

and rations, and wear distinguishing insignia which would serve as a pass for surface when their taskwork is completed.

Finally, I wish to raise a matter of principle arising out of the authors' statement that the results from this study can be used to determine 'optimum' (*sic*) levels of production from Bantu mine workers. It is not altogether clear what nuances the authors have in mind by putting 'optimum' in quotation marks, but presumably it is some sort of euphemism for 'reasonable maximum'. The South African mining industry must be unique in being able not only to measure the physiological reactions of its labour force under stress, but also in being able to lay down 'optimum' production rates based on these measurements. In an earlier paper from the Human Sciences Laboratory (the *Journal*, November 1968) it was reported that a significant number of labourers are presently working at oxygen consumptions in excess of 50 per cent of their maximum oxygen intake; if the day should come when standards set by the Human Sciences Laboratory can be enforced by management there should be appointed some sort of official ombudsman.

AUTHOR'S REPLY

Dr C. H. Wyndham (Member): Mr Martinson asks some very pertinent questions.

His first series of questions relate to the maximum oxygen intakes of the Bantu workers and our use of 3.0 l/min as the 'average' maximum oxygen intake. Mr Martinson is quite correct in his suggestion that maximum oxygen intake is a function of age and physical condition. It is also related to body weight. Our findings are that after the Bantu has gone through the physical conditioning of eight days of acclimatization then the mean maximum oxygen intake increases to a value which is close to 3.0 l/min and this improvement in physical conditioning is associated with a gain in mean body weight of about 7 lb.

We, at Human Sciences Laboratory, hope to persuade mine managers in the next few years to use the simple, rapid and accurate physical work capacity selection test in conjunction with acclimatization in climatic rooms. By this means mine managers could ensure that *all* men who go onto the shovelling of rock in stopes would have maximum oxygen intakes of 3.0 l/min and more. Such

selection would solve Mr Martinson's problem with regard to our use of 3.0 l/min as the maximum oxygen intake of the 'average' Bantu and, perhaps, even more important it would ensure that no men with a low physical work capacity worked hard in hot conditions and are therefore liable to heat stroke.

Mr Martinson, in his second general point, has very perceptibly discerned our frustration at the failure of the gold mining industry to apply this information. We had hoped that the work study and production engineers in the mining industry would take this information, and similar information on the energy expenditure and mechanical efficiency of tramping rock at different speeds and with various loads, and work out a training manual for the two tasks and draw up a set of standard practices for the shovelling of rock in stopes and the tramping of it. The work study and production engineers have not done this.

My interpretation of their failure to do so is that they are frustrated and discouraged by the very negative attitude of the miners' to innovations in mining practices. This negative attitude is, perhaps the biggest single obstacle to increasing the productivity of the Bantu in the gold mining industry. It also frustrates much of the effort put into the training of Bantu in safety. If I am correct in my interpretation then it is high time that the industry makes a systematic study of the attitudes, motivation and aspirations of the miners with a view to uncovering the reasons for this negative attitude to innovations and, possibly, of removing the causes. Unless this is done it is possible that much of the effort and excellent research put into innovations in mining methods and machinery might come to nought.

We at the Human Sciences Laboratory would, therefore, welcome Mr Martinson's suggestions that a high level study group be set up in the gold mining industry to investigate the human and engineering problems of increasing productivity. Research and practical engineers, and physiologists and psychologists should be represented in the study group. This is no novel idea, 'Ergonomics' came into being in the industrially more advanced countries when they were faced with similar bottlenecks in their attempts to increase productivity and they, in a rational manner, got together the experts in the human and engineering sciences to try to solve the problems.

Notice

WATER YEAR 1970

The Water Year Office for South Africa has supplied a provisional list of scientific congresses and meetings due to be held during 1970 with "Water" as the main or secondary theme, as follows:

February: SARCCUS conference on "Water for Progress," Lourenco Marques.

March 16-20: Annual Congress, Institute for Water Pollution Control, Cape Town.

May: Possible S.A. Akademie conference on Cooling Tower Experiments, Pretoria.

May: Annual Meeting of Association of Municipal Electricity Undertakings, Potchefstroom.

May 27-29: Congress on "Water Resources of Natal", Durban.

June 29/July 4: Annual Congress, South African Association for the Advancement of Science, Cape Town.

July 2: Joint meeting of South African Association for the Advancement of Science and S.A. Akademie, Stellenbosch.

July: Winter School, Federation of University Engineering Students.

July: Youth Science Week. Foundation for Education, Science and Technology.

July 21-24: The South African Tunneling Conference.

September: Proposed SARCCUS conference on water in Nature Conservation, Skukuza.

November 16-20: International Convention on "Water for the Future", Pretoria.