The planning of Ventilation and Refrigeration requirements in Deep Mines

By D. F. H. Grave* and R. M. Stroh** (Visitors)

SYNOPSIS

In this paper ventilation planning methods are discussed, with particular reference to the application of computer techniques to the solving of the many problems associated with the forecasting of ventilation and refrigeration requirements in mines of high production rates going to depths and rock temperatures higher than previously experienced.

The use of the Starfield-Dickson programmes for calculating heat flow into airways and advancing stopes is demonstrated in the case of ventilation planning on a large mine extending to a brief depth of over 3 km below the surface.

The possible effects of new mining methods on ventilation requirements in the future is briefly discussed.

SINOPSIS

In hierdie verhandeling word die metode van ventilasie beraming bespreek met spesiale verwysing na komper tegnieke deurmiddel waarvan baie probleme, wat betrekking het op die beraming van ventilasie en verkoelings vereistes van myne met hoë produksie tempo's wat tot groot dieptes strek en waar rots temperature hoër as ooit tevore ondervind word, opgelos word.

Die gebruik van die Starfield-Dickson program, deurmiddel waarvan hitte vloei in luggange en ontwikkelende werkfronte bereken word, word gedemonstreer in die geval van ventilasie beraming vir 'n groot myn wat strek tot 'n diepte van meer as drie kilometers onder die oppervlakte.

Die moontlike uitwerking wat nuwe metodes op toekomstige ventilasie vereistes mag hê, word ook kortliks behandel.

GEOTHERMIC GRADIENT

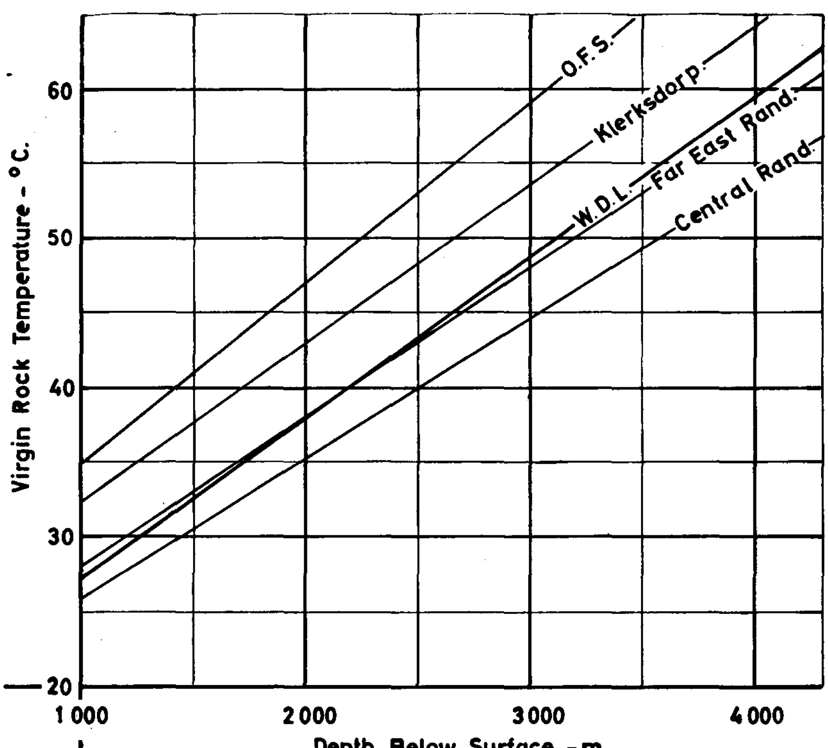

FIG. 1.

ASPECTS OF ENVIRONMENTAL CONTROL IN MINES

Prediction of ventilation and refrigeration requirements in hot mines is necessarily difficult, particularly with the great depths and high production rates now becoming commonplace on the Witwatersrand and Orange Free State Goldfields in South Africa.

In these areas high virgin rock temperatures are encountered. They are, however, consistent and can be predicted with reasonable accuracy, even at depthsgreater than those at which mining is currently taking place. (Figs. 1, 1A). Auto-compression effects, which are appreciable at these depths, have also to be considered.

In the past these facts, coupled with practical experience, have been successfully used in the prediction of the ventilation requirements for deep mines. The use of this empirical method is admirably illustrated by Lambrechts'. At the same time the use of refrigeration to make possible the reuse of air that would otherwise be too hot, is well demonstrated. In addition refrigeration may be necessary to cool fresh air from the shaft before it reaches the first working place. This is

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GEOTHERMIC GRADIENT.

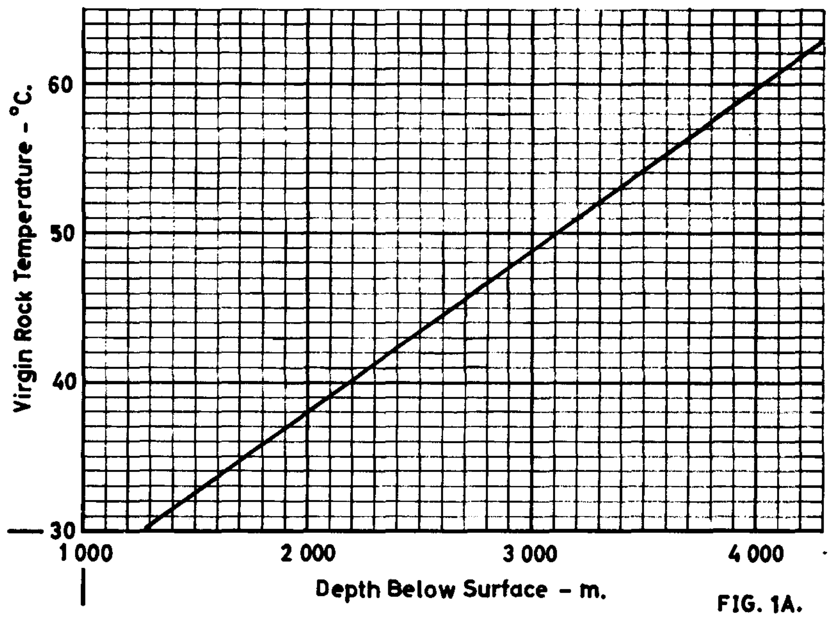


FIG. 1A.

essential in very deep mines because of the heating of the downcast air by autocompression. Hence refrigeration has great economic significance since the two factors that primarily decide the size of a shaft are its hoisting capacity and its capacity for handling air. In general, at virgin rock temperatures below approximately 35 °C, air can be reused throughout the workings without its becoming too hot for use. Above this critical rock temperature the air heats up rapidly to over 30 °C wet bulb, after passing through only one or two working places. Suppression of dust with water aggravates the condition.

Many attempts have been made over the years to arrive at a scientific basis for the prediction of air requirements in deep mines. In general, the scientific method has been less successful than the empirical method because of the variability of the many parameters involved. Parameters, such as stoping width, face advance, air control and utilization, wetness of airways and working places, thermal conductivity and diffusivity of the rock, time of residence of the broken rock in the face after the blast, frequency of blast, temperature and humidity of the intake air, length of stope face worked, distance of scatter walls from the face, type of support, are all subject to variation. Many of these variations cannot be foreseen from day to day, let alone years in advance. Factors such as the virgin rock temperature and the depth of workings which involve the raising of the initial temperature of the air by autocompression, have to be accepted as a natural datum.

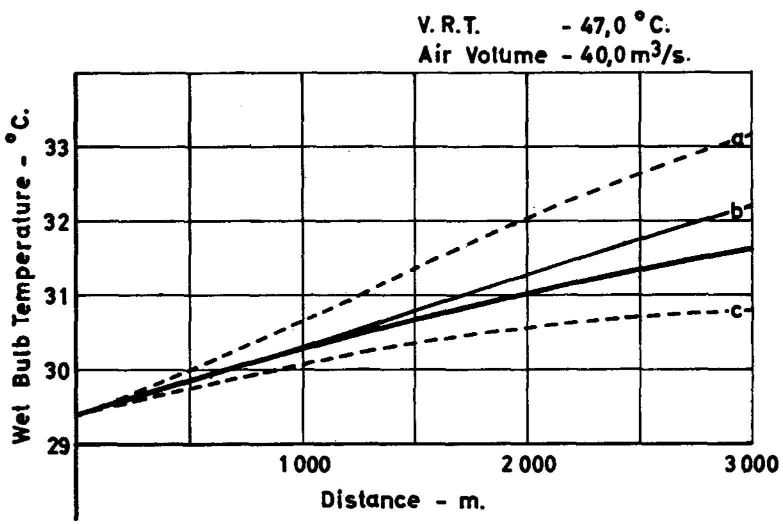
VENTILATION PLANNING

In South Africa the basic concept in ventilation planning is to determine the air requirements as a function of tonnage produced and virgin rock temperature. An empirical graph such as that produced by Lambrechts[1] is a very valuable basis for arriving at the total air requirements. However, the exponential nature of this curve indicates very high air requirements at rock temperatures over 45 °C and extrapolation of this curve into these regions can be misleading.

With the aid of the digital computer, a more satisfactory basis for predicting the changes in temperature of air travelling along an airway, along the face of an advancing stope, and in an advancing development end has been pioneered by Starfield and Dickson [2,3]. The effect of many of the parameters involved may now be calculated with reasonable accuracy. The calculations, while subject to a number of assumptions, show sufficient positive correlation with underground observations to justify confidence in the Starfield-Dickson stope and airway programmes for predicting conditions at greater depths and higher rock temperatures.

Starting with the Goch-Patterson tables for heat flow into tunnels, the airway programme calculates the temperature increase in air travelling along an airway under wet, damp and absolutely dry conditions. The thermal conductivity and diffusivity of the rock, virgin rock temperature, air quantity, barometric pressure, air temperature (wet and dry bulb), age of the airway, length and perimeter are all taken into account. As far as it has been possible to compare

TEMPERATURE INCREASE ALONG MAIN INTAKE AIRWAYS.

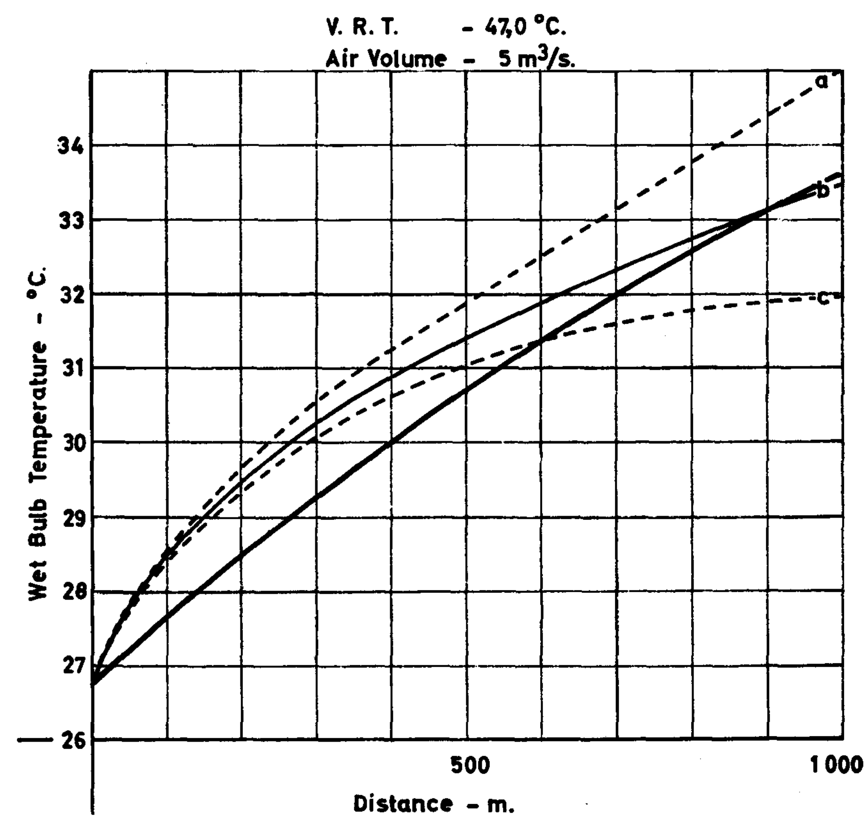


Computed Increase: a. Wet haulage. b. Damp " . c. Dry " .

— Measured temp increase based on run of mine conditions.

FIG. 2.

TEMPERATURE INCREASE ALONG STOPE FOOTWALL HAULAGES.



Computed Increase: a. Wet haulage. b. Damp " c. Dry "

— Measured temp. increase based on run of mine conditions.

FIG. 3.

them, the results of this computation agree remarkably well with practical observations. The most difficult point in applying the method, is to make realistic estimates of the variables involved.

Similarly, the programme developed for advancing stopes ingeniously rationalises the large number of variables involved by breaking the various stages of the mining cycle into time steps. The wetness of the footwall at each time step, the size of the "bite" taken out of the advancing face at each blast, the time that the hot broken rock blasted off the face lies in the stope face before removal, the air quantity actually travelling along the face at each stage (in practice this varies greatly because of the blocking of the face by broken rock), and the stoping width and span between the face and the scatter barricade, are allowed for. Frequently the relevant figures are not accurately known. However, Starfield has shown that variations in the input data in numerous instances have very little effect on the result.

Figs. 2, 3 and 4 show how measured temperature increases in haulages at large and small air velocities, and along stope faces, compared with the computed temperature rises. The agreement is reasonably close and gives one confidence in the usefulness of the method for the prediction of the temperature pattern in airways and stopes at greater depths.

The importance of maintaining dry airways in order to obtain the best utilization of the downcast air is well known. In practice, however, with notable exceptions as at Vlakfontein and in the long development ends at Buffelsfontein (Jacobs[4]) it has proved impracticable to keep all intake airways perfectly dry, and it would be unwise to rely on complete dryness in intake airways when planning the ventilation requirements of a new mine.

It is therefore possible to predict reliably the air temperatures in the workings of a mine or specified depth, rock temperature, rate of production and concentration of mining. From this one can estimate the total air quantity required for the scale of operations envisaged. Important variables to be taken into consideration are the wetness or dryness of the airway, and the air velocity (quantity) in the face area of the stope between the advancing rock face and the scatter barricade, as distinct from the total air quantity in the stope, much of which bypasses the face unless air control is very effective.

Once the total air quantity has been determined, a decision must be made on how the air is to be distributed. This has been described by Lambrechts[1]. In general the choice is between the supply of fresh downcast air for each working place or the reconditioning of used air where necessary. The latter method has many advantages in the practical situation as will be shown.

While it is often possible to predict the whereabouts of payable ore from borehole information, and to make preliminary plans for airway, haulages, etc., well in advance of the actual opening up of the mining area, detailed airway requirements cannot be determined until the production rate from each area is decided upon. Often, because of grade considerations, this is not done until a very late stage and even then requirements are subject to change. In such cases, there simply would not be time to develop the required airways to an area of high production at short notice. Conversely, it has happened that airways have been developed to areas that have proved unpayable, or which have not been worked at the high rate envisaged, thereby rendering these airways redundant.

There are considerable advantages, therefore, in planning for a piped supply of chilled water, which can be routed where it is needed relatively quickly, in preference to additional airways.

A further aspect of basing ventilation planning for deep mines on the use of a combination of air and refrigeration is the fact that substantial increases in production rate (which are often decided upon when the mine is already committed to certain sizes of shaft system and to a basic layout which cannot be altered) can be accommodated by increasing the size of the refrigeration installation.

The high cost of sinking and equipping a shaft system with its associated offices, compounds, ore and material handling facilities, change rooms, etc., makes it imperative to obtain the maximum utilization of the shaft. Normally the hoisting shaft handles downcast air, with a separate shaft or compartment for the upcast. In the past, it was considered that a shaft system could serve an area some 2 000—2 500 metres in radius, the limitation being generally imposed by both men-and-material handling considerations and by the heat gathered by the air in travelling to the working places from the shaft bottom. At depth, high rock temperatures make this latter restriction more severe.

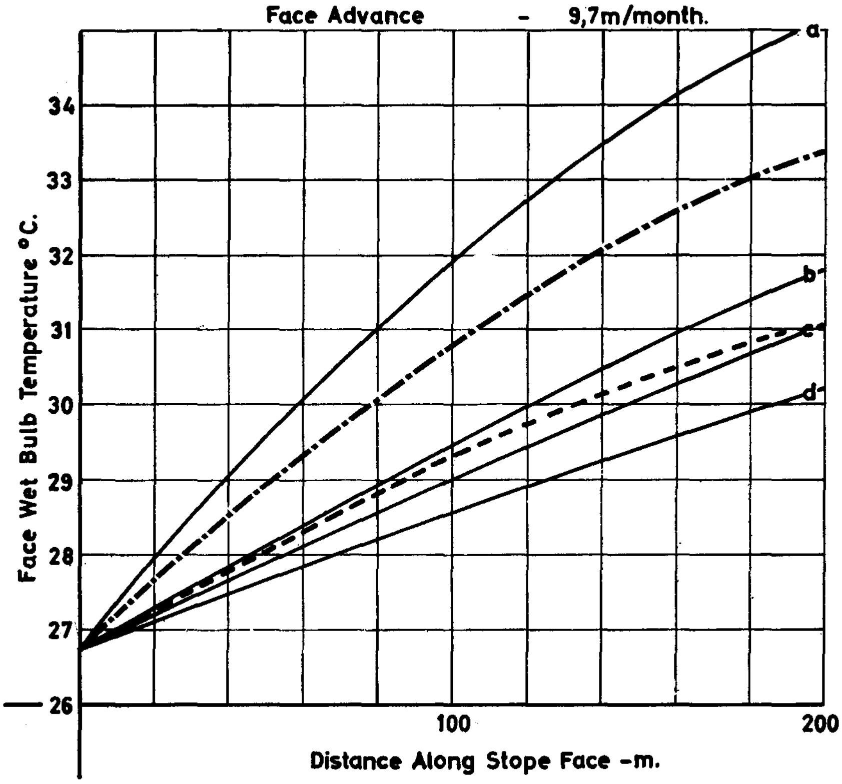
In recent years, however, the high cost of shaft sinking and equipping has caused mining engineers to look towards methods not only of increasing the rate of production possible for a given shaft system, but also of increasing the area that a shaft can serve. The former aim has, to a great extent, been achieved, and the latter may be implemented by use of refrigeration techniques, both for precooling hot downcast air, and for reconditioning used air for reuse elsewhere.

Furthermore, in areas of high virgin rock temperature, air in working places (as distinct from intake airways) heats up so rapidly, that reconditioning at the working face has become a necessity for both longwalls and scattered mining. It follows that air would have to be replaced once it reached the reject temperature (say, 31 °C wet bulb). If there were no refrigeration this would require a large number of intake and return airways to serve the various working areas, and would result in a complex and expensive ventilation system. Distance from the shaft would further burden the system. The use of refrigeration, while in itself expensive, is certainly far less so than the above alternative. In addition it is a more practical solution.

Therefore the establishment of whole shaft systems can be avoided and removed from the estimates, by making the existing shaft system, which would otherwise become inadequate, serve, with the aid of refrigeration, areas far beyond those originally intended.

FACE TEMPERATURE INCREASE IN LONGWALL STOPES.
COMPUTED INCREASE Versus MEASURED INCREASE.

Barometric Pressure - 1 175 mbar.
Stoping Width - 1 m.
Air Velocity - 1,5 m/s.
V.R.T. - 47,0 °C.
Face Advance - 9,7 m/month.



—·— 90% Probability design line based on measured temp. increase.
— — Mean measured temp. increase comparable with computer increase.
a. 2,5 m span - 12 hrs. after blast.
b. 2,5 m " - 28 " " ".
c. 3,5 m " - 28 " " ".
d. 3,5 m " - 48 " " ".

FIG. 4.

This has been done at Western Deep Levels, where the two shaft systems originally sunk from surface will serve for the mining of the entire lease area.

PRACTICAL APPLICATION WESTERN DEEP LEVELS MINE

How are these considerations and the findings of these calculations applied to the practical mining situation? The stoping layout is very largely predetermined, and the main parameters are laid down by rock mechanics and mining methods. Mining layouts involving many hundreds of metres of development and requiring much time for their preparation cannot readily be altered. It is virtually essential, given the mining frame-work, to fit the ventilation and refrigeration to it rather than the reverse. This is in fact reasonably practical where extensive use is made of refrigeration.

By the use of the airway program it is possible to predict with reasonable accuracy the temperature of the air at given distances from the shaft.

For estimates of stoping conditions, a large number of assumptions have to be made. These are based on experience and have to fit into the mining framework.

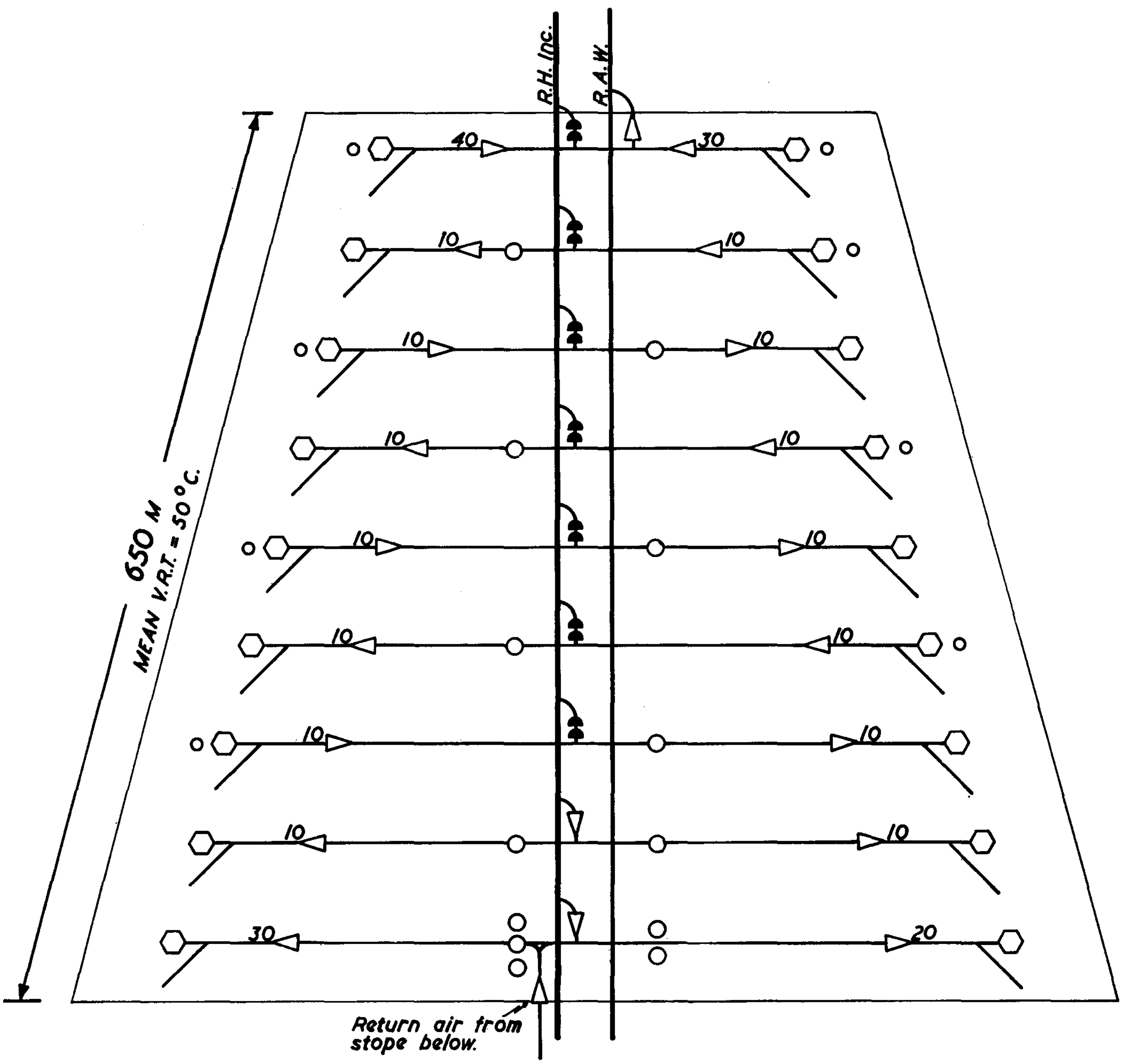
A diagrammatic sketch of the longwall layout is shown in Fig. 5.

At Western Deep Levels the following "standard conditions" for ventilation planning purposes are applied:

Stoping width	— 1 metre
Face advance per blast	— 0,75 m
Frequency of blast	— 24 hours

VENTILATION AND REFRIGERATION ARRANGEMENTS FOR STOPES BELOW 100 LEVEL.

With Air Volumes In Haulages 10 m^3/s.



LEGEND:

- ▷ AIR DIRECTION AND QUANTITY - IN m^3/s.
- o DEVELOPMENT COOLER – 100 kW.
- ○ HAULAGE COOLER – 200 kW.
- ⬡ STOPE FACE COOLER – 250 kW.
- ◗ VENTILATION DOOR.

TOTAL AIR CIRCULATION:

1. BEFORE ESTABLISHING REPLACEMENT-INCLINES = 90 m^3/s.
2. AFTER ESTABLISHING REPLACEMENT-INCLINES = 120 m^3/s.

FIG. 5

Broken rock residence time — 12 hours
Virgin rock temperature — 50° C

The computer print-out predicts temperatures (wet and dry bulb) at selected distance intervals along the face and at selected time intervals after the blast. Distances of 30 m and time intervals of 4 hours are commonly selected. In practice, temperatures at the face between the time of the blast and the removal of the broken rock are of academic interest only. After the statutory 4 hour re-entry interval, scraping of broken rock from the working face begins. This is controlled from the scraper winch position some distance from the face. Men normally enter the face only some 16 hours after the blast, and this is taken as the relevant point at which conditions are assessed; i.e., comparisons are made between the 'sixteen-hour' temperatures with differing air quantities and intake temperatures. The assumptions naturally vary from application to application.

The stope face programme was run successively for a number of changes in the variables, e.g. distance of the scatter barricade from the face, time after the blast (16 hours was eventually decided upon, as indicated above), air quantity and velocity and inlet air temperature. This latter variable is determined by the position of the re-cool point, which is subject to limitations imposed by the mining layout. An example of the face cooling arrangements is shown in Fig. 6.

Examples of these results, in which differing variables are applied, are shown in Figs. 7, 8 and 9.

In Fig. 10 it is shown how the position of the re-cool point was decided upon for stopes in three different mining zones and rock temperature ranges—viz., virgin rock temperatures below 49 °C, 49-54 °C and 54-59 °C. The latter range affects the zone below 120 Level (down to 135 Level), which will be reached many years hence.

For design purposes a reject temperature of 31 °C wet bulb was decided upon, and the design conditions were selected such that this temperature would not be exceeded in more than 10% of cases. "Average conditions" were not used.

From the calculations it was possible to arrive at figures for the air quantities and amount of cooling required in each of the longwall stopes. Apart from stopes and development ends, the cooling capacity for the entire complex of airways, haulages, sub-vertical shafts, service inclines, hoist chambers, plant rooms, etc., all sited some 3 kilometres below surface and in zones of high rock temperature was determined. The cooling required for the mine as a whole could then be calculated. An example of the form used in compiling these requirements is shown in Fig. 11, while the final graphs indicating the predicted refrigeration requirements of the mine as a whole are shown in Figs. 12, 13 and 14.

TYPICAL FACE COOLING INSTALLATION.

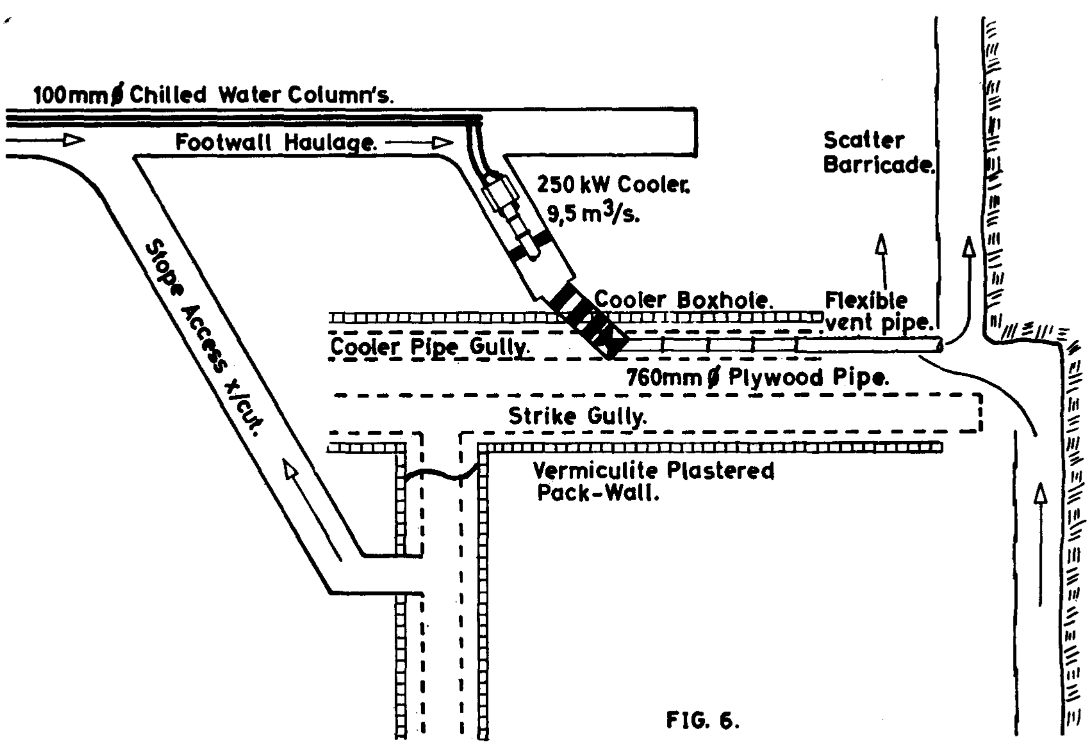
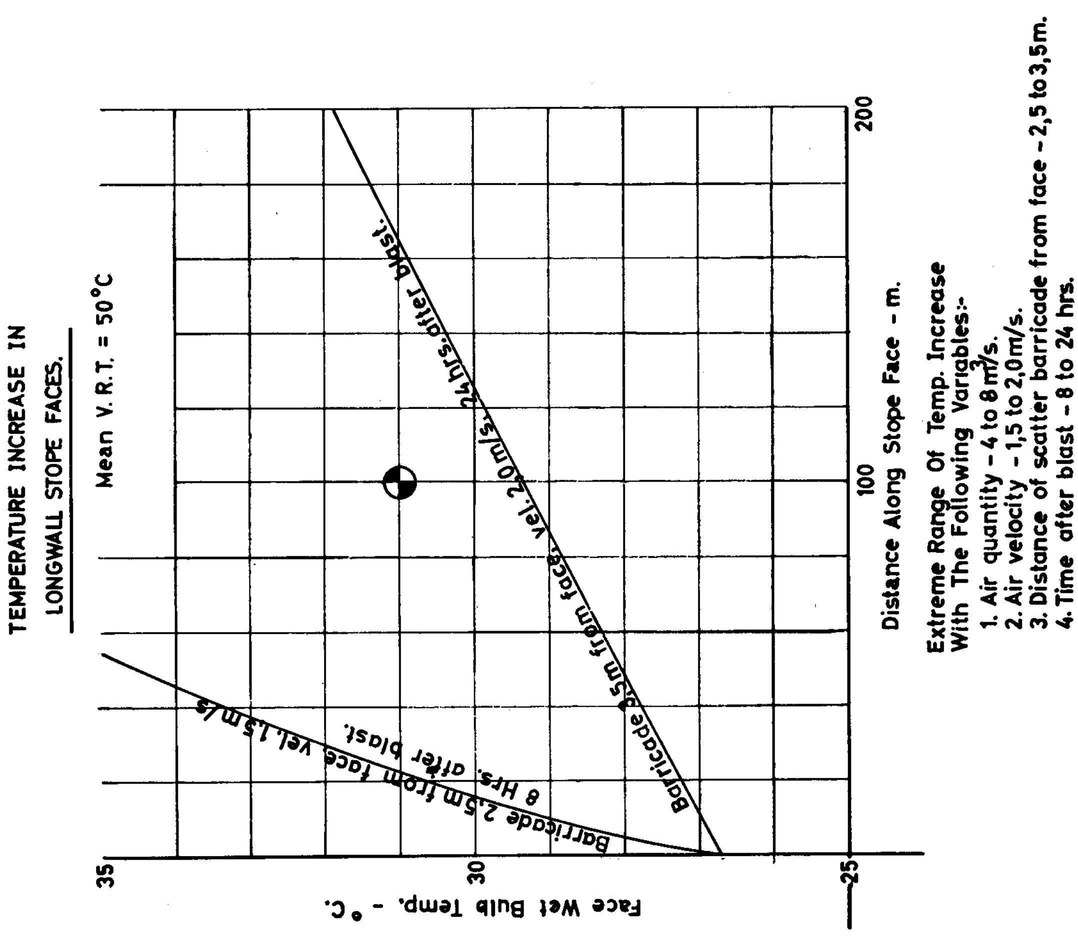
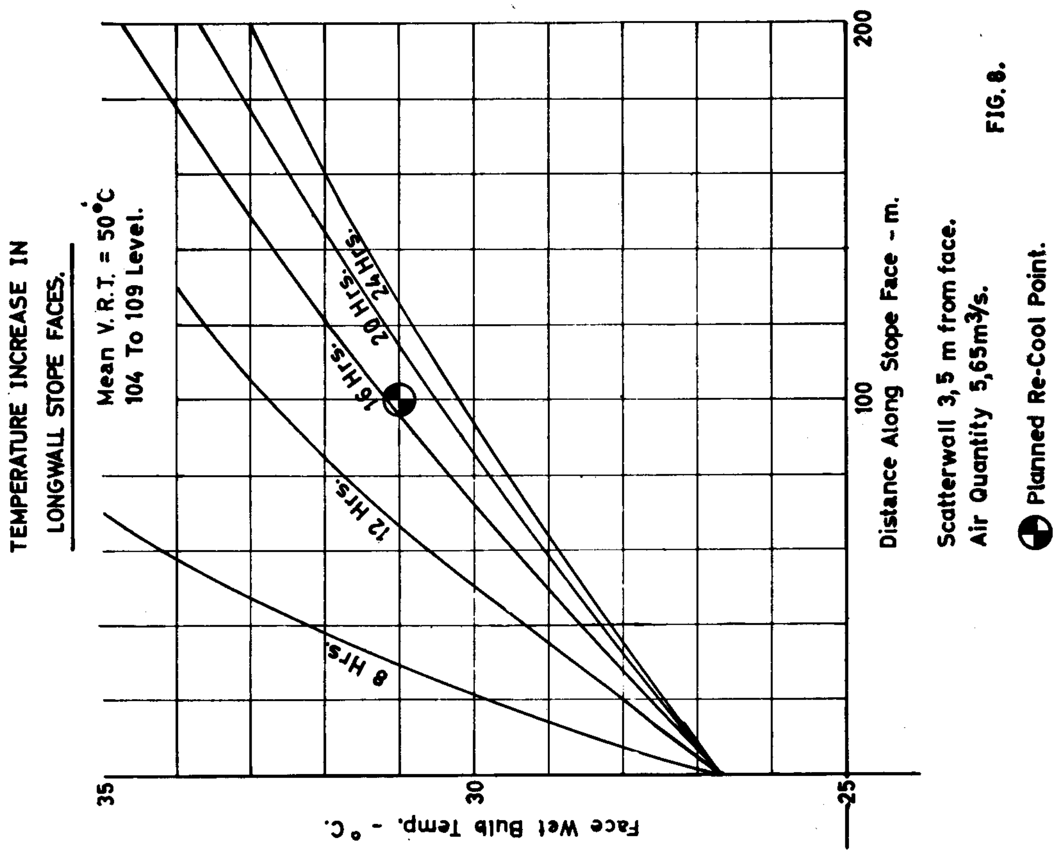


FIG. 6.



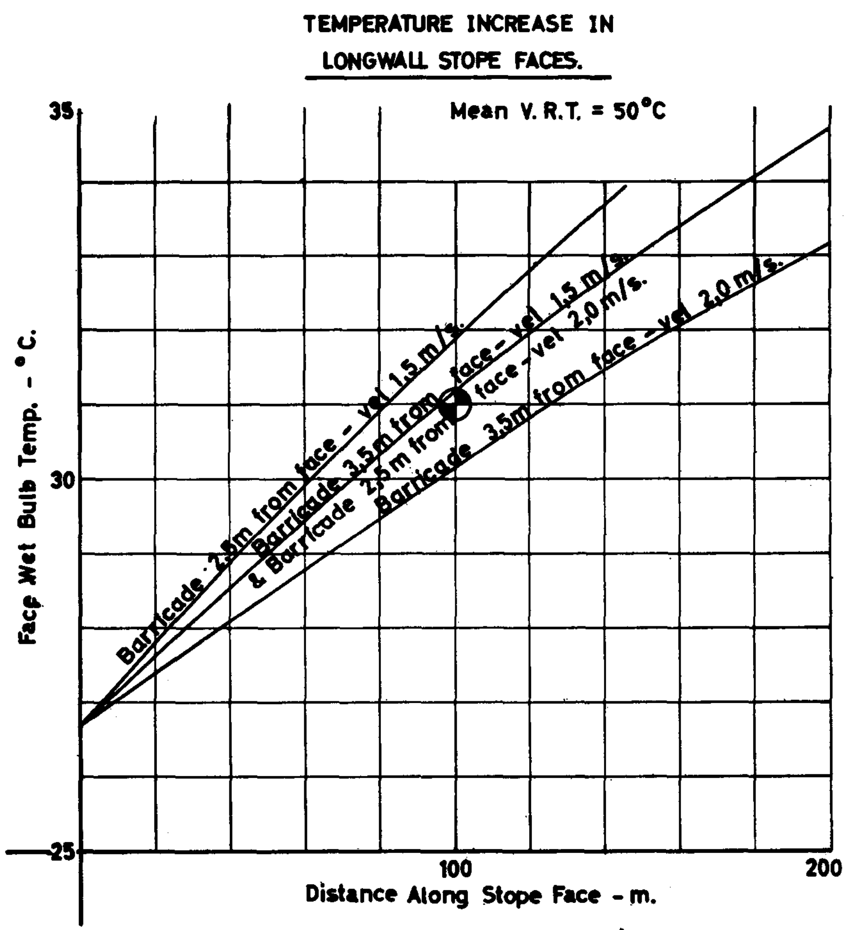
TEMPERATURE INCREASE IN
LONGWALL STOPE FACES.
Mean V.R.T. = 50°C
Barricade 2,5m from face vel. 1,5 m/s
8 Hrs. after blast.
Barricade 3,5m from face vel. 2,0 m/s, 24 hrs. after blast.
35
30
25
Face Wet Bulb Temp. - °C.
100
200
Distance Along Stope Face - m.
Extreme Range Of Temp. Increase
With The Following Variables:-
1. Air quantity - 4 to 8 m³/s.
2. Air velocity - 1,5 to 2,0 m/s.
3. Distance of scatter barricade from face - 2,5 to 3,5 m.
4. Time after blast - 8 to 24 hrs.
Planned re-cool point.

FIG. 7.



TEMPERATURE INCREASE IN
LONGWALL STOPE FACES.
Mean V.R.T. = 50°C
104 To 109 Level.
8 Hrs.
12 Hrs.
16 Hrs.
20 Hrs.
24 Hrs.
35
30
25
Face Wet Bulb Temp. - °C.
100
200
Distance Along Stope Face - m.
Scatterwall 3,5 m from face.
Air Quantity 5,65 m³/s.
Planned Re-Cool Point.

FIG. 8.



Effect of distance of scatter barricade from face at various velocities 16 hrs. after blast.

FIG. 9.

⊕ Planned re-cool point.

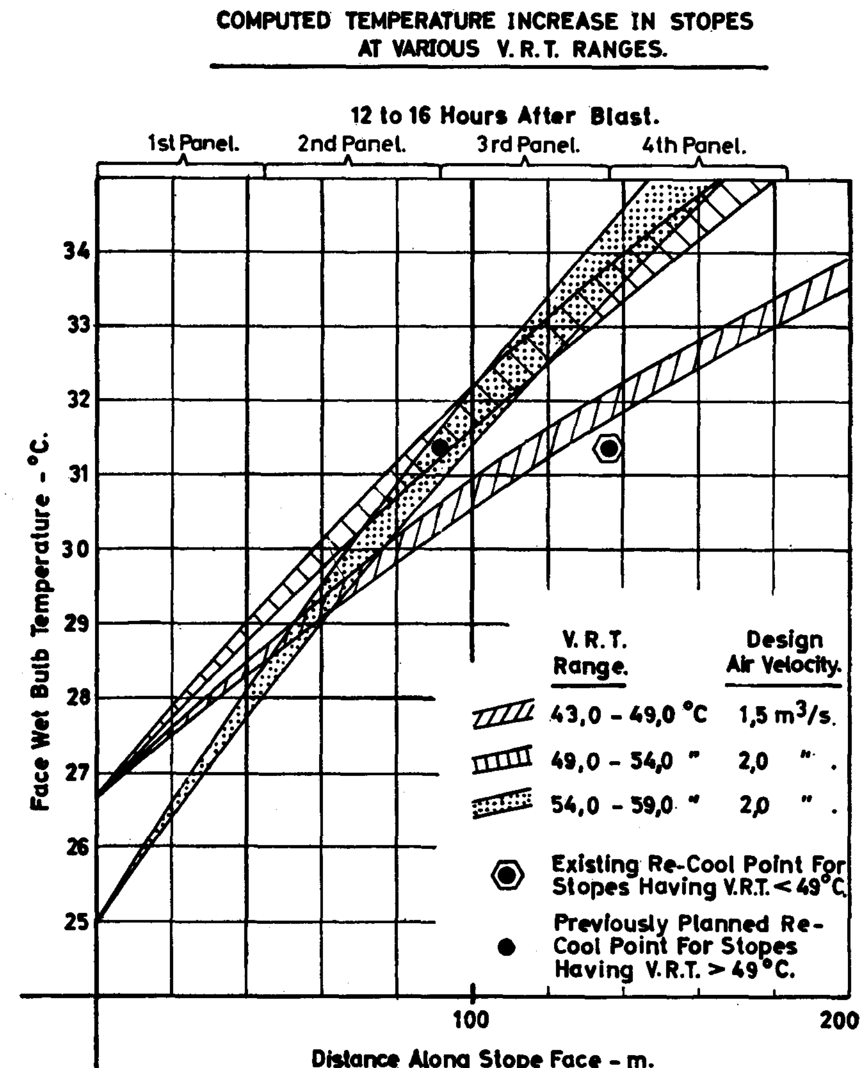


FIG. 10.

Western Deep Levels.

FIG 11.

No SHAFT LEVEL PLANT.

COOLING REQUIRED.	100/60	94/64W	94/64E	100/69	100/60	94/64W	94/64E	100/69	100/60	94/64W	94/64E	100/69	100/60	94/64W	94/54E	100/69
INTAKE AIRWAYS																
Vertical Shafts to Inclines																
Service Inclines to Stope Faces																
Bulk Cooling Bottom of each Stope																
STOPES																
Face Cooling																
DEVELOPMENT																
Follow on Haulages																
Replacement Haulages																
Replacement Inclines																
Reef Exploration ahead of Stope Faces																
SUNDRIES																
Faulting																
Winders																
Waste Stowing																
RETURN AIRWAYS																
Stope Faces to Service Inclines																
Service Inclines to Upcast Shaft.																
TOTALS.																

87 Fridge Plant

97 Hoists

GRAND TOTAL

Line losses

PLANT CAPACITY

REFRIGERATION REQUIREMENTS.

100 LEVEL PLANT.

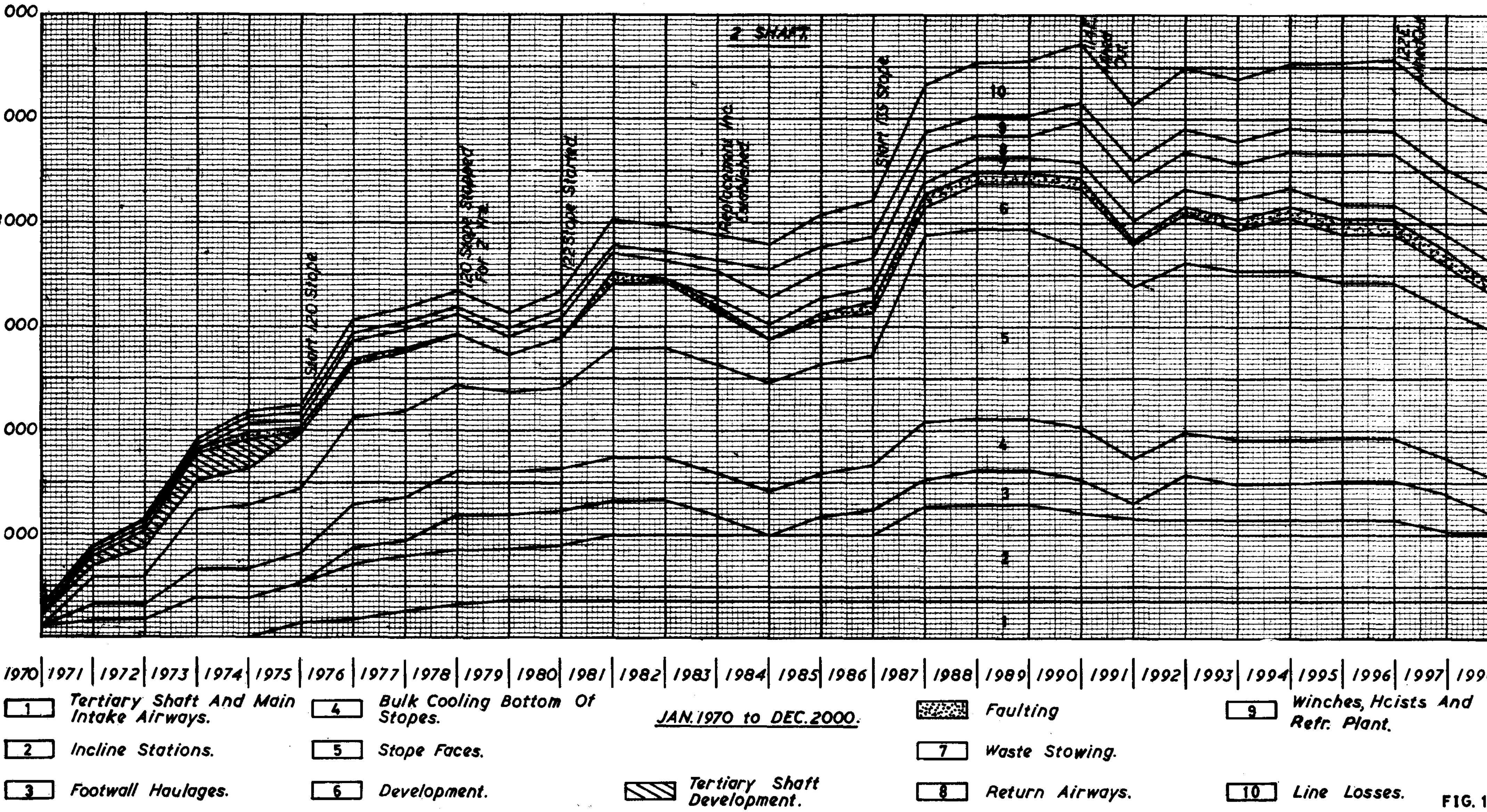


FIG. 12

TOTAL REFRIGERATION REQUIRED FOR C.L. HORIZON.

JAN. 1970 TO DEC. 2000.

FIG. 13.

PLANNING OF REFRIGERATION.
REQUIREMENTS.

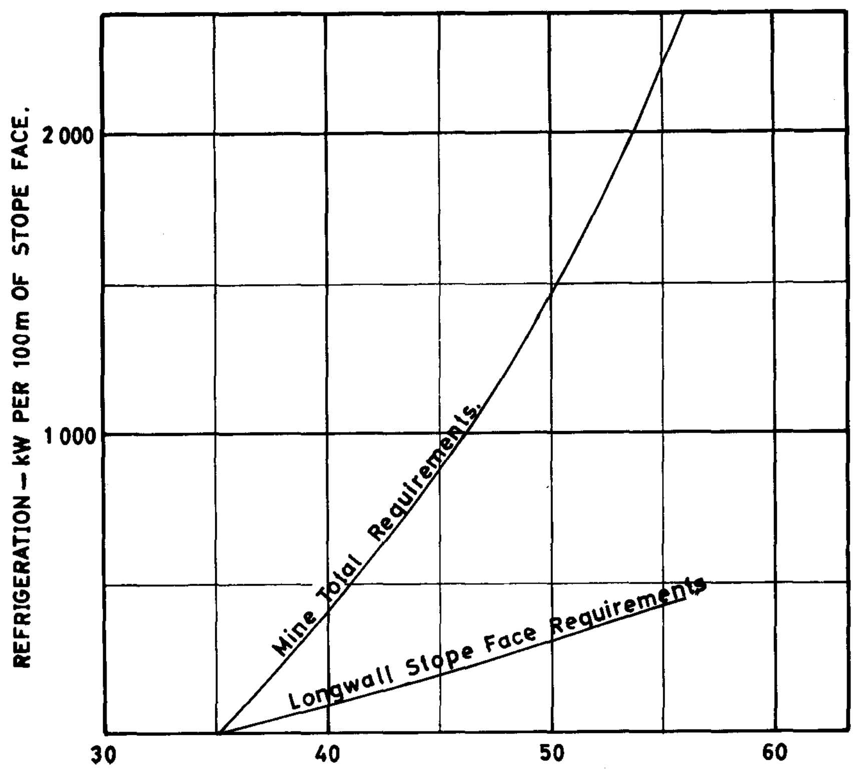


FIG. 14.

THE FUTURE

In South African gold mines the stoping practice in narrow reef deposits has not changed much during the past fifty years. Research work is now being undertaken which might produce a fundamental change in the method of rock breaking and thereby of mining methods as a whole. This change could be implemented within the forseeable future and will, if effective, make a considerable difference to ventilation requirements. This refers to the use of the rock cutter for selective mining of the reef. If this device successfully eliminates the necessity for blasting it will mean that one of the purposes of mine ventilation will be removed, namely the removal of blasting fumes. Concentrated, multi shift mining for the whole mine or parts of the mine will result in improved utilization of the available air. With selective mining the volume of reef removed from the face is reduced, and the waste, which is approximately 50 per cent of the stoping width, is packed behind the face. This waste packing will result in considerable improvements in ventilation control at the face by reducing air leakage. The need for cool, comfortable and safe working conditions will remain but it will apply to a rather different cycle of operations and possibly a smaller complement of workers at the face than that used at present. The concentration of mining made possible by this method may enable greater depths to be mined without increasing the present total available air quantity and refrigeration capacity.

Another development that may become of practical significance is the use of cool suits. These are jackets containing pockets of ice which cool the body and make work in hot conditions safe and reasonably comfortable. This method is very much in the experimental stage at present and has yet to be proved on a large scale. However, if successful, it could mean that the cooling of the workers bodies instead of vast areas of rock wall and support, might be a practical proposition. This would almost certainly be much less expensive and the cost structure of mining might be improved.

There is hope, therefore, that the large quantities of circulating air and underground refrigeration capacity which now appear to be necessary for future mining in deeper and hotter areas may after all not be required on such a large scale. However, these new methods of rock breaking and man cooling have yet to be proved in practice and the next few years will certainly yield much that is of great interest to all mining and ventilation engineers.

Network programmes which were first used in connection with colliery ventilation are now becoming applicable to ventilation layouts of the deep gold mines of the Transvaal and Orange Free State. We refer in particular to the work of Dr. M. J. McPherson of Nottingham University in this connection. The possibilities of this application are fascinating and it will certainly lead to great advances in ventilation planning.

ACKNOWLEDGEMENTS

Thanks are due to the Consulting Engineers, Anglo American Corporation of South Africa Limited and to the General Manager, Western Deep Levels Limited for permission to publish this paper.

REFERENCES

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2 Starfield, A. M. "Rapid method of calculating temperature increases along mine airways" *J.S. Afr. Institute Mining and Metallurgy*. Vol. 70, No. 4, Nov. 1969, p 77.
3 Starfield, A. M. "A single computer program for calculating air temperature increases in advancing stopes" (Chamber of mines of S.A.—Internal Report.).
4 Jacobs, J. C. "Ventilation of twin haulages at depth" *Jnl. Mine Vent. Soc. of S.A.* Vol. 20, July 1967, p 117.

ORANGE FREE STATE BRANCH

Proceeding of the November General Meeting.

The November General Meeting of the Branch was held at Western Holdings at 3.15 p.m. on the 18th November, 1971.

Mr J. M. Meyer (Chairman, O.F.S. Branch) was in the Chair.

There were also present:-

(*Fellows*): Messrs J. Handley, C. J. Isaac, G. C. P. Labuschagne, P. Nathan, D. A. Smith, I. G. Thomas, L. J. Thorne, E. T. Wilson and J. W. Wilson.

(*Members*); Messrs D. E. Couperthwaite, B. Drysdale, A. H. Edwards, G. T. G. Emere, H. Escyenberg, C. B. Roper, P. L. Schalkwyk and G. Young.

(*Graduates*); Messrs H. F. Bartels, H. Miller, M. H. Smith and G. R. W. Walker.

(*Associates*); Messrs J. D. Dean, W. F. de Lange, R. M. Erasmus, A. Paschalides, C. Poulton, W. Todd, P. J. v.d. Bank and L. Vorster.

(*Students*); Messrs J. C. Simms and D. J. Hammond.

and nine visitors, making a total of forty-one.

Minutes of the Annual General Meeting

As the minutes of the Annual General Meeting held on the 4th August, 1971 had not been published in the Journal, it was moved that the adoption and discussions thereof be deferred to the next General Meeting.

Demonstration and talk by Messrs J. W. Wilson, G. T. G. Emere and H. D. S. Miller

The meeting proceeded to the Rock Mechanics Department of the Anglo American Research and Development Division where Mr Emere demonstrated and discussed the Timber Press as well as the Minsim program for the mining of shaft pillars and remnants.

Mr Wilson demonstrated and discussed the use of the Analogue.

Mr Miller discussed the work done on Comminution Rock Mechanics.

The presentations of these talks and demonstrations were very interesting and entertaining and all present found this type of meeting to be very informative.

After all those present had reassembled in the canteen Mr Meyer proposed a vote of thanks to Messrs Wilson, Emere and Miller on behalf of all the members of the O.F.S. Branch.

After thanking all present for their attendance, the Chairman declared the meeting closed at 6.00 p.m.

SA FACES COMPETITION FOR MINERAL MARKETS

South Africa must prepare now to meet the challenge from other developing countries for her share of the mineral export market, said the Minister of Mines. Dr de Wet was speaking at the foundation stone ceremony of the new R6-million complex for the National Institute of Metallurgy.

"Many countries", said Dr de Wet, "are now actively engaged in exploration for new mineral deposits and developing mineral exports to the American, European and Japanese markets. It would be foolhardy in the extreme to expect that our unique situation as regards platinum, chrome, diamonds and several other minerals is likely to continue; and we must face up to the situation that exports of minerals and mineral products will depend on our developing mining, processing and marketing techniques which are better than our competitors'. Research and technical development work will play a most important role in establishing our competitive position".

Dr de Wet expressed concern that there were less than 200 students in South Africa's four university departments of Mining and Metallurgy, of whom a small fraction were specifically interested in extraction metallurgy and mineral processing.

Replying to the Minister, Dr R. E. Robinson, Director of the Institute, said:

"If we are to expand our exports of minerals and mineral products our technical expertise is going to have to be of the very highest order. We shall have to dispel the naive belief that we can purchase technology from big brother overseas and then hope to compete with him in international markets. We must now develop our own processes, specifically designed to suit our particular requirements, and use every local advantage to make us competitive in world markets."

The National Institute for Metallurgy, now housed at Milner Park, is able to do less than 40% of the research work it should be undertaking for both Government and the private sector, because of limited facilities. The new complex is being built at Randburg (16 km north of Johannesburg and easily accessible from Pretoria and Pelindaba). The final phase is due for completion in April 1974.

INDEX TO SOUTH AFRICAN PERIODICALS

The Johannesburg City Librarian, Miss A. H. Smith, has drawn our attention to the fact that the above bibliographical work has been produced annually by the Johannesburg Public Library since 1945.

The *Index* is an alphabetical list of articles appearing in South African Periodicals, and is arranged under the name of the author and the subject. It should be of value to all research workers concerned with current South African material.

The *Index* may be consulted in the Reference Department of the Johannesburg Public Library and in most of the larger libraries in the country. The current issues are also obtainable from the Johannesburg Public Library at R10,00 per annual volume.

SYMPOSIUM ON THE ANALYTICAL CHEMISTRY OF THE PLATINUM-GROUP METALS

The National Institute for Metallurgy and the South African Chemical Institute (Southern Transvaal Section) are the joint sponsors of a symposium to be held at the University of the Witwatersrand, Johannesburg, between 2nd and 4th February, 1972.

The purpose of the symposium is to help promote the close examination of the analytical procedures currently used and to encourage the dissemination of data relating to methods of analysis for the platinum-group metals and associated gold.

The guest speaker at the symposium will be Mr G. H. Faye, who is a Research Scientist in the Department of Energy, Mines and Resources, Ottawa, Canada.

SYMPOSIUM OOR DIE ANALITIESE CHEMIE VAN DIE PLATINUMGROEPMETALE

Die Nasionale Instituut vir Metallurgie en die Suid-Afrikaanse Chemiese Instituut (Afdeling Suid-Transvaal) sal 'n simposium wat by die Universiteit van die Witwatersrand, Johannesburg, tussen 2 en 4 Februarie 1972 gehou sal word, gesamentlik borg. Die doel van hierdie simposium is om te help 'n moderne ondersoeking van analitiese metodes tans in gebruik aan te dui en die verspreiding van data in verband met metodes vir ontleding van die platinumgroepmetale en bybehorende goud, aan te moedig.

Die besoekende spreker op die simposium sal mnr. G. H. Faye wees, wat 'n navorsingswetenskaplike in die Departement Krag, Mynbou en Hulpbronne, Ottawa, Kanada, is.

THE ASSOCIATION OF EXPLORATION GEOCHEMISTS

The Fourth International Geochemical Exploration Symposium will be held at the Institution of Electrical Engineers, London, England from 17th to 20th April 1972.

Particulars and registration forms may be obtained from
The Secretary,
The Institution of Mining and Metallurgy,
44 Portland Place,
London WIN 4BR.
ENGLAND.