamps alone should be characterised, but it seems to me that the authors' treatment is not valid in relation to the real work situation in most stopes.

The authors also make fleeting reference to miners' nystagmus, and state that 'One of the diseases dreaded in the past was nystagmus, *caused by inadequate illumination of working places*' (my italics). The extensive literature on miners' nystagmus in the medical press is surely witness to the fact that the aetiology of this unpleasant condition is more complex than the authors suggest. Certainly since the mid-'twenties the consensus of opinion seems to be that miners' nystagmus is a psychosomatic disease, and that poor lighting is only one of the several possible causative factors. It would be interesting to know, incidentally, what grounds the authors have for stating that 'at present, no new cases of nystagmus are occurring'.

Underground illumination is the one environmental factor in South African gold mines which could probably be improved dramatically at relatively modest cost, since electric power is readily available throughout most mines and the increased power consumption is likely to be small. It seems to me that the picture which emerges from the present paper constitutes adequate grounds for suggesting that the general standard of underground lighting in the gold mining industry should be improved immediately even though we apparently lack direct evidence of the resulting economic benefit in terms of increased productivity and reduced accident rates. The subject needs far more research, but in the meantime this contributor heartily endorses the authors' suggestion that the industry should issue a handbook on mine illumination. Ideally this should be compiled by an illumination engineer in collaboration with the Human Sciences Laboratory.

REFERENCES

1. BETTENCOURT, J. J., and JENSEN, A. *Journal of S. Afr. Inst. of Mining and Metallurgy*. Dec. 1970.
2. Mine Managers Association — Papers and Discussions, 1939-1941, pp. 568 and 569.

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