"The Bolsover Story"

NATIONAL COAL BOARD

EAST MIDLANDS DIVISION • AREA No. 1

BOLSOVER • DERBYSHIRE

"The Bolsover Story"

AN EXPERIMENT TO REDUCE THE COST OF COAL PRODUCTION AND TO ALLEVIATE THE DIFFICULTIES ARISING FROM THE DECLINE IN MANPOWER IN THE COAL MINING INDUSTRY

NATIONAL COAL BOARD
EAST MIDLANDS DIVISION · AREA No. 1
BOLSOVER · DERBYSHIRE

Foreword

BY SIR HUBERT HOULDSWORTH, K.C., D.Sc.

Chairman, East Midlands Division

A PROGRESSIVE industry must ever be searching for ways and means of increasing its efficiency. Such search is particularly necessary in a great basic industry like coalmining, afflicted, as it is, with a difficult manpower problem, and in which a substantial reduction in production costs, and consequently in selling price, would lower, materially, production costs in many other industries.

The experience of a relatively efficient coal producing district (e.g. the East Midlands Division) indicates that a reduction in cost of production is unlikely to be attained in sufficient magnitude or in sufficient time by traditional methods of mining, if present wage levels are maintained. The overall O.M.S. of saleable coal in the East Midlands Division increased from 31.7 cwts. in 1948 to about 34.3 cwts. in 1950, without improvement in wages costs or in total costs.

It is necessary to seek urgently for changes in technique of wide applicability, and for improved machines, which will bring about quickly a pronounced increase in O.M.S., both face and overall, and so enable the coalmining industry to produce all the coal required for inland consumption and for export with the manpower likely to be available in a period of full employment. At the same time, the changes should result in a substantial reduction in the cost of production, and, if possible, all this should be secured without a heavy capital expenditure programme. Experiments, of which the "Bolsover Experiment" was one, were started about twelve months ago, the emphasis at that time being to secure, if possible, a substantial reduction in production costs, whilst maintaining weekly earnings. During the course of the experiments, because of the decline in the industry's manpower (the East

Midlands Division has lost some 3,700 adult workers to date this year, of which about 600 are coal face men), the saving of manpower envisaged in the experiments became of primary importance, although the reduction in the cost of production retained its full value.

It now seems appropriate to bring the results so far obtained in this particular experiment, which has taken place at a pit nearly sixty years old, to the notice of management and of Colliery Consultative Committees throughout the Division.

A great debt is owed by the Divisional Board to Mr. W. V. Sheppard, the Area General Manager, for his courage in putting forward the project, and for his skill and determination in its execution, and to those Area Officials who were actively and closely associated with him:—Mr. J. Brass, Production Manager; Mr. J. N. Booth, Mining Development Engineer; Mr. J. Mawson, Mechanisation Officer; Mr. J. C. Jeffrey, Planning Engineer; and Mr. G. Bishop, Manager at Bolsover Colliery. The way of the pioneer is often hard and anxious, and these mining engineers have had to carry heavy responsibilities in the course of this experiment.

No experiment is likely to succeed unless there is mutual confidence between management and men, and wholehearted co-operation between all employed at the pit. At Bolsover there have been this full confidence and co-operation, and I pay tribute to all at Bolsover, management and men, for their determined efforts to make a success of this experiment. It was a great thing for the men at Bolsover to agree that one out of every two men would be prepared to transfer to other Pits in order that the experiment, which they were warned might fail, could be tried at that pit. I am most grateful to all the men and also to Alderman Bayliss, the President of the Notts. Area of the N.U.M., to Councillor M. Simpson, the Secretary of the Bolsover Branch, to Councillor S. T. Fisher, the President of the Bolsover Branch, and to their colleagues on the Branch Committee, for their constant help and faith in what, at first, were anxious and trying days. Rarely does an experiment succeed without great difficulties being encountered. But Alderman Bayliss, Councillor Simpson and Councillor Fisher and their colleagues, were never daunted, and their spirit was at all times an inspiration to a necessarily anxious management.

Possibly, one disappointment has been a blessing in disguise. The experiment, in its completeness, depends upon the use of the Gloster Getter or some other suitable face machine, but, because of the modifications which were found to be necessary in the selected face machine, and the consequent delay in production of the machine, the experiment was started up with hand-filling at the face. The results show, that with hand-filling, a material increase in O.M.S. and a reduction in manpower and production costs can be attained. Thus, where the conditions are suitable for the application of this method, material improvement can be effected quickly, even if there is delay in devising or manufacturing an appropriate face machine.

The results, now, are so encouraging that the Divisional Board can consider an extension of the system to other pits where the conditions are suitable, and it is hoped that a study of this brochure may assist in preparing the way for further advances.

It is anticipated that Gloster Getters will be in operation on all faces at Bolsover early in 1951, and the results thereby obtained will be given to management and Colliery Consultative Committees in the Division as soon as practicable.

Contents

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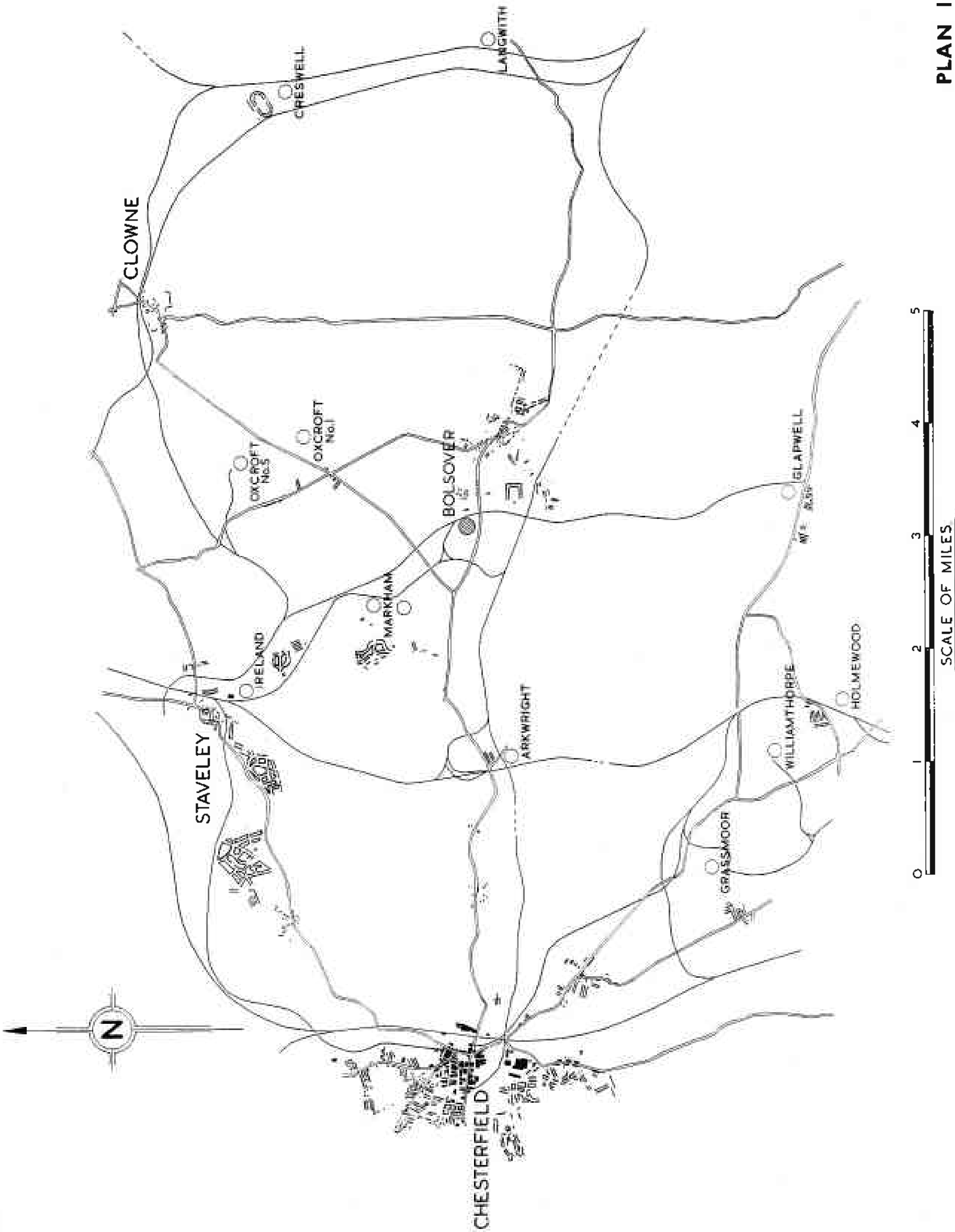

N
CLOWNE
CRESWELL
LANGWITH
OXCROFT No.5
OXCROFT No.1
BOLSOVER
MARKHAM
IRELAND
STAVELEY
ARKWRIGHT
GLAPWELL
HOLMEWOOD
WILLIAMTHORPE
GRASSMOOR
CHESTERFIELD
0 1 2 3 4 5
SCALE OF MILES

PLAN I

Introduction

BY W. V. SHEPPARD

THE principles underlying the "Bolsover System" of mining are not new. For many years it has been my aim to adapt the Longwall system of coalmining to continuous mining methods. An article in the *Colliery Guardian*, dated June 30th, 1949, set out my considered views on the subject, and it is hardly worthwhile covering the ground of that article in this introduction. Rather it is desired to set out clearly how it became possible to apply the ideas at the Bolsover Colliery and then to observe, but briefly, on the system's basic principles.

On Tuesday, July 15th, 1949, Sir Hubert Houldsworth, Chairman of the East Midlands Divisional Board, at a meeting with AREA GENERAL MANAGERS at the Divisional Headquarters, threw down a challenge somewhat in the following terms:—

> If the Mining Industry was to make its full contribution to Great Britain's economic recovery, the selling price of coal must be reduced by 10 to 20 shillings per ton.
>
> Such a reduction must be brought about quickly.
>
> The necessary result must be achieved without vast capital expenditure.
>
> There must be no thought of achieving the necessary result either by an attack on wages or by increasing the workers' daily effort, in a Division where great effort was already being made.

Such were our terms of reference and in these terms of reference I saw a golden opportunity of demonstrating the soundness of those ideas which were started in my mind many years ago, and which found their culminating expression in the article to which I have referred. I immediately took up the Chairman's challenge and asked for facilities to carry out an experiment at the Bolsover Colliery.

There was an immediate response and I was invited to submit a detailed project to the Board. This was done at the beginning of

August, 1949. The full details of the proposed experiment were set out in a project report to the Board, and to illustrate the aim of the project I cannot do better than quote from the introductory paragraph to that project report.

"The economic position of the country to-day demands an urgent and drastic reduction in the selling price of coal.

	Per Ton s. d.
Current selling price—Bolsover Colliery	45 6
Desired reduction in selling price	20 0
Allowed profit margin	3 6
Operating costs	22 0

The above calculation constitutes the foundation stone of this project, the object of which is to demonstrate the practicability of producing the necessary efficiency to achieve a reduction in the selling price of coal of 20s. per ton at a typical British mine under average British conditions".

The technical details of the system will be found in subsequent pages of this brochure, and at this stage it is only necessary for me to observe upon the basic general principles of the system:—

With wages held at present levels, only a spectacular increase in mining efficiency can give the desired results. A spectacular increase in overall O.M.S. is therefore a prime necessity.

With the high prices ruling for plant and equipment, the best use of the optimum amount of machinery has to be made if depreciation costs are to be held. Double shifting, at least, of a pit is therefore necessary.

The best use must be made of *natural* underground support, so that all main and secondary roadways must have full pillar support and all gates must have, at least, ribside protection.

There must be the highest possible concentration of workings with the necessary high rate of development.

A simple transport system involving minimum "dead" manpower requirements is necessary.

A simple and efficient surface layout designed to facilitate three or two shift working with maximum economy of manpower is required.

The coal-getting operations must be based on the rapid removal of "slices", and the faces must either be on alternate advance and retreat, full retreat, or—where gates in the goaf stand for a reasonable time—full advance. The success of the system must not depend on any one machine. The system itself is independent of any machine though it is desirable rapidly to remove the "slices" from the face by suitable mechanical means.

There is no place for excessive front rippings and no place at all for back rippings. Likewise, any stone work, other than limited ripping or dinting at the working faces, must be confined only to essential cross-measure drifting as dictated by faulting or entry to subsequent seams of coal.

The "Bolsover System" is based upon a day-wage to all workers. Though a day-wage system is not necessarily an integral part of continuous mining systems, it has its advantages at a colliery where labour relations are excellent.

Under existing mining practice, the cost of overtime and week-end work is substantial. With the "Bolsover System" a full shift is worked by all, there is no overtime, and week-end work is confined to necessary maintenance by tradesmen.

As each member of the relatively small teams of workmen perform varied tasks, a day-wage system of payment is attractive. It, of course, places a premium on efficient managerial organisation and also upon the team-spirit of the men. In the Bolsover price list the N.U.M. gladly co-operated in inserting a "Fair Day's Work Clause" agreeing to join in disciplinary action against anyone not pulling his weight in the team.

There is little doubt that, given good labour relations, the day-wage system does give satisfaction to the men, and there is no doubt at all as to its economic advantages. A day-wage system of payment reduces the number of clerks required—in point of fact at the Bolsover Colliery it has enabled the clerical staff to be cut by more than one half.

No introduction would be complete without reference to the aspect of labour relations. The success of the "Bolsover System", as I have emphasised, does not depend upon the use of any one machine, but its success does depend upon the whole-hearted co-operation of the men. At Bolsover the spirit of co-operation was there. When the men were addressed by Sir Hubert Houldsworth and Alderman W. Bayliss, though it was made clear that the project was only in the nature of an experiment and though it was made clear that over one half of the men then employed would become redundant at Bolsover, not one dissentient voice was raised. Need more be said?

Finally, what of the future?

Any system which can transform mining efficiency at a pit and, in present circumstances, reduce substantially the manpower required at the pit within a period of twelve months from planning to realisation is worthy of consideration.

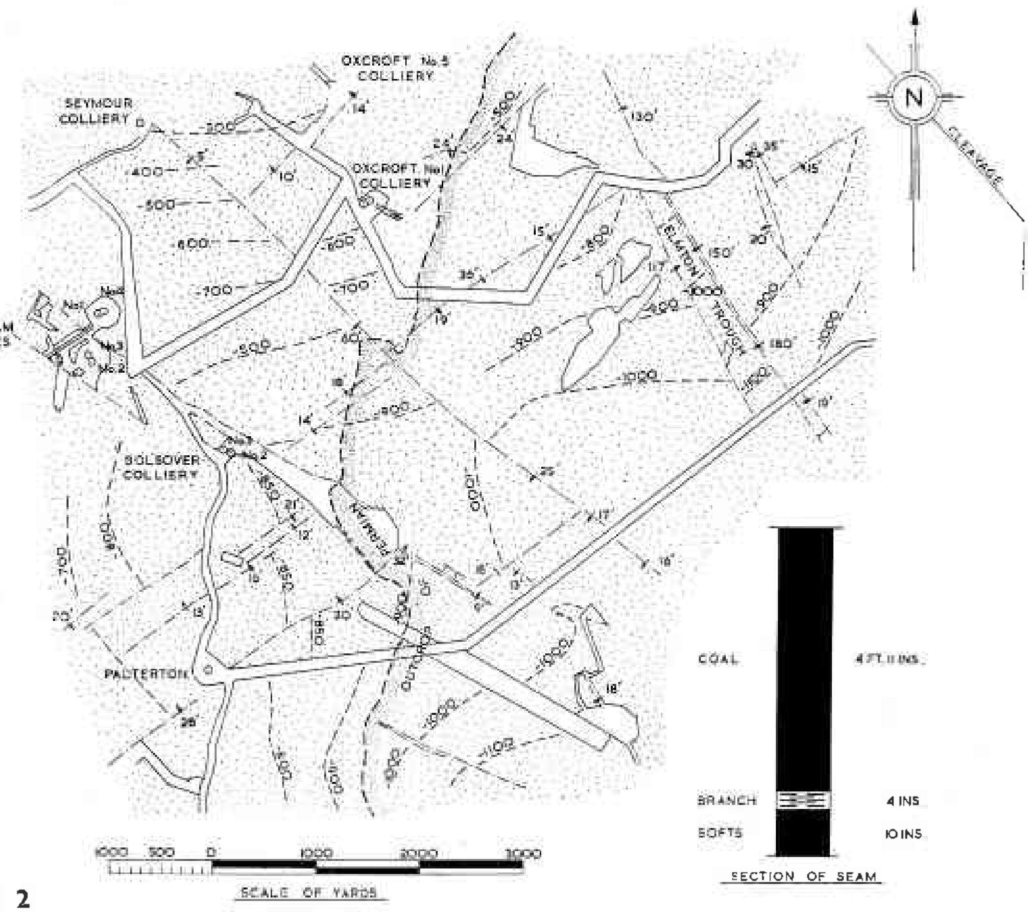
In seams where headings will behave satisfactorily, as narrow drivages, there is immediately available efficient machinery for economic working. Where a wider place or "breasting" has to be taken to ensure satisfactory main road conditions, or where it is essential to stow dirt at the working face, then the question of efficiency is less easily answered. But it is not incapable of solution. In seams of 2 ft. 3 in. upwards we have experiments in hand to solve this urgent problem, because it is appreciated that rapid and economic development "in the solid" is essential to any application of the "Bolsover System". If we are to succeed with the greatest possible speed, the manufacturers of mining machinery must be made aware of the problem in all its detail.

There is no additional problem of marketing in the application of the "Bolsover System" to Bolsover Colliery, but if the system is to become more widespread, the fullest co-operation with the Marketing Department will be necessary in respect of sizes and qualities.

There is no doubt that the "Bolsover System" can be applied more or less generally. In Area No. 1 it is estimated that 75 per cent. of the coal can be mined by this system. It follows, therefore, that now is the time to start thinking in terms of the necessary machines and in terms of training officials in the system. The problem of training officials in the new system is not as difficult as it might appear at first sight. The system itself is simple, and we propose to use Bolsover as a training pit.

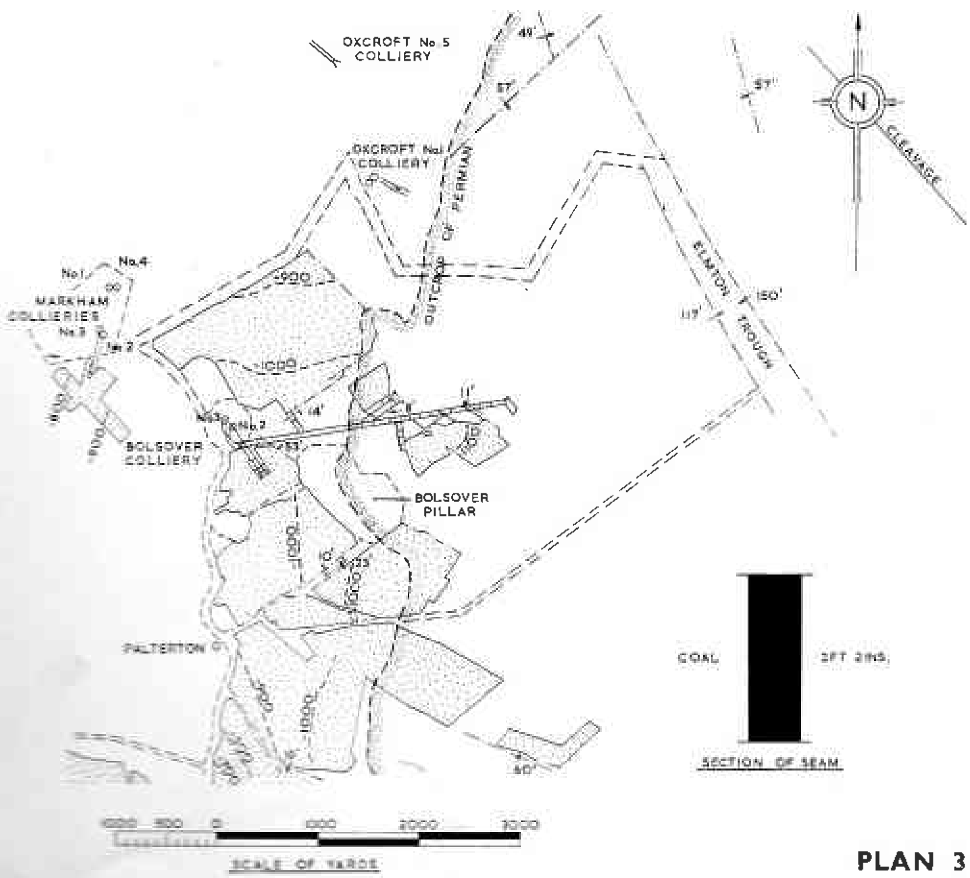
Those engaged in the planning and implementation of the "Bolsover System" have experienced many difficulties and set-backs, but the road is now clear and it is hoped that this brochure will enable pitfalls to be avoided elsewhere.

TOP HARD SEAM



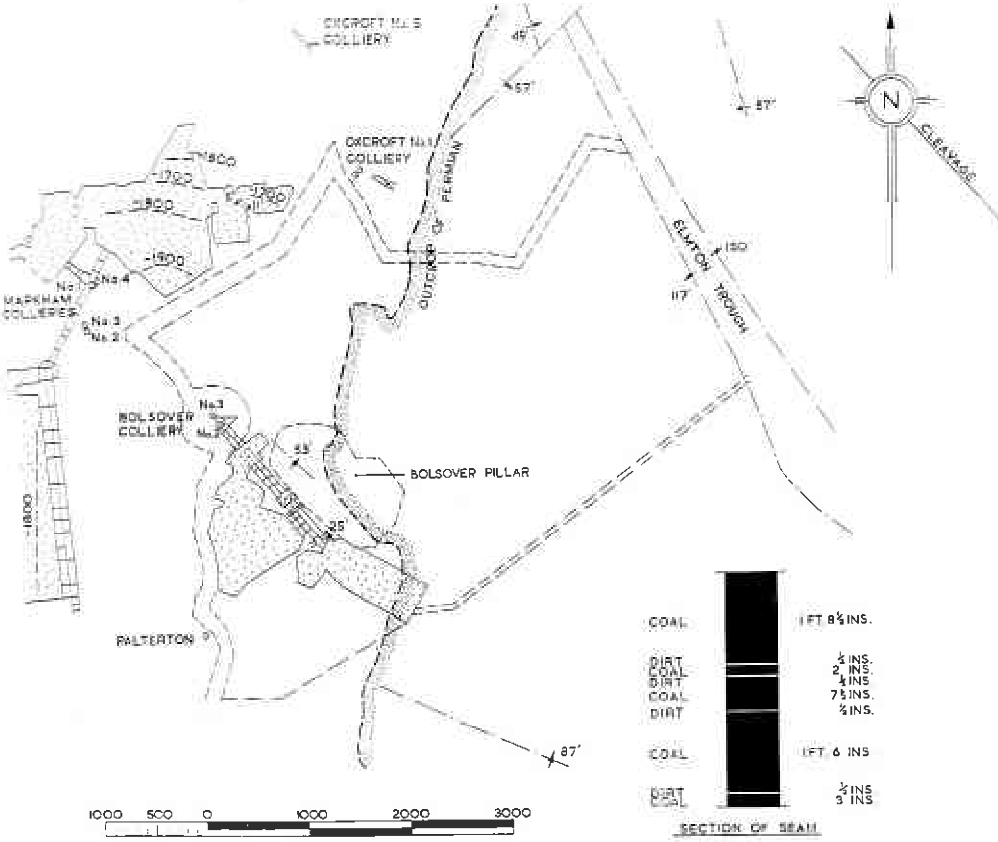
PLAN 2

FIRST WATERLOO SEAM



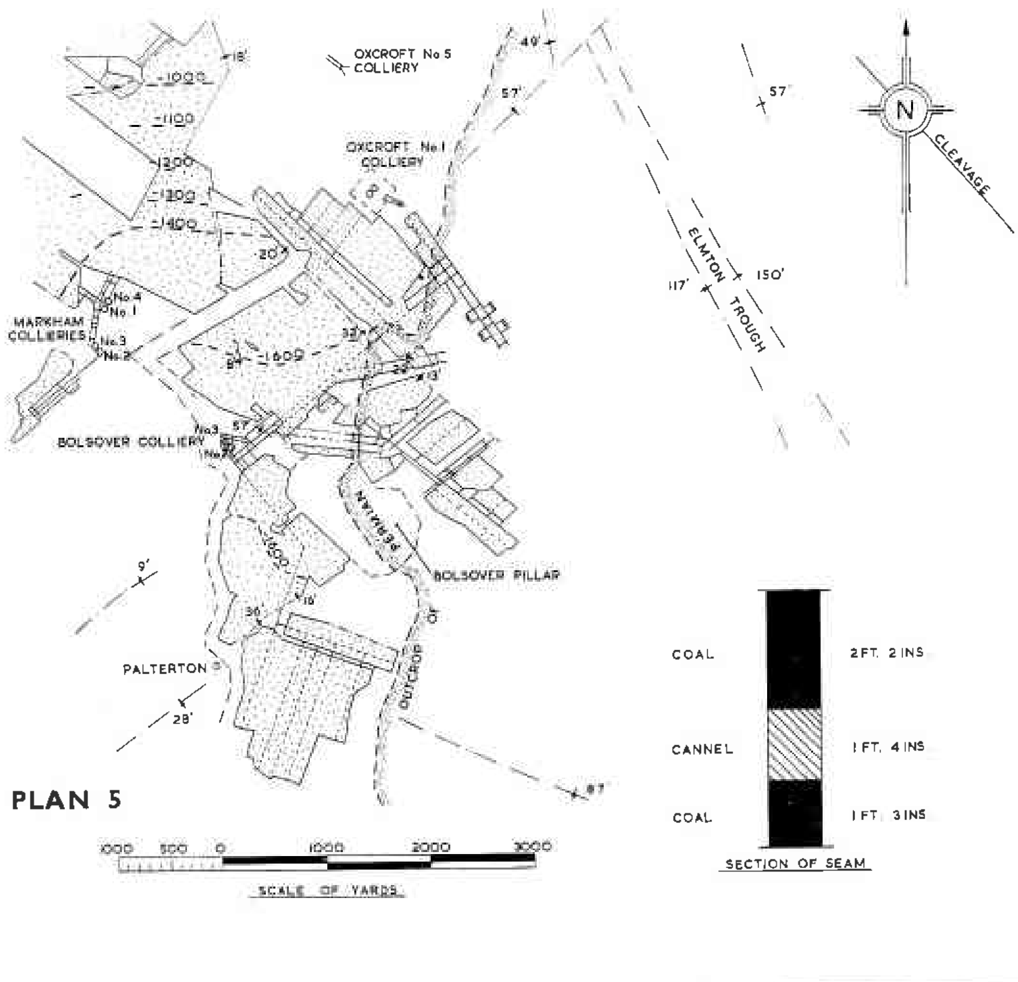
PLAN 3

BLACKSHALE SEAM

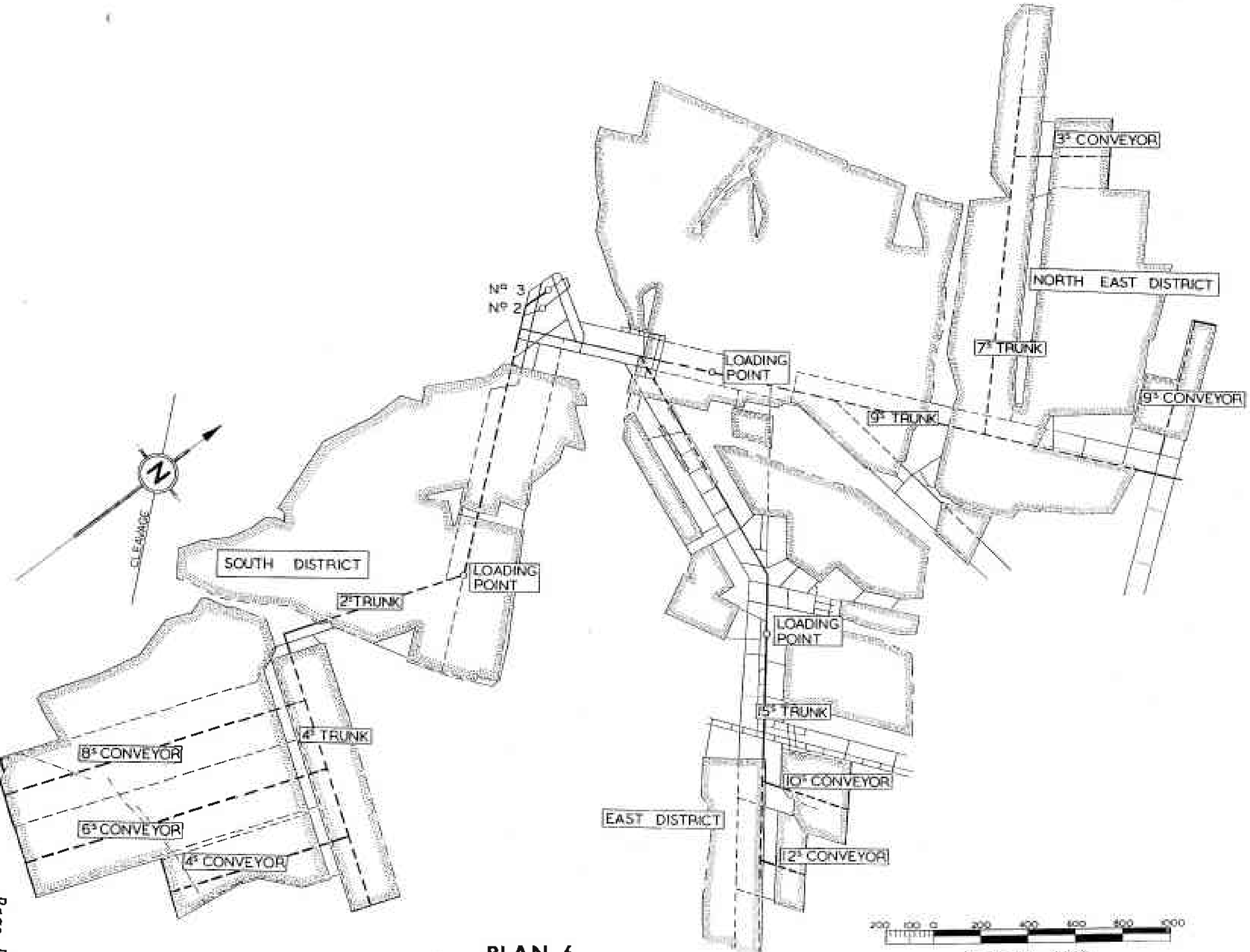


PLAN 4

DEEP HARD SEAM

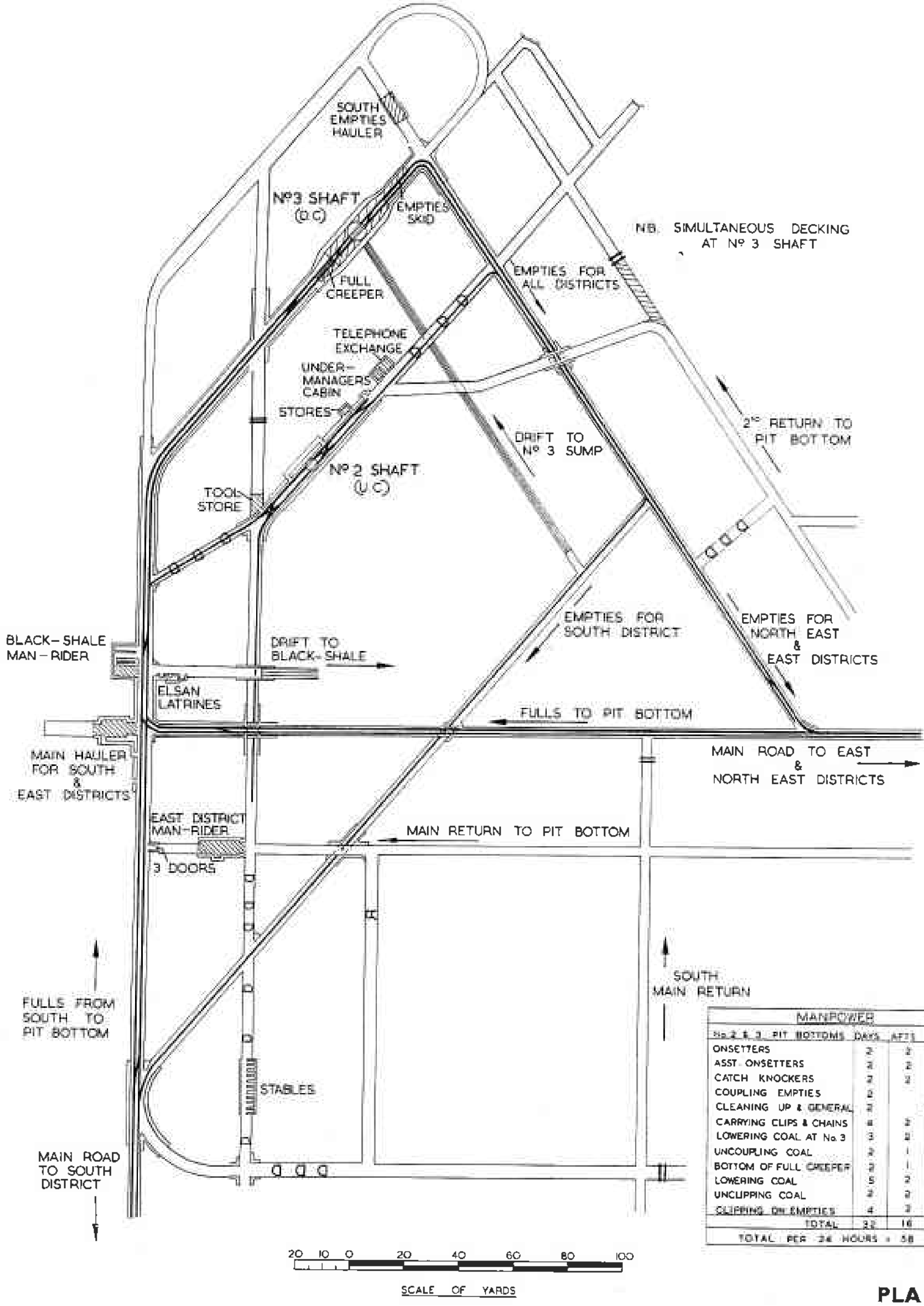


PLAN 5


3D CONVEYOR
NORTH EAST DISTRICT
7T TRUNK
9S CONVEYOR
9S TRUNK
LOADING POINT
Nº 3
Nº 2
CLEAVAGE
SOUTH DISTRICT
LOADING POINT
2S TRUNK
LOADING POINT
15S TRUNK
10S CONVEYOR
EAST DISTRICT
12S CONVEYOR
4S TRUNK
8S CONVEYOR
6S CONVEYOR
4S CONVEYOR
200 100 0 200 400 600 800 1000
SCALE OF YARDS

PLAN 6

PIT BOTTOMS BEFORE REORGANISATION



MANPOWER			
No. 2 & 3 PIT BOTTOMS	DAYS	AFTS	NIGHT
ONSETTERS	2	2	2
ASST. ONSETTERS	2	2	2
CATCH KNOCKERS	2	2	2
COUPLING EMPTIES	2		
CLEANING UP & GENERAL	2		
CARRYING CLIPS & CHAINS	4	2	7
LOWERING COAL AT No. 3	3	2	
UNCOUPLING COAL	2	1	
BOTTOM OF FULL CREEPER	2	1	
LOWERING COAL	5	2	
UNCLIPPING COAL	2	2	
CLIPPING ON EMPTIES	4	2	
TOTAL	32	16	10
TOTAL PER 24 HOURS = 58			

PLAN 7

THE TECHNICAL DETAILS

Bolsover Colliery before Reorganisation

GENERAL

The Bolsover Colliery is situated in the County of Derbyshire some five miles east of Chesterfield, as shown on Plan 1.

The Colliery started producing coal in 1891, and has been modernised to some extent on the surface and underground.

The Top Hard Seam has been completely extracted, and the reserves of the First Waterloo and Blackshale Seams have been partially worked and abandoned in favour of the Deep Hard Seam, which is the only seam being worked at the present time. Plans 2–5 show the extent of the workings in the four seams.

An average daily saleable output of 2,340 tons was produced in 1949 from the Deep Hard Seam from a depth of 623 yards.

The performance of the Colliery was as follows:—

Face-	O.M.S.	87.7 cwts.
Underground	O.M.S.	43.4 cwts.
Surface	O.M.S.	139.3 cwts.
Overall	O.M.S.	33.1 cwts.

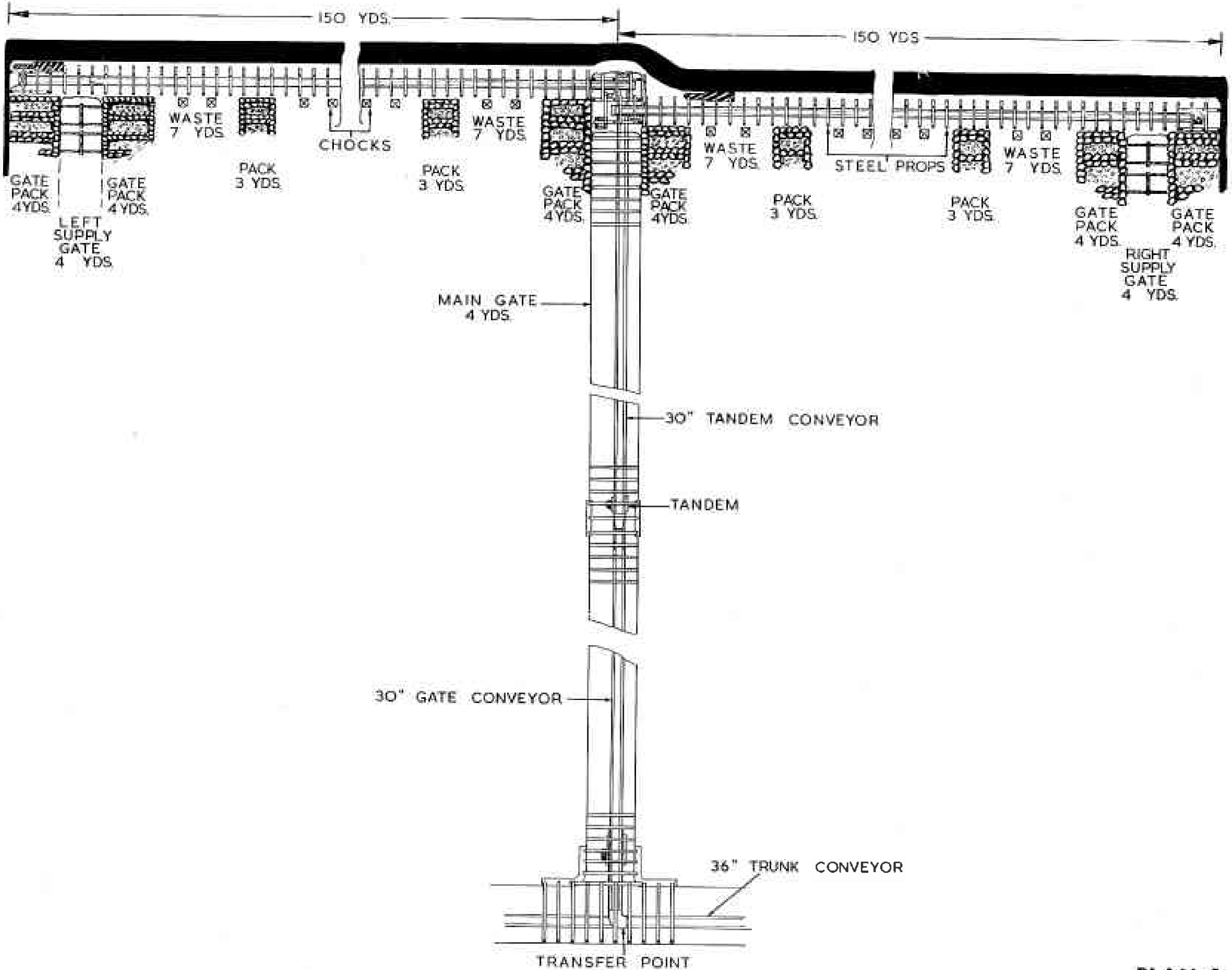
THE UNDERGROUND LAYOUT AND FACE OPERATIONS

The output was won from three main districts, as shown on Plan 6.

In the South District three double unit faces were worked, delivering their output on to a 36-in. conveyor system—thence to an under-rope endless haulage, 1,800 yards long, delivering the coal in tubs to the Pit Bottom.

In the East District the output from two double unit faces was gathered to a district loading point by a 36-in. trunk conveyor—the coal being transported thence to the Pit Bottom by an over-rope endless haulage, with a change point at the main N.E. haulage road.

A CONVENTIONAL FACE



PLAN 8

In the North East District output was produced by two double unit faces, 3B on one 36-in. trunk system, and 9's on the main trunk system. Coal from these two faces was loaded at a loading point on the N.E. haulage road, and was transported thence by under-rope and over-rope haulage systems, in tandem, to the Pit Bottom.

The Pit Bottom arrangements were not good for the large output wound. No. 3 Shaft and Pit Bottom could only deal with 2,000 tons per shift, and this with a heavy labour force, in spite of simultaneous decking. Surplus output over 2,000 tons per shift was wound from No. 2 Upcast shaft, again involving a heavy labour force. Plan 7 shows the Pit Bottom arrangements and manpower.

The normal longwall advancing system was employed with double unit faces, 300 yards long, carrying a centre and two supply roadways and equipped with 26-in. Meco face conveyors of the bottom loading type, running on structure and delivering on to Meco top loading 30-in. gate conveyors (see Plan 8).

The faces were undercut 5 feet by Samson or A.B. coalcutters, the coal being drilled and shot in the normal way. The cycle of operations was as follows:—

Dayshift - - - -	Filling.
Afternoon shift - -	Cutting, turning over and packing.
Night shift - - -	Drawing off and ripping.

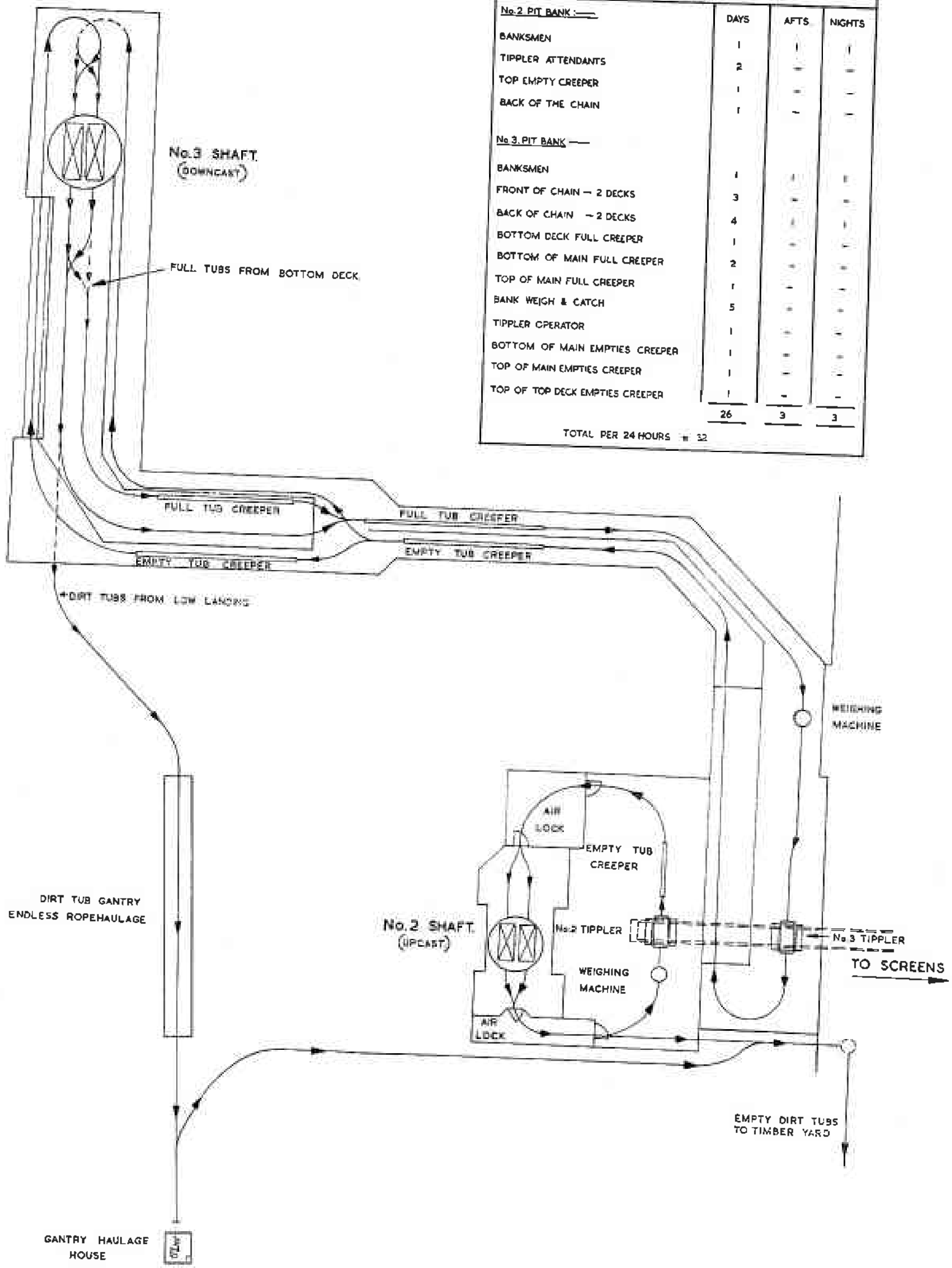
The seam section varied from 2 ft. 10 in. to 3 ft. 10 in.—face support being by rigid steel props and corrugated 7-ft. bars, and waste support being by 3 yard packs and 5 yard to 7 yard wastes. By preventing the wastes breaking the optimum face conditions were produced, and this practice has always been rigidly adhered to, even to the extent of a loss of coal as packing material.

Main gate rippings were large, dinting and ripping operations at the face involving a labour force of nine men. It was also the practice to backrip main gates and remove the face cambers, replacing them with arch girders. This operation involved a further two men, and made an excellent roadway. Supply gates were supported by wooden herring-bones and required a team of five rippers.

MANPOWER

	DAYS	AFTS.	NIGHTS
No. 2 PIT BANK :—			
BANKSMEN	1	1	1
TIPPLER ATTENDANTS	2	—	—
TOP EMPTY CREEPER	1	—	—
BACK OF THE CHAIN	1	—	—
No. 3. PIT BANK —			
BANKSMEN	1	1	1
FRONT OF CHAIN — 2 DECKS	3	—	—
BACK OF CHAIN — 2 DECKS	4	1	1
BOTTOM DECK FULL CREEPER	1	—	—
BOTTOM OF MAIN FULL CREEPER	2	—	—
TOP OF MAIN FULL CREEPER	1	—	—
BANK WEIGH & CATCH	5	—	—
TIPPLER OPERATOR	1	—	—
BOTTOM OF MAIN EMPTIES CREEPER	1	—	—
TOP OF MAIN EMPTIES CREEPER	1	—	—
TOP OF TOP DECK EMPTIES CREEPER	1	—	—
	26	3	3

TOTAL PER 24 HOURS = 32



PLAN 9

THE SURFACE ARRANGEMENTS

The surface coal handling arrangements were involved and costly in manpower, as shown on Plan 9.

Bank staffs were necessary at both No. 2 and No. 3 shafts to deal with the daily output of 2,340 tons, although both coal tipplers fed a common conveyor system to the coal preparation plant.

The washery is a single box of the Baum type, and its hourly capacity is 150 tons of $3\frac{1}{2}$-in. coal. Due to this capacity limitation it was necessary to hand pick all coal above $3\frac{1}{2}$ in., involving a large screening staff. Plan 10 shows the coal preparation arrangements with manpower.

Qualities produced were nine in number:—

Hand picked	*Washed*
$+ 6''$	$3\frac{1}{2}'' \times 2''$
$6'' \times 3\frac{1}{2}''$	$2'' \times 1''$
$+ 3\frac{1}{2}''$	$1'' \times \frac{1}{2}''$
$3\frac{1}{2}'' \times 2\frac{1}{2}''$	$\frac{1}{2}'' — 0''$
	Filter Cake

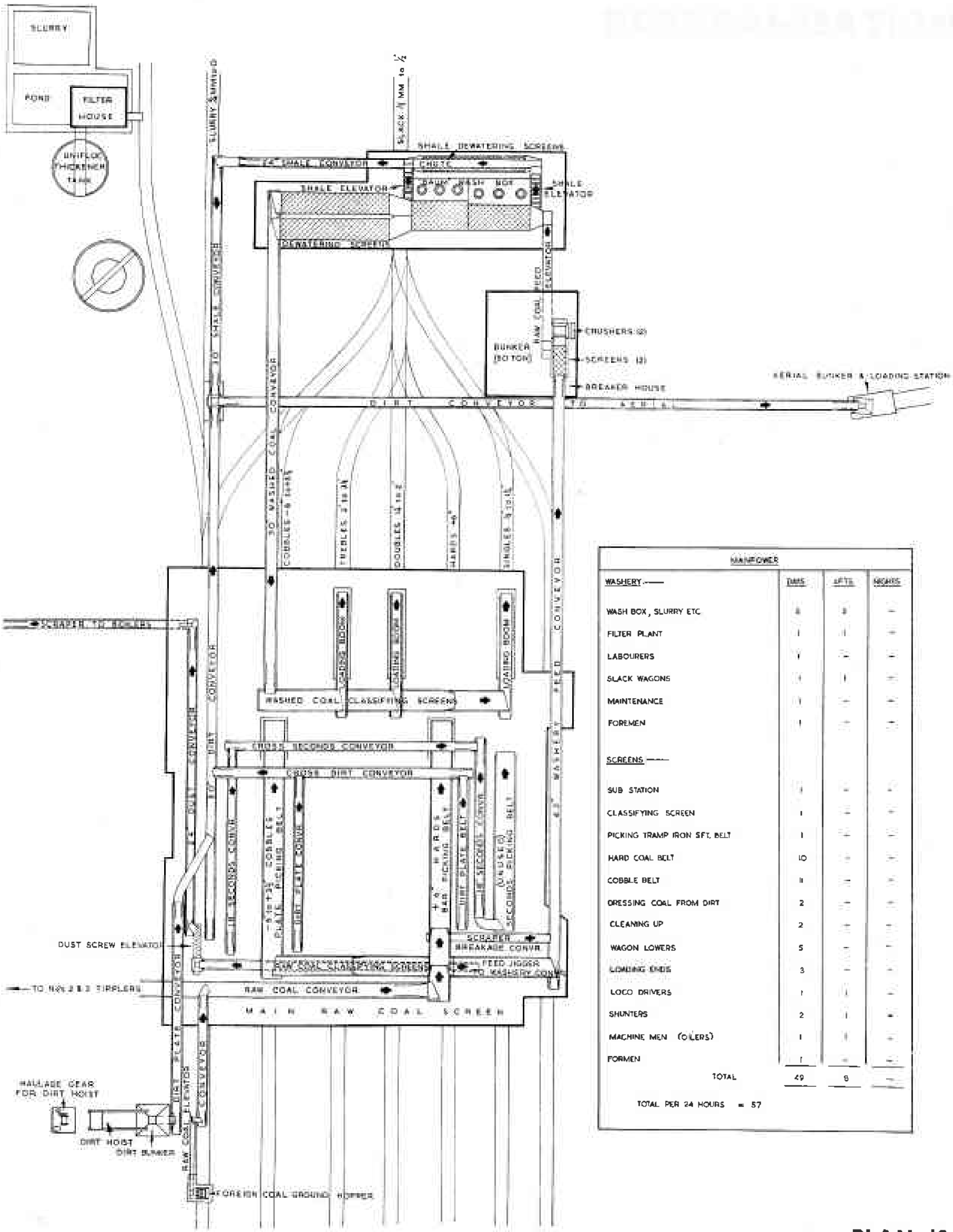
A band of cannel coal running in the seam and varying in thickness was picked out on the screens and sold as a separate quality.

Filter cake was produced in the flocculating plant for consumption in the colliery boiler plant.

There were two boiler plants at the colliery raising steam for the winding engines and the power station—the latter forming part of a ring main serving six collieries and their villages.

THE EXISTING PLAN OF DEVELOPMENT

Before the present reorganisation was considered, a scheme was in existence to concentrate the North East and East District outputs, by Trunk Conveyors, to a point near the pit bottom. Coal from the South District was to be trunk-conveyed to an in-bye loading point and from there, by locomotive haulage and mine cars, to the pit bottom.



MANPOWER			
WASHERY.—	DAYS	AFTS	NIGHTS
WASH BOX, SLURRY ETC	3	3	—
FILTER PLANT	1	1	—
LABOURERS	1	—	—
SLACK WAGONS	1	1	—
MAINTENANCE	1	—	—
FOREMEN	1	—	—
SCREENS.—			
SUB STATION	1	—	—
CLASSIFYING SCREEN	1	—	—
PICKING TRAMP IRON SFT. BELT	1	—	—
HARD COAL BELT	10	—	—
COBBLE BELT	11	—	—
DRESSING COAL FROM DIRT	2	—	—
CLEANING UP	2	—	—
WAGON LOWERS	5	—	—
LOADING ENDS	3	—	—
LOCO DRIVERS	1	1	—
SHUNTERS	2	1	—
MACHINE MEN (OILERS)	1	1	—
FORMEN	1	—	—
TOTAL	49	8	—

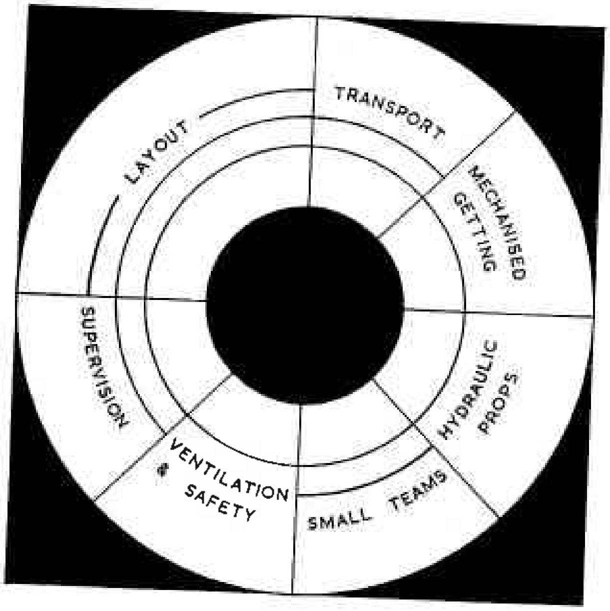
TOTAL PER 24 HOURS = 57

PLAN 10

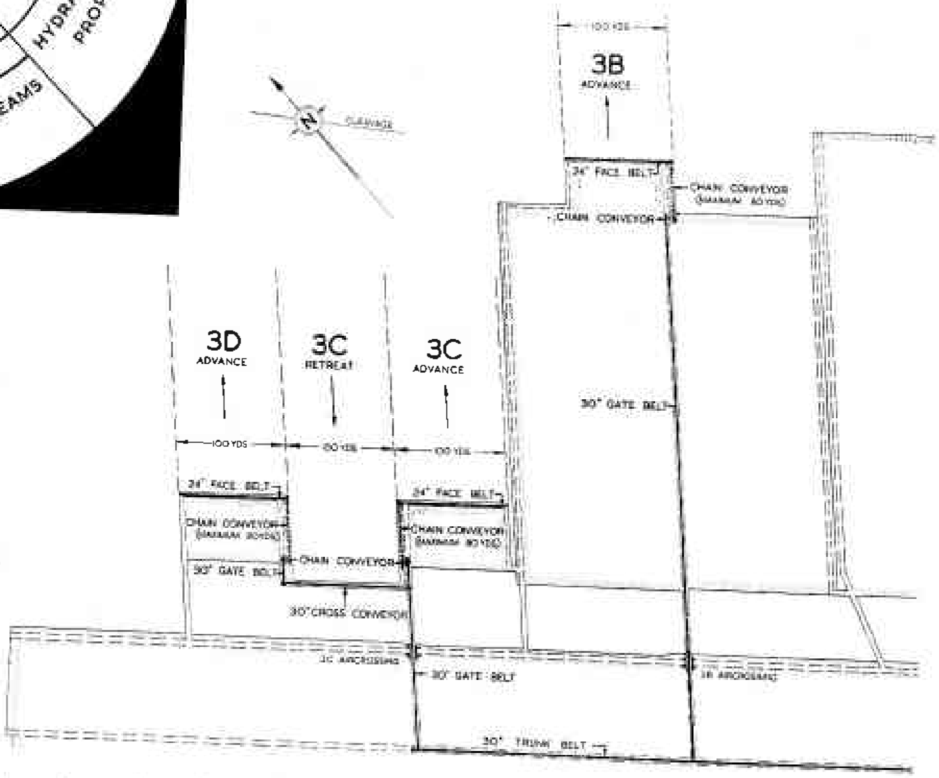
This scheme was devised to produce an overall O.M.S. of 40 cwts. by 1951, i.e. six years from its inception.

At the time of the experiment there had been completed only the projected gathering conveyors; the mine cars and locomotive installation, together with the necessary surface alterations, had not begun.

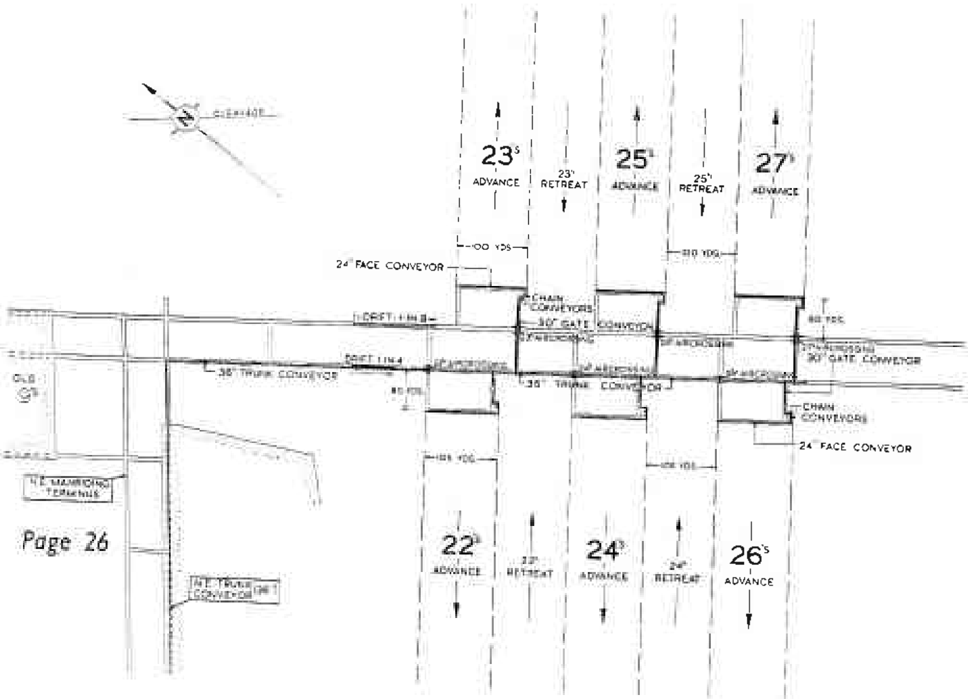
The above description gives a picture of a typical British Colliery drawing coal from a horizon which is neither deep nor shallow, from a seam neither thick nor thin, showing an O.M.S. improvement from 27 cwts. to 33 cwts. since Vesting Date and, in common with the majority of collieries, having a vast capital project in the making—destined ultimately to arrive at an O.M.S. of 40 cwts. overall.



PLAN 11



PLAN 12



PLAN 13

THE NEW SYSTEM AND ITS DEVELOPMENT

GENERAL

The "Bolsover System" of mining in essence is three shift production of coal from a concentration of a small number of short faces in one working district, with a simple transport system to a simple Pit Bottom and Surface.

Detailed planning of the system commenced in August, 1949.

Plan 11 shows in diagrammatic form the necessary component parts of the system—the size of segment being an indication of its relative importance within the system as a whole.

The short faces were planned to advance at the average rate of 20 yards per week in alternate 100-yard panels—the intermediate faces being retreated from the pre-determined boundary, which was fixed at a distance to obviate unnecessary repair work (i.e. roadways), to reduce walking distances, and at the same time make maximum use of natural coal pillar support.

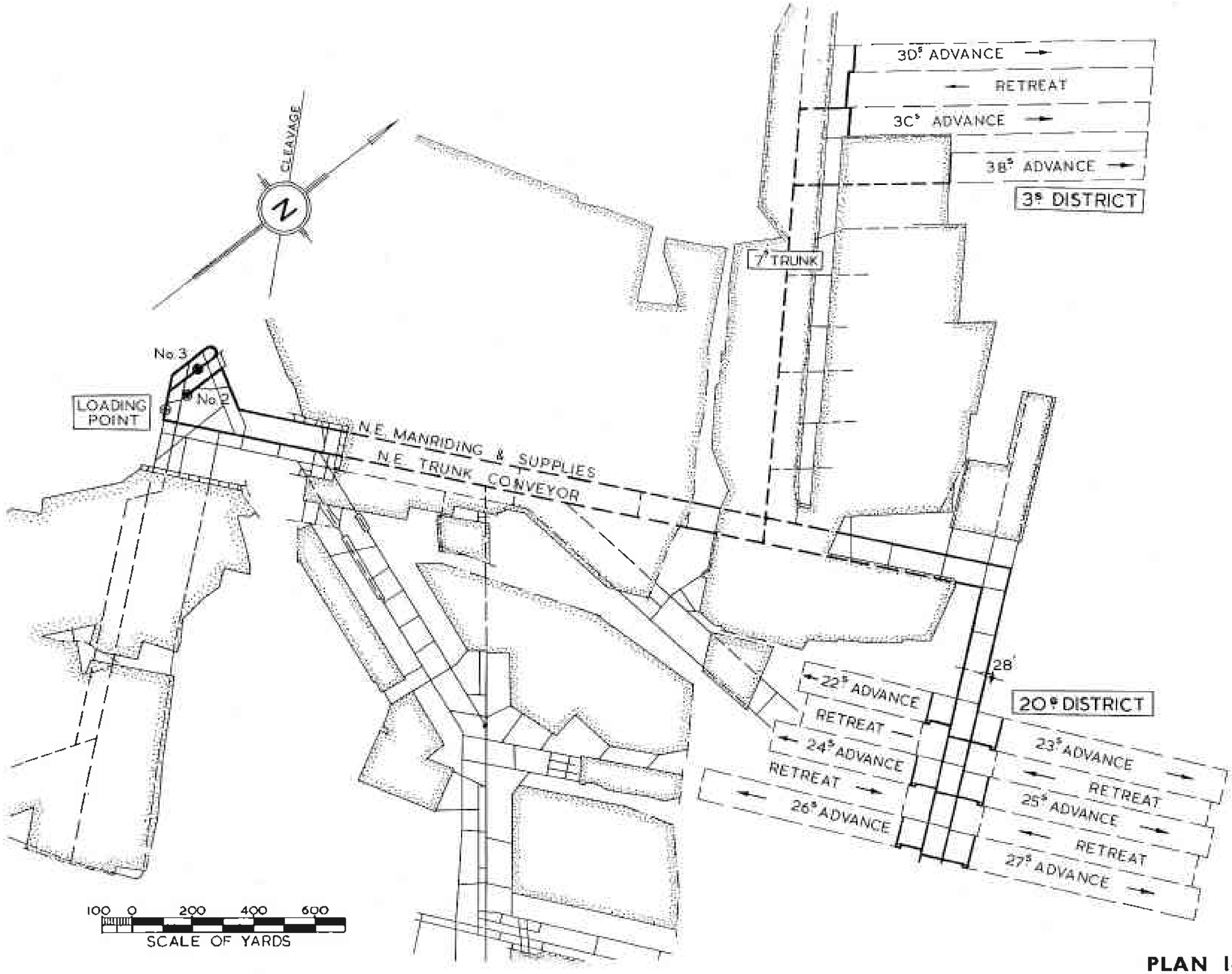
It was decided to produce a minimum daily saleable output of 2,400 tons on three shifts, each shift to wind 800 tons. Thus the minimum planned daily saleable output did not differ appreciably from the average daily saleable output of 2,340 tons in 1949.

Full implementation of the project was planned in two stages:—

The employment of two producing districts on a common trunk conveyor system.

A final concentration to one district where lie the major reserves of the N.E. area of the Deep Hard Seam.

Apart from the prudent aspect of commencing with two producing districts, this arrangement allowed the project to be implemented at a much earlier date—a factor which was assisted by the successful experiments in rapid face advance by hand methods—to bridge the period between the commencement of the project and the delivery of the number of Gloster Getters required for full mechanisation.


3D^S ADVANCE
RETREAT
3C^S ADVANCE
3B^S ADVANCE
3^S DISTRICT
CLEAVAGE
N
7^S TRUNK
No.3
No.2
LOADING POINT
N.E. MANRIDING & SUPPLIES
N.E. TRUNK CONVEYOR
28'
22^S ADVANCE
RETREAT
24^S ADVANCE
RETREAT
26^S ADVANCE
20^S DISTRICT
23^S ADVANCE
RETREAT
25^S ADVANCE
RETREAT
27^S ADVANCE
100 0 200 400 600
SCALE OF YARDS

PLAN 14

In the initial stage of the project two producing districts were planned, 3's and 20's, both served by a common trunk conveyor system. These districts are shown in detail on Plans 12 and 13.

It will be seen that each district is self-contained, 3's having two faces available for working, with one spare face; 20's district has three working faces with one spare unit.

These districts together can produce a daily saleable output of 3,000 tons, including development coal.

Eventually it is hoped to have five working faces on 20's district, with two spare units, giving an output capacity of 3,200 tons, including development coal.

The second stage will provide the highest degree of concentration, thus enabling "other" underground labour to be reduced to an absolute minimum.

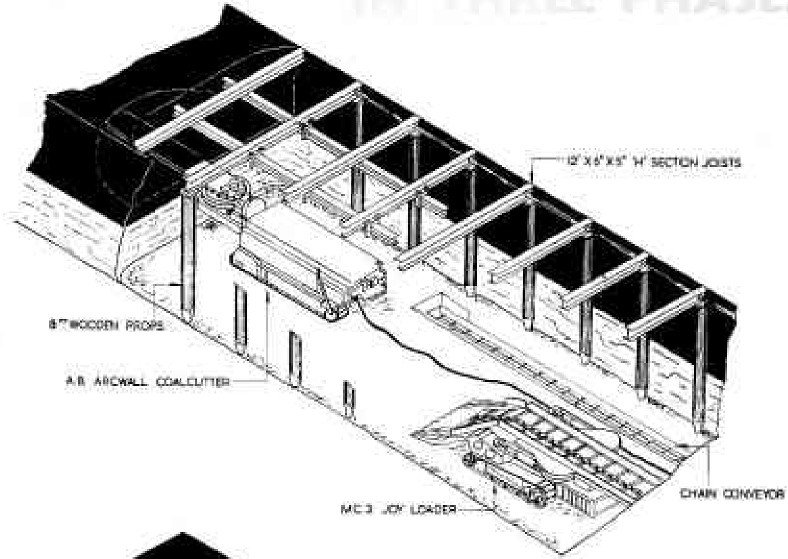
UNDERGROUND DEVELOPMENT WORK AND LAYOUT

Headings and Faces

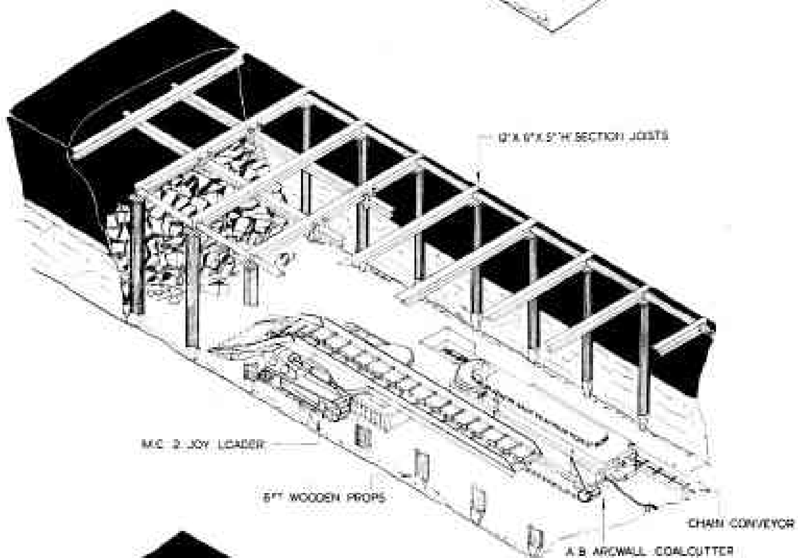
Plan 14 shows the general development layout of 20's district in the North East area. Two main district arteries were driven 12 ft. wide and 8 ft. 6 in. high, by simultaneous heading and dinting—the roof, of a strong nature, being left unbroken and being supported by 12 ft. by 6 in. by 5 in. "H" section joists set on 8-ft. wooden props. The main headings were driven at 80 yards centres, and the face headings were driven 80 yards from the main headings. The large "bearer" pillars are considered to be a major factor at Bolsover Colliery in preserving the headings from damage during the main extraction, and from "creep" due to depth.

The "American" or mechanised room and pillar venture failed at Bolsover, in 1945, due to multiple headings being driven at short centres, leaving inadequate pillar support. The overall 240-yard "bearer" pillars in the "Bolsover System" are sufficiently broad to be retreated economically in the final extraction.

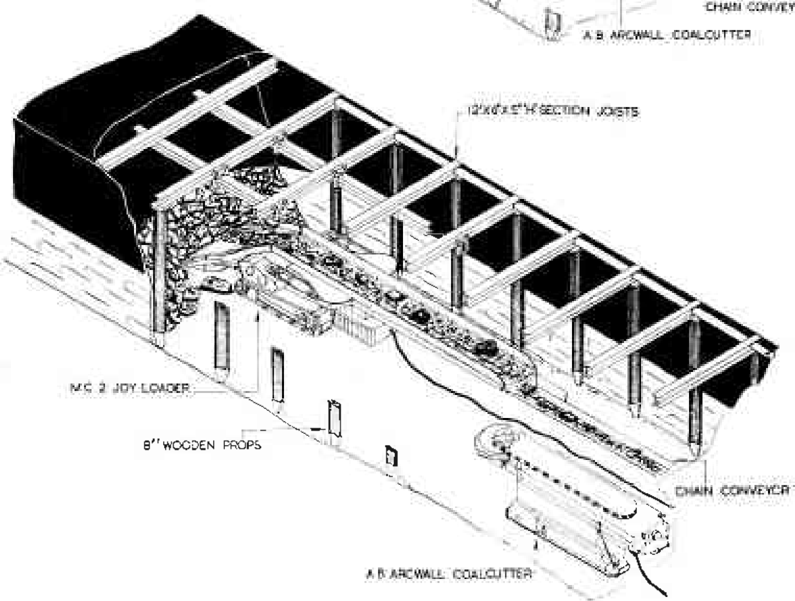
MAIN HEADINGS—INCLUDING EQUIPMENT—SHEWING CUTTING, TIMBERING AND LOADING IN THREE PHASES



PLAN 15 (a)
CUTTING



PLAN 15 (b)
FIRED AND TIMBERED



PLAN 15 (c)
LOADING

Plans 15 (*a*), (*b*) and (*c*) show the detail of the main headings and their equipment.

The main headings are each fully mechanised, with an M.C.2 Joy Loader, an A.B. arcwall coalcutter on caterpillars, chain conveyor, drilling machine, auxiliary fan, and the necessary electrical switchgear.

The headings are manned by three men per shift, and work three shifts per day. Weekly advances of 50 yards are being comfortably maintained.

As shown on Plan 14, main heading "crosscuts" are made to coincide with the main and supply gates of the right- and left-hand faces The width of the "crosscuts" is 12 ft. the height for a supply gate being 6 ft. and for a main gate 7 ft.

Whilst the main headings are being driven, the "opening-out" headings for the faces are driven simultaneously.

A point of major emphasis for management is that the main headings must never stop or lag behind—a platitudinous statement in conventional longwall mining, but one which cannot be over-emphasised in a system entailing a very rapid extraction.

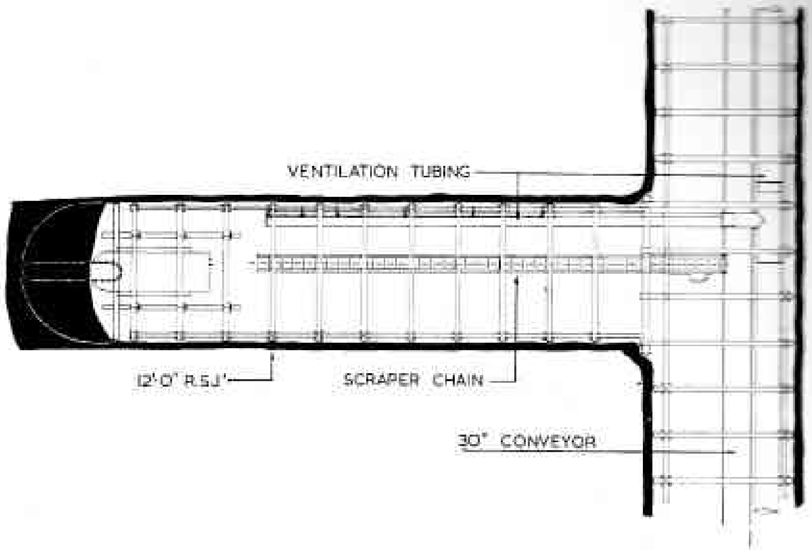
The face gate headings are driven by simultaneous heading and dinting—main gates are driven 12 ft. wide and 7 ft. high, and are supported by 12 ft. by 6 in. by 5 in. "H" section joists set on 6 ft. 6 in. wooden props, with two wire mesh bags filled with small dirt under each prop, to accommodate the small amount of gate convergence and to prevent breaking of the wooden props.

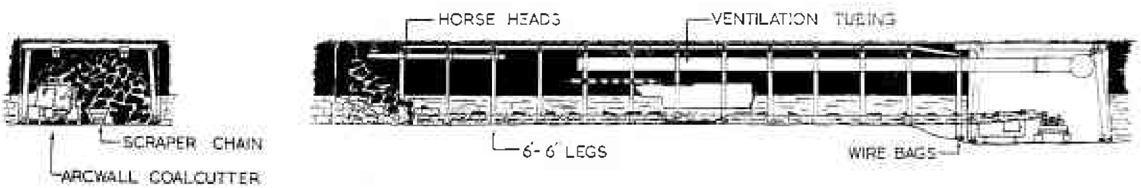
Supply gate headings are similarly supported to the unbroken roof, but the 12-ft. girders are set on 5 ft. 6 in. wooden props.

Equipment in the face gate headings consists of an A.B. arcwall coalcutter mounted on caterpillars, a chain conveyor, a drilling unit, an auxiliary fan, and the necessary electrical switchgear.

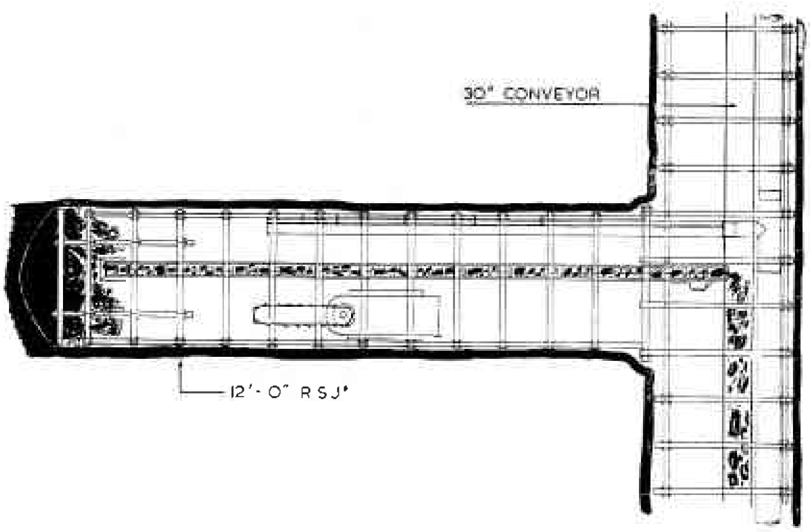
The face gate headings are manned by a crew of three men who hand fill the coal and dirt on to the chain conveyor. The headings work three shifts and weekly advances of 30 yards are achieved. The

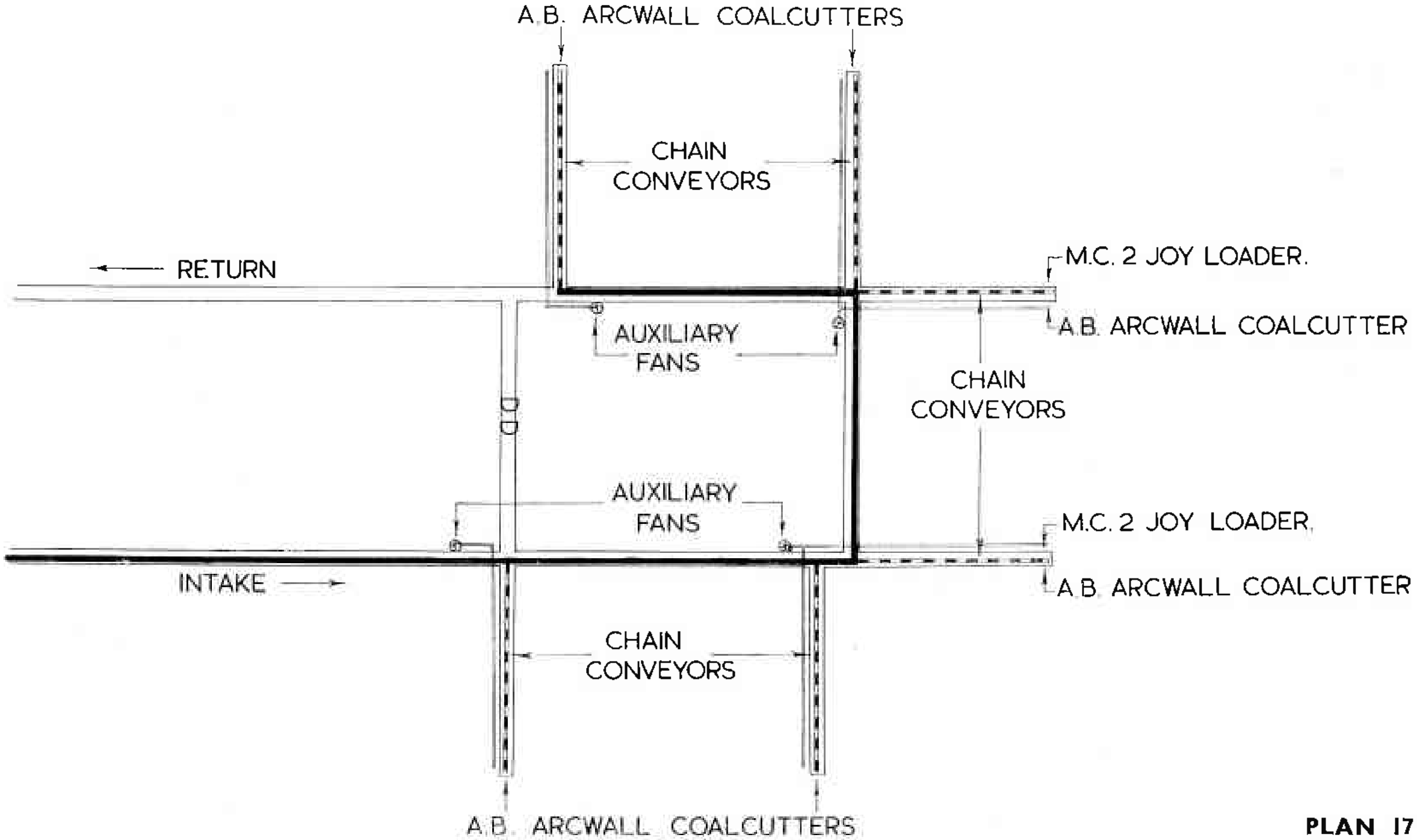
PLAN 16 (a)





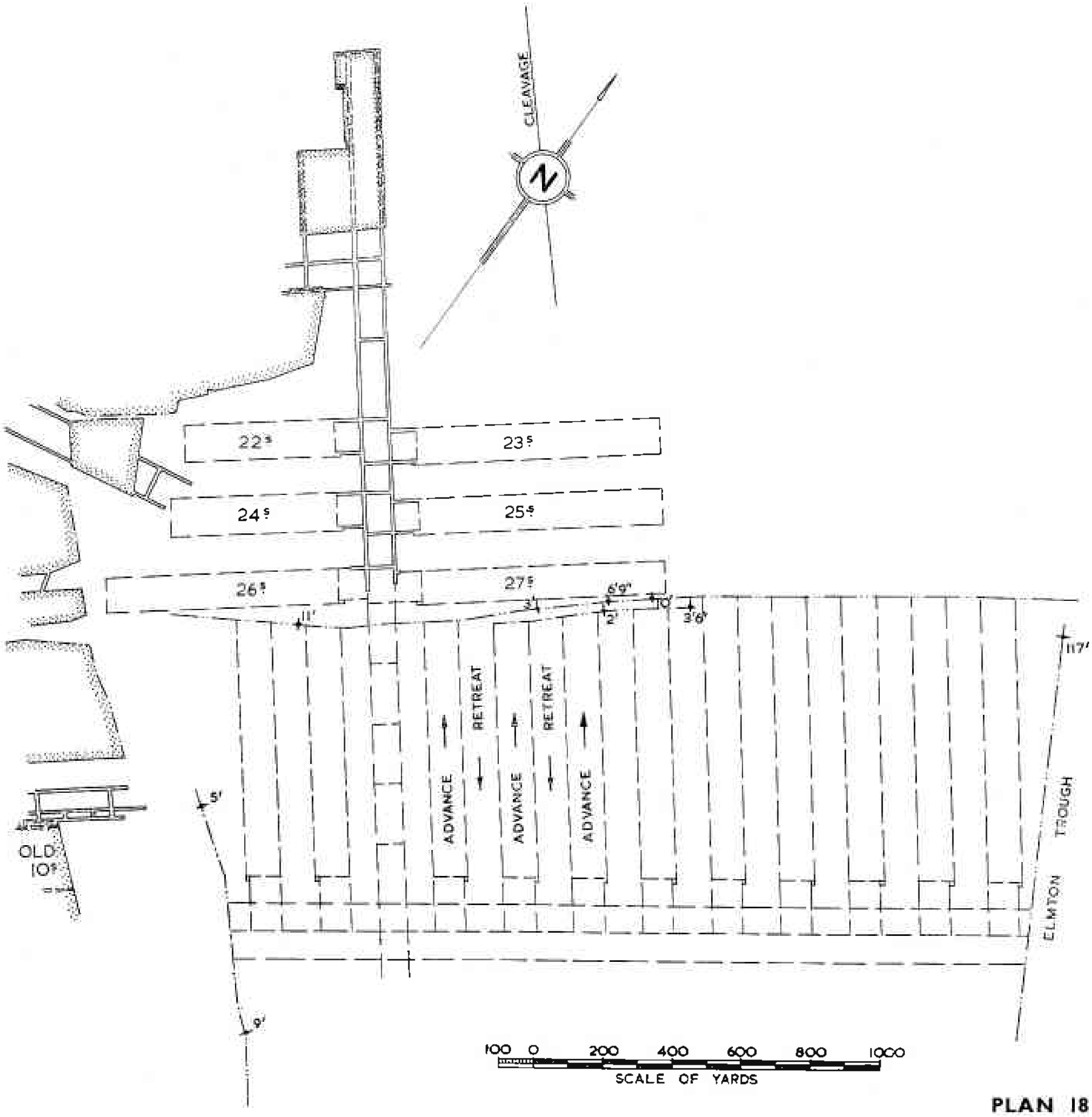
PLAN 16 (b)




A.B. ARCWALL COALCUTTERS
CHAIN CONVEYORS
RETURN
M.C. 2 JOY LOADER.
A.B. ARCWALL COALCUTTER
AUXILIARY FANS
CHAIN CONVEYORS
D.D.
AUXILIARY FANS
M.C. 2 JOY LOADER.
INTAKE
A.B. ARCWALL COALCUTTER
CHAIN CONVEYORS
A.B. ARCWALL COALCUTTERS

PLAN 17

GENERAL LAYOUT OF 20's DISTRICT—4½ YEARS PLAN



PLAN 18

introduction of a Joy loader into these headings, when available, will increase the weekly advance to that of the main headings.

Plans 16 (*a*) and (*b*) show the operations of cutting, timbering and filling in the face gate headings.

The face headings are driven with longwall coalcutters, the cut coal being hand filled on to the bottom loading face conveyor which is permanently installed as the face heading advances. These headings are manned by three men per shift, and achieve weekly advances of 35 to 40 yards.

As the main headings advance, the permanent trunk conveyor is laid forward in the main intake heading. "Move-up's" take place approximately every other week.

In the original development of the project, it was necessary to drive six headings simultaneously. Plan 17 shows the detailed arrangements. After opening-out and in full production, the system only requires three headings to be driven simultaneously.

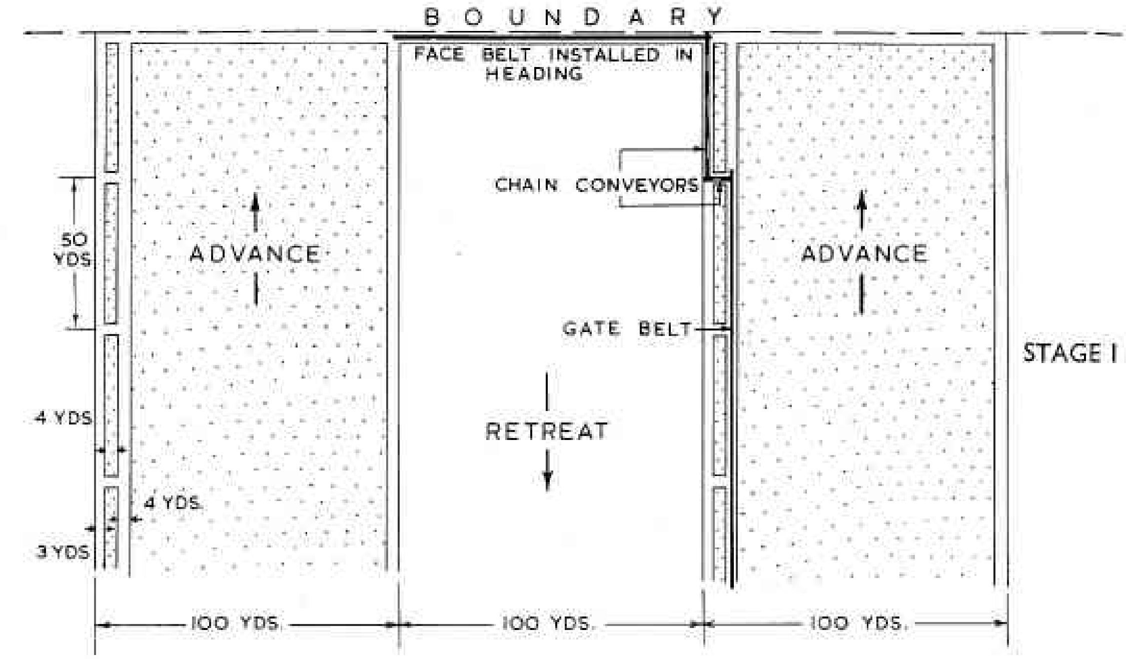
The general face layout in 20's district is shown on Plan 18.

It will be seen that alternate short faces on either side of the main roadways are advanced for a pre-determined length (400 yards to 1,000 yards according to geological and other considerations). The intermediate pillars between advancing faces are to be retreated, thus achieving the maximum extraction for the minimum number of roadways. This method also ensures that all roadways are salvaged in the retreat operation, without maintaining a special salvage crew—the drawn-off equipment being at the main roadway side when the face has finished (see Plan 19).

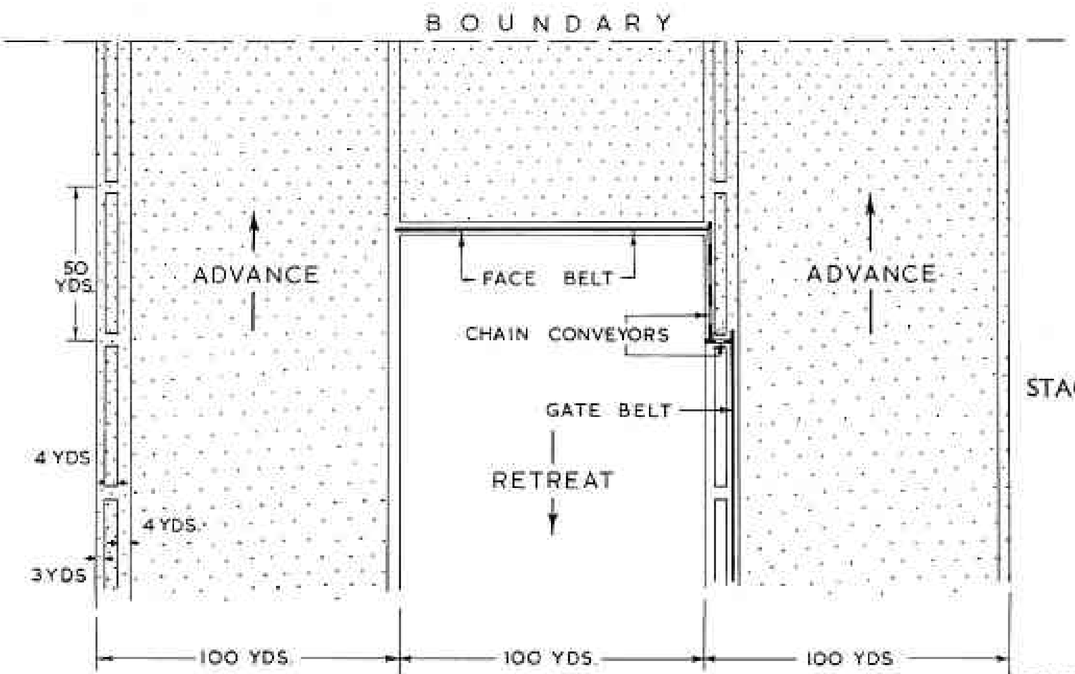
To preserve maximum continuity of output and to provide for contingencies, two spare faces, fully equipped, are always maintained. These spare faces also:—

Provide output replacement when the retreat faces are being headed out, and when output is being transferred from one block to another.

Allow main production faces to halt their rapid advance for one day each week, thus preventing a sudden roof weight which may occur if a sustained rapid face advance is suddenly halted.



STAGE I



STAGE II

PLAN 19

The weekly day's rest of main faces allows for gate conveyor extensions being made without overtime, and for weekly examination and overhaul of plant.

The face length of 100 yards was selected for the following reasons:—

It is a suitable length for face roof control, there being no possibility of "sag" in the middle of the face, as can occur on long faces.

For ease of ventilation and supervision.

For ease of face conveying with structureless belt conveyors running on the pavement.

For rapid development and heading of retreat faces.

To eliminate the need for a middle gate and consequent repairs—all gates in the layout have ribside protection on the advance.

To facilitate the employment of relatively small working teams.

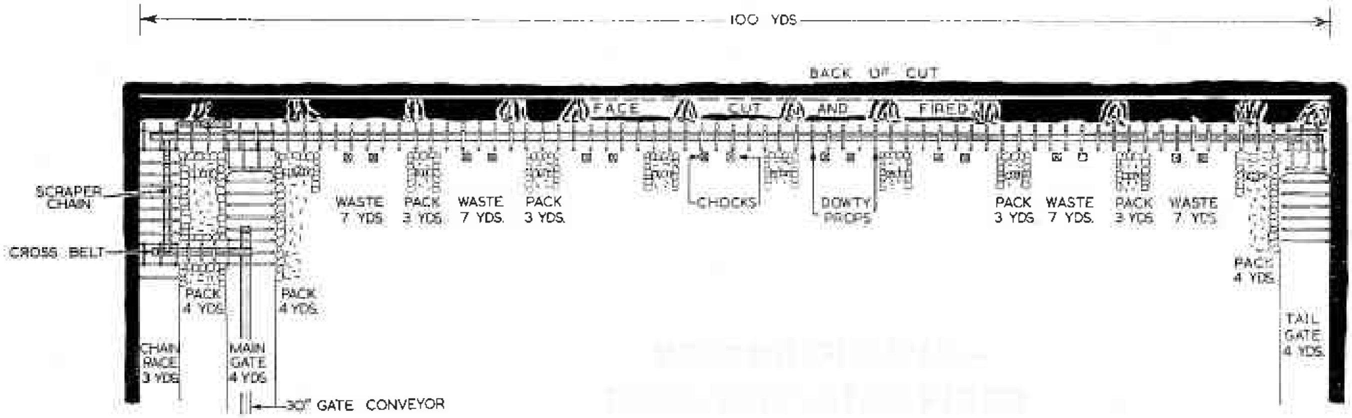
To minimise capital expenditure—particularly in equipping spare face room.

The Hand Filling Face

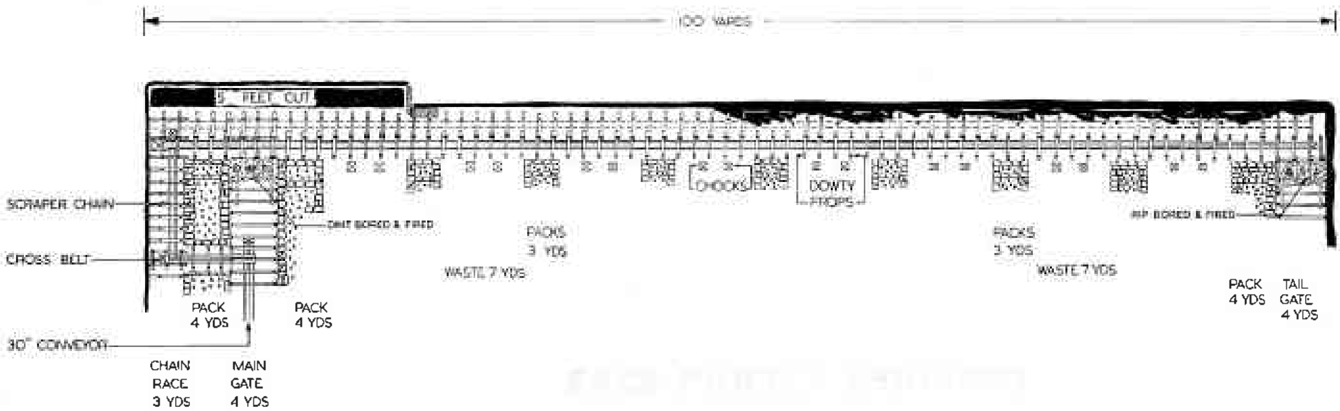
Plans 20 (*a*), (*b*) and (*c*) show the detailed layout of a face for hand filling. Equipment consists of a bottom loading face conveyor, a 25-h.p. Huwood driving gear with plough, the bottom belt running on the pavement, and the top belt running in specially designed "hanger" bars. Plan 21 shows the detail of the top belt "hanger" bars.

The face conveyor bye-passes the main "gate end" and delivers on to a ribside chain conveyor, type 61 A.M. B.J.D., or 20-in. Joy Sullivan, which, in turn, delivers via a short cross chain conveyor to the bottom loading gate conveyor. This last conveyor is of the bottom loading type to permit transport of supplies on the top belt, as no track is laid in either gate to the face. The ribside chain arrangement may not be necessary under certain seam conditions, e.g. where a small ripping is taken over a thick seam. In such a case the loader gate can be located directly on the ribside.

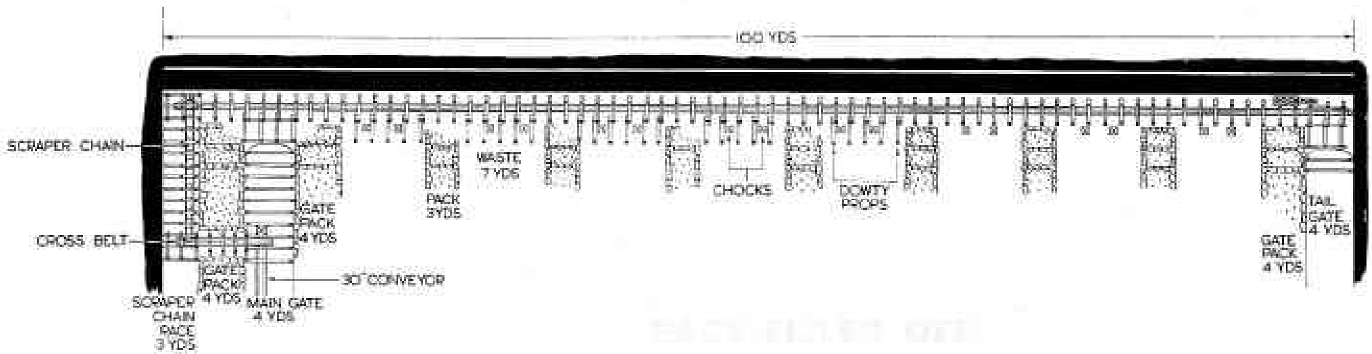
The face is equipped with a Samson or A.B. longwall coalcutter and a drilling unit.



PLAN 20 (a)



PLAN 20 (b)



PLAN 20 (c)

All faces are supported by steel corrugated bars and Dowty hydraulic props fitted with semi-permanent cap lids—each face having a complement of 360 props.

Waste support is similar to that employed on the conventional longwall faces, i.e. 3-yard packs with 7-yard wastes, except that there are two fabricated steel chocks fitted with Meco chock releases in each waste.

Main gate supports are 12 ft. by 6 in. by 5 in. "H" section joists set on 6 ft. 6 in. wooden props on wire mesh bags of dirt. A 4-ft. dint is taken at the face, and 4-yard packs are built on either side of the gate.

Airway gates are ripped to a total height of 6 ft. from the floor, and are supported by 7 ft. by 4 in. by 4 in. "H" section joists on 5 ft. 6 in. wooden props set on wire mesh bags of dirt.

Plan 22 shows the system of support in both main and airway gates.

The Hand Filling Face Operations

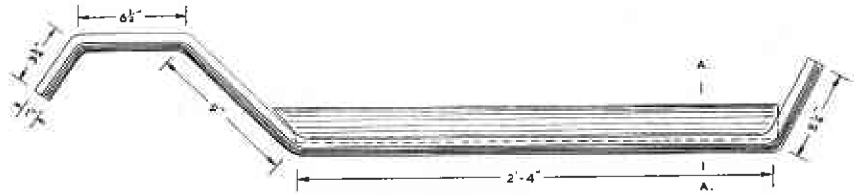
The following schedule shows the manpower for a 100 yards face in the "Bolsover System", with a seam thickness of 3 ft. 6 in.:—

19	Faceworkers.
4	Main Gate Dinters.
2	Airway Gate Rippers.
1	Shotfirer.
1	Deputy.
1	Gearhead Attendant.
28	Total.

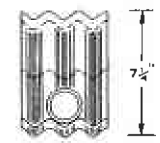
The 19 faceworkers are made up as follows:—

10	Fillers.
1	Borer.
2	Erectors.
2	Coalcutter Operators.
4	Packers.
19	Total.

TOP BELT "HANGER BAR"

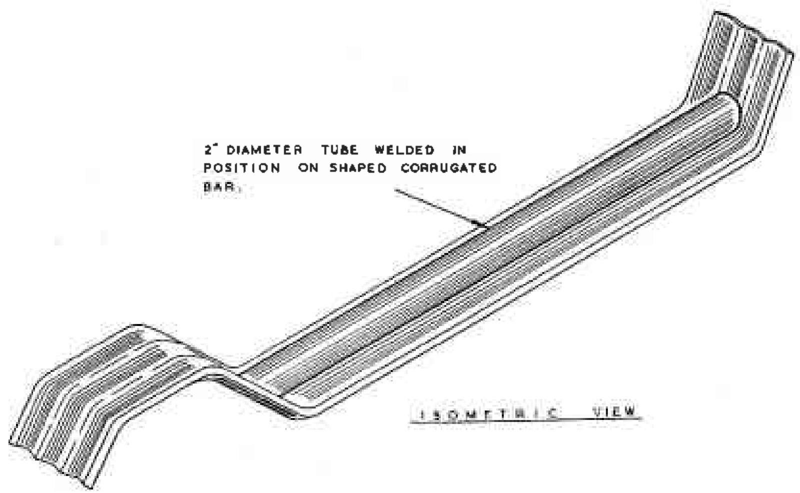


E L E V A T I O N

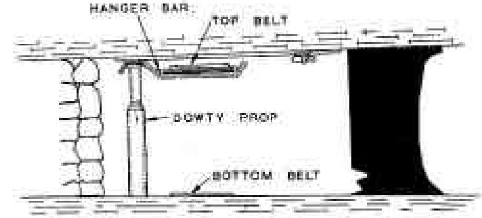


SECTION A-A

P L A N



I S O M E T R I C VIEW



SECTION OF THE FACE SHEWING BAR IN POSITION

PLAN 21

The planned face performance is as follows:—

Output per 5-ft. cut shift - - - - - - -	180 tons.
Output per 24 hours - - - - - - - -	540 tons.
Face O.M.S. - - - - - - - - - -	5/6 tons.

All members of the face team act as a unit, and no one man has a specialised job.

The cut and shot coal is filled off in front of the coalcutter by all faceworkers, as shown on Plan 20 (*b*).

As soon as sufficient coal is cleared, the coalcutter is jibbed in and commences cutting along the face behind the faceworkers, who systematically clear the face.

When all coal has been cleared, the face conveyor driving gear is moved over to the new position, together with the tension end, by two men. The remainder of the team throw the belting into the new track, and commence packing and drawing off operations. Meanwhile, the face conveyor is re-erected and run. The coalcutter, on reaching the gate end, is turned round, flitted to the corner, and cuts back to the gate end.

Main gate dinters and airway gate rippers work continuously, independent of actual face operations.

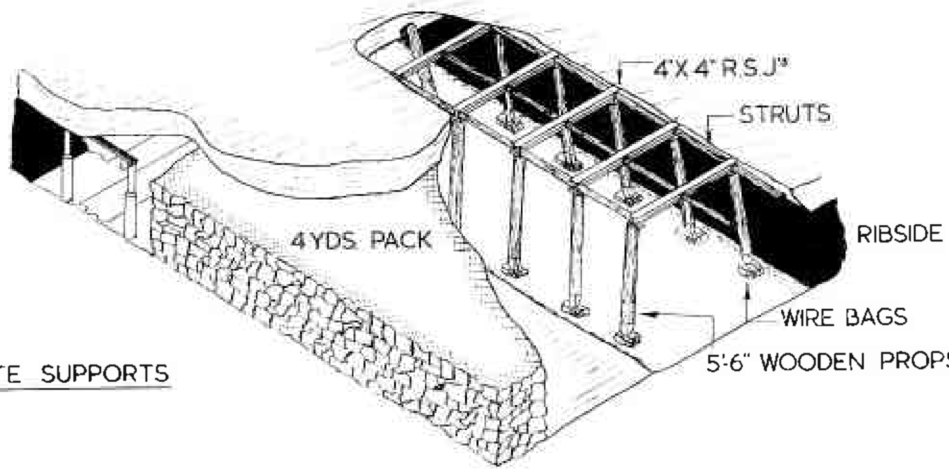
It is not necessary to pack the face before cutting, as the time interval is so short between the packs being built and the coalcutter passing.

A typical time study of hand filling is shown below:—

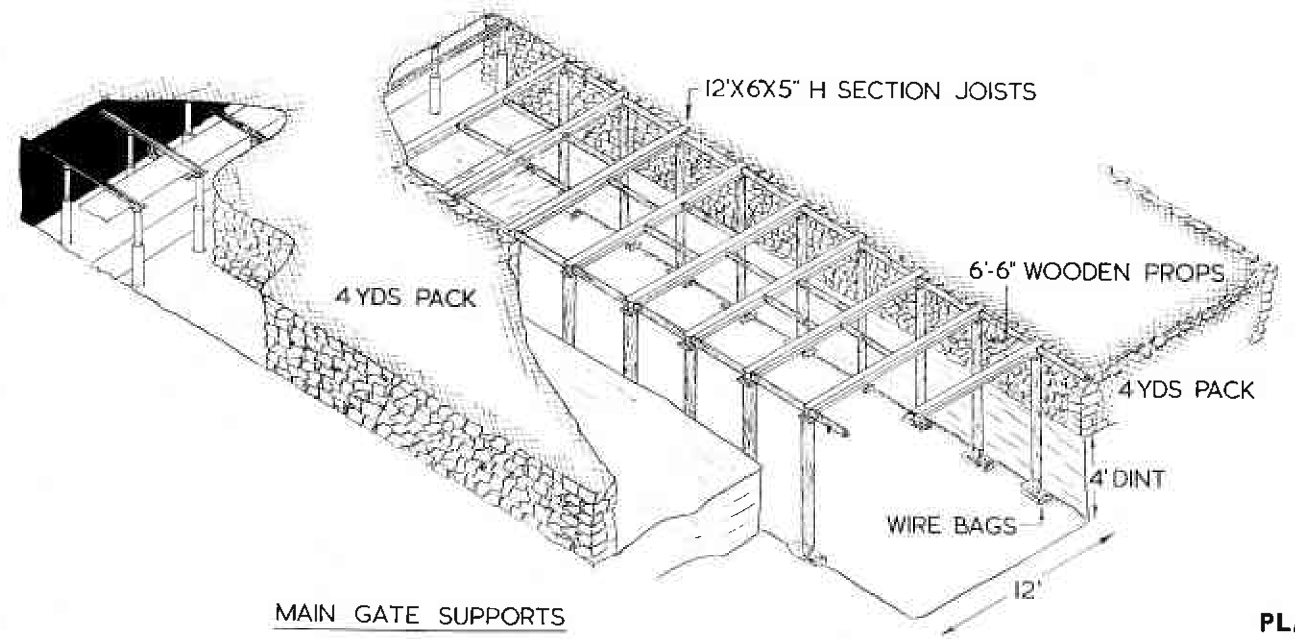
Commenced filling - - - - - - -	7.20 a.m.
Coalcutter jibbed in - - - - - - -	9.15 a.m.
Filling completed - - - - - - -	11.15 a.m.
Cutting completed - - - - - - -	12.30 p.m.
Packing and drawing off completed - - -	1.15 p.m.
Face ready for filling- - - - - - -	1.45 p.m.

The use of the hydraulic prop is an indispensable part of the system, apart from the desirability of this type of prop, for roof control.

The mechanical advantages in speed of setting and withdrawal are great.



AIRWAY GATE SUPPORTS



MAIN GATE SUPPORTS

PLAN 22

The ribside chain arrangement is a desirable part of the system. It enables continuous dinting of the Main Gate to proceed, thus ensuring elimination of delays and complete disposal of all dinting material into the gateside packs. Further advantages are that there is free passage for material supplies to the face, and for gate conveyor extensions to be made without being part of the face operations. In effect, the gate conveyor becomes a subsidiary trunk conveyor, and wear and tear is reduced to a minimum, thus ensuring greater life of belting and structure.

It is considered that hand filling is a useful contribution to the system as a whole. The method is essential where mechanised faces encounter faulted conditions, and for this reason it is advisable to have one hand face at a colliery to act as a reservoir against absenteeism on mechanised faces, and to deal with faulted conditions.

Experience on the present hand filling system has shown that face workmen previously incapable of stint work have been able, without difficulty, to complete the more varied tasks worked—indeed, it has been stated that at least five years' additional face work has been added to the normal face worker.

The Mechanised Face

Plans 23 (*a*), (*b*) and (*c*) show the layout of a mechanised face.

Waste support and gate ripping arrangements are similar to the hand filling operations.

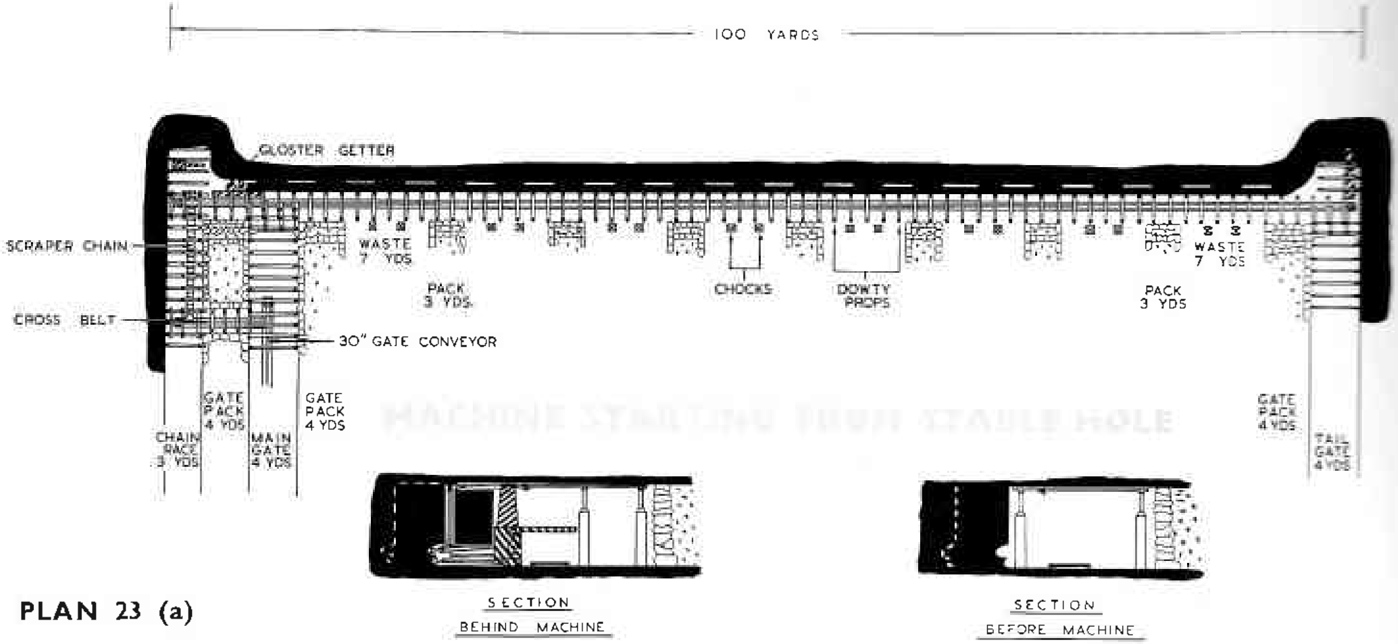
Face equipment consists of a bottom loading face conveyor with ribside chain delivery to the gate conveyor, a Sullivan 5B shortwall coalcutter in the Main Gate stable hole, and a longwall A.B. or Samson coalcutter in the airway gate stable hole.

Electrical switchgear is located in both face gates to allow two-way feed to the Gloster Getter, and to keep stable hole cutter cables off the run of face.

Two drilling units are supplied—one in each gate road.

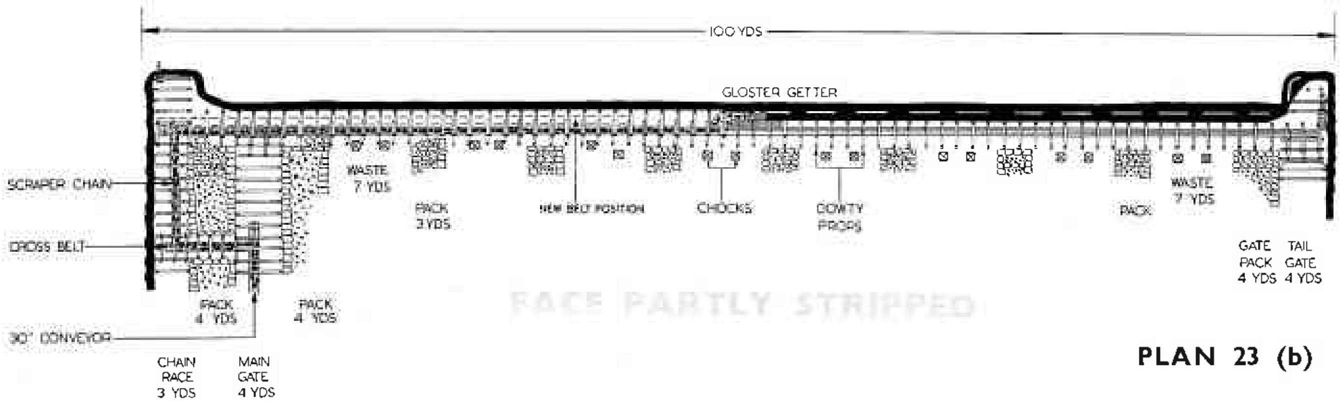
The only other equipment on the face is the Gloster Getter cutter loader. Photographic views of the Gloster Getter are shown on pages 47 and 48. The machine is 13 ft. long by 1 ft. 3 in. wide, by 2 ft. high,

LAYOUT OF MECHANISED FACE
THREE PHASES OF GLOSTER GETTER



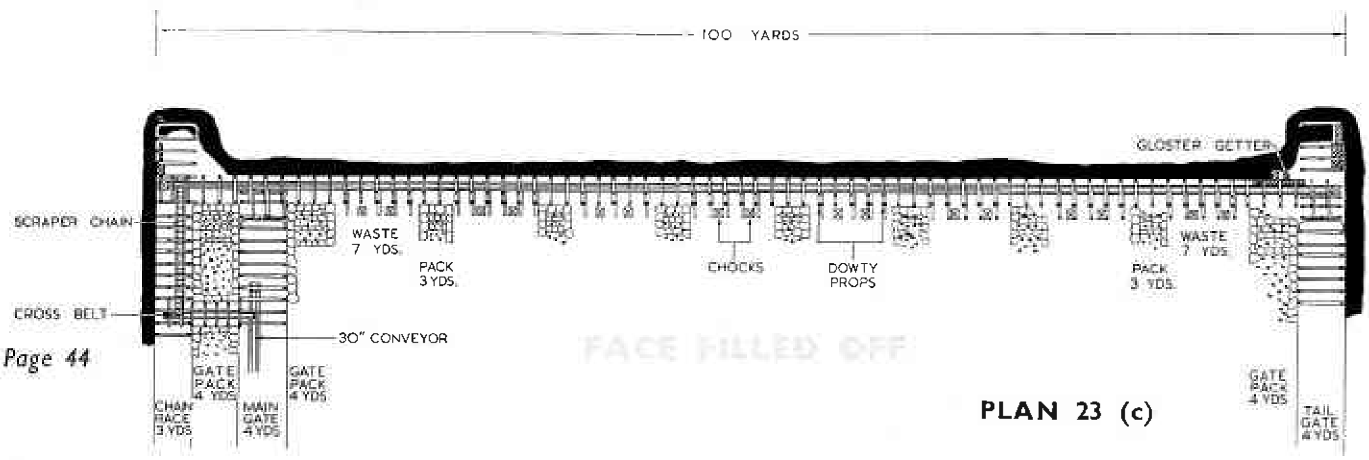
MACHINE STARTING FROM STABLE HOLE

PLAN 23 (a)



FACE PARTLY STRIPPED

PLAN 23 (b)



FACE FILLED OFF

PLAN 23 (c)

and consists of three main parts—the driving motor, a 50 h.p. unit, the haulage end with single face-side drum holding 50 yards of $\frac{5}{8}$-in. haulage rope. The centre section contains the gearing to drive the cutting jibs.

There are four cutting members—two undercutting jibs—the lower one being 3 ft. long and giving a 6-in. "precut" over the solid coal, the upper one being 3 ft. 4 in. long, giving a 10-in. "precut". The upper jib is the longer member for two reasons:—

To allow the top chain to be depressed to cut out the 2-in. fillet of coal left uncut between the jibs.

To give better coal preparation.

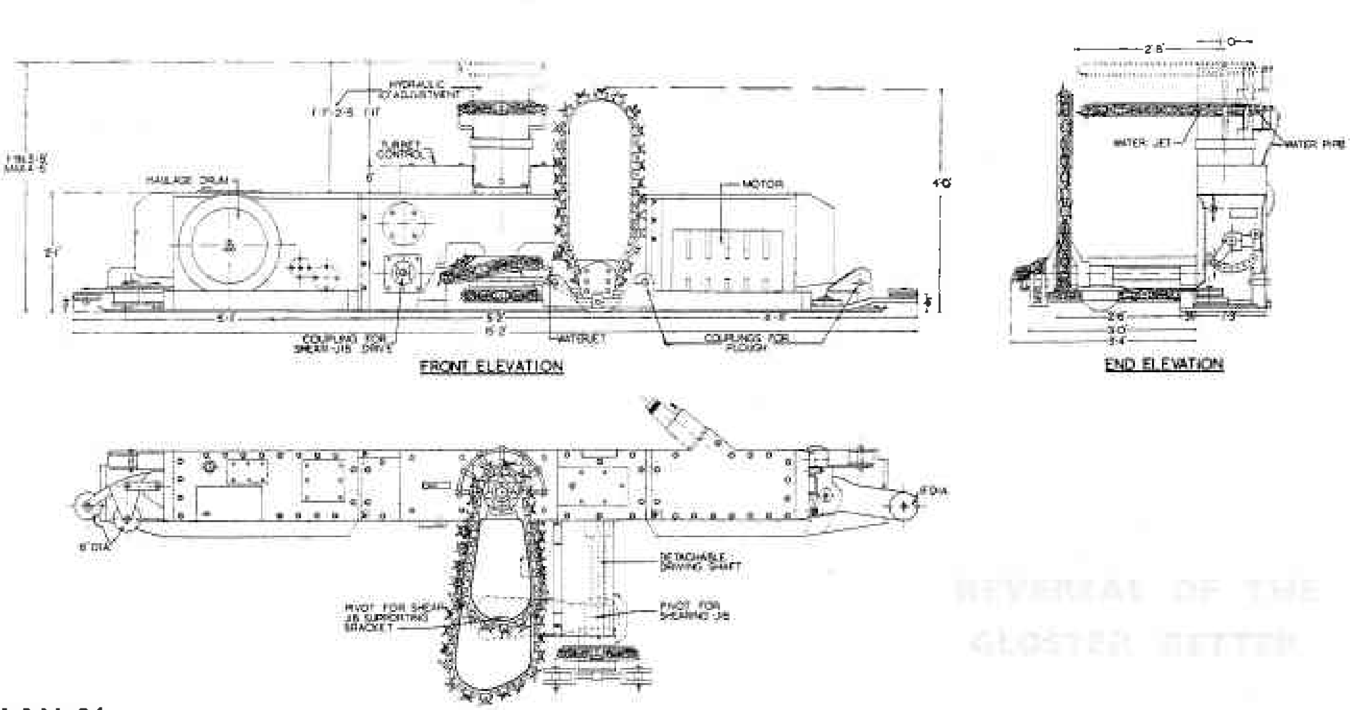
The shear jib is at the back of, and at right angles to, the undercutting jibs, and is driven by a shaft from the main frame gearing. The arrangement for suspending and driving the shear jib is shown in Plan 24, which also illustrates how the machine is reversed at the end of its turn.

An overcutting jib and hydraulic turret with a range of 10-in. can be fitted to the machine if it is necessary to make an artificial roof parting. All chain speeds are 400 ft. per minute.

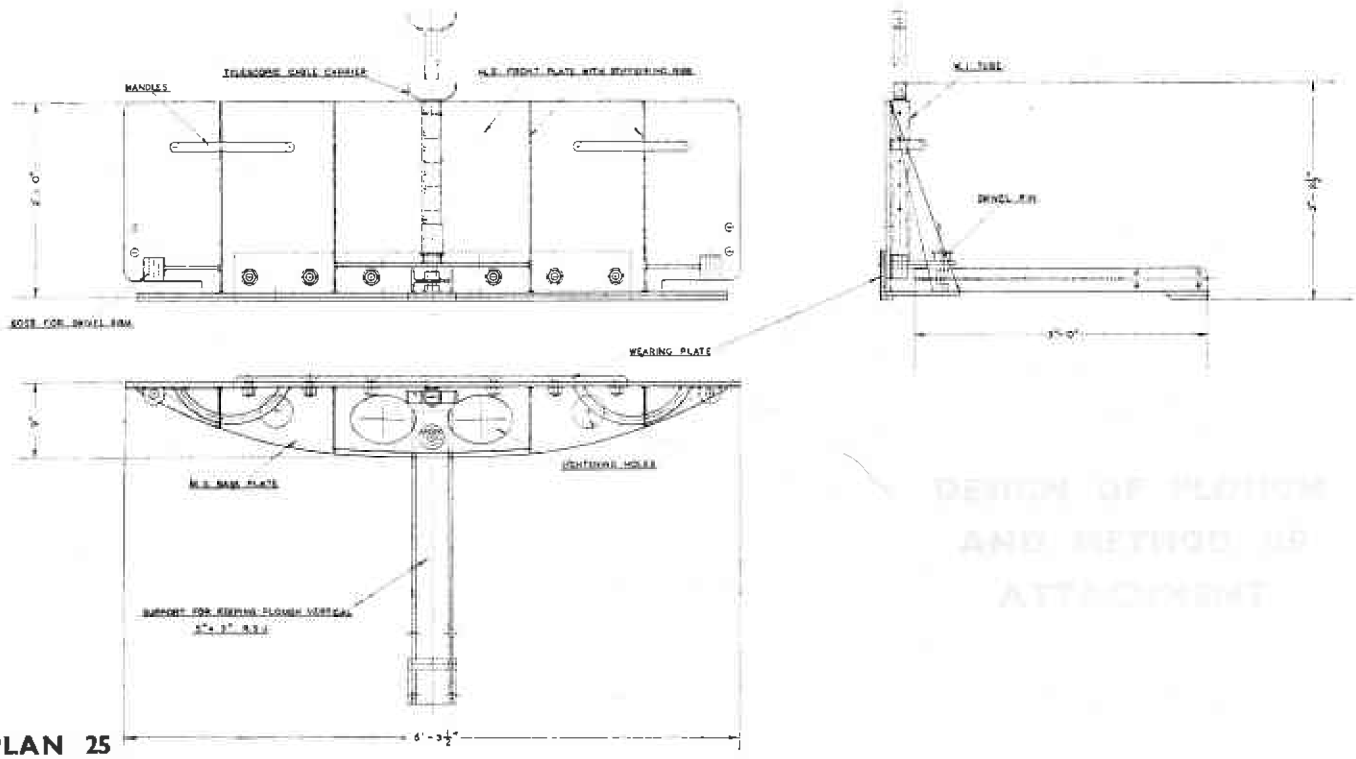
The loading section of the machine consists of a plough blade attached to the machine by towbars on the face and gobside—these towbars being fitted with universal joints to accommodate undulations in the floor and to counteract lateral movement of the machine. The design of the plough is shown on Plan 25.

All cutting chains are equipped with Duplex picks, "Mohar" tipped to avoid loss of time in pick changing during the reversal operation.

To reverse the machine the plough is detached whilst drawing into the stable hole. Owing to the design of the top undercutting jib (the top plate is depressed on one side to divert the chain to remove the 2-in. fillet of coal between the jibs), it is necessary to change this jib when changing direction. This operation is done by uncoupling the cutter chain, and sliding the jib off its post. The shear jib is then pivoted to its new position. The new top jib is then fitted, the chain coupled up, and the machine is then ready for the return journey.

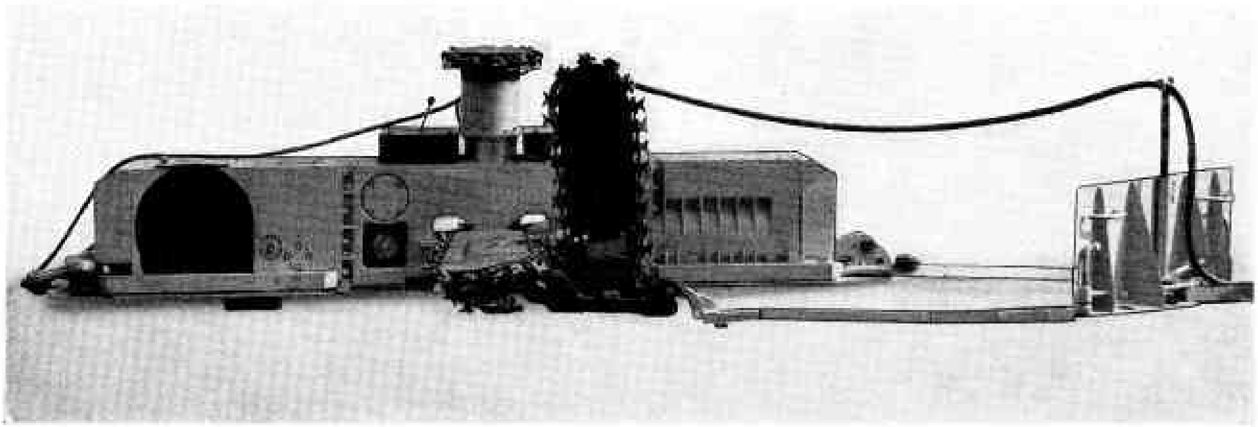


PLAN 24

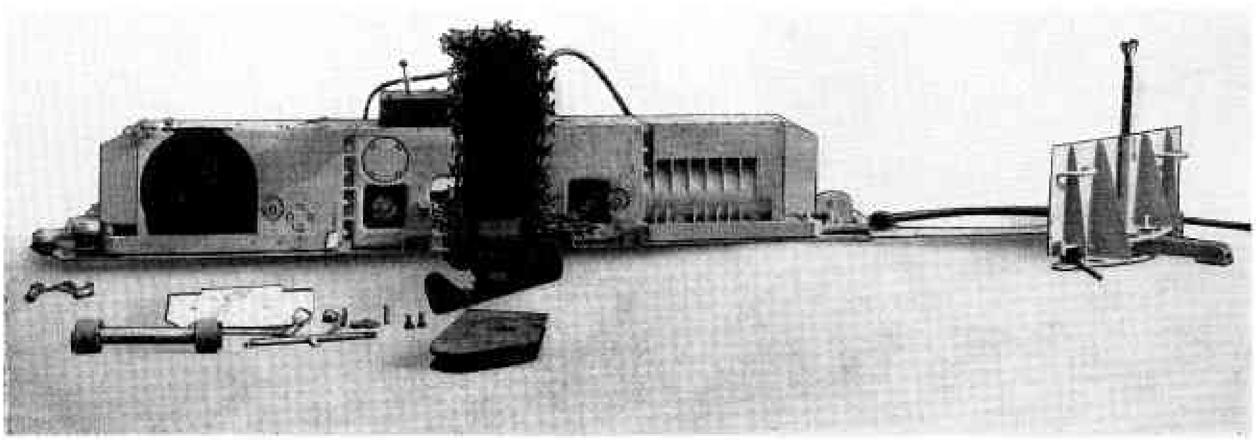


PLAN 25

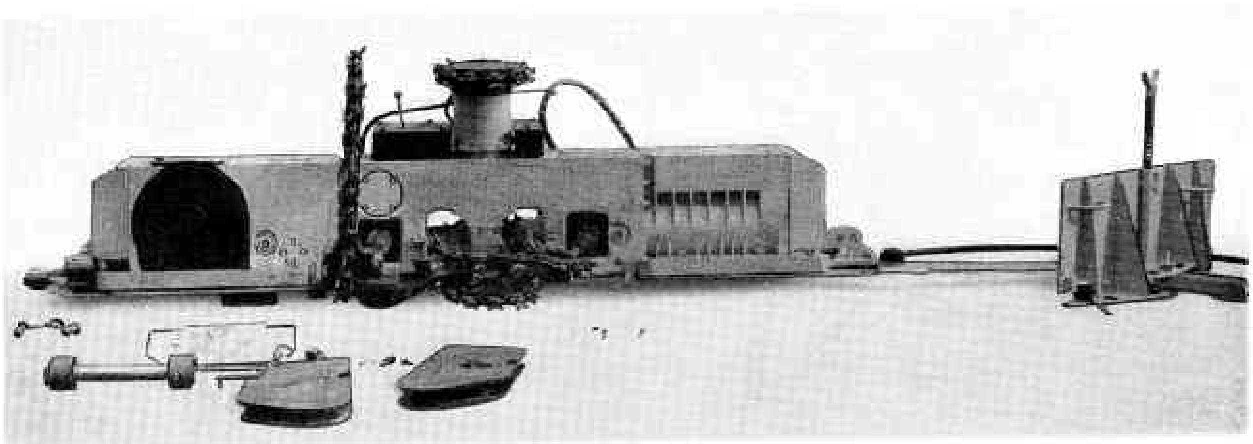
THE GLOSTER GETTER
DETAILS OF TURN-ROUND IN STAGES

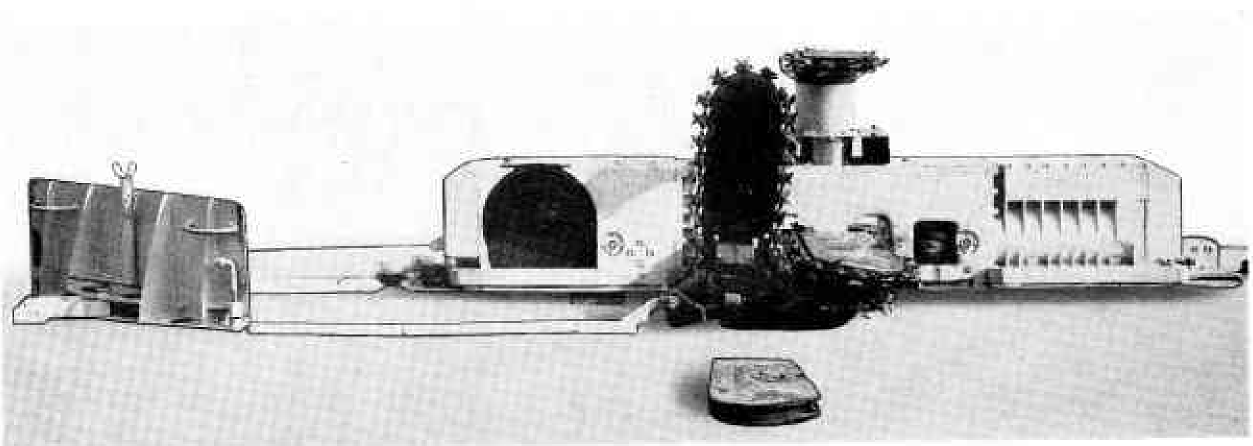


ENTERING RIGHT-HAND STABLE HOLE



1st STAGE IN REVERSAL





This operation can be achieved in 50 minutes, during which period the face conveyor is moved over to its new position.

The machine can cut and load at a maximum rate of 6 ft. per minute.

The Mechanised Face Operations

The following schedule shows the manpower for a 100 yards face in the "Bolsover System":—

2	Gloster Getter Operators.
2	Timberers.
4	Packers.
4	Stable Hole Men.
4	Main Gate Dinters.
2	Airway Gate Rippers.
1	Deputy.
1	Gearhead Attendant.
20	Total.

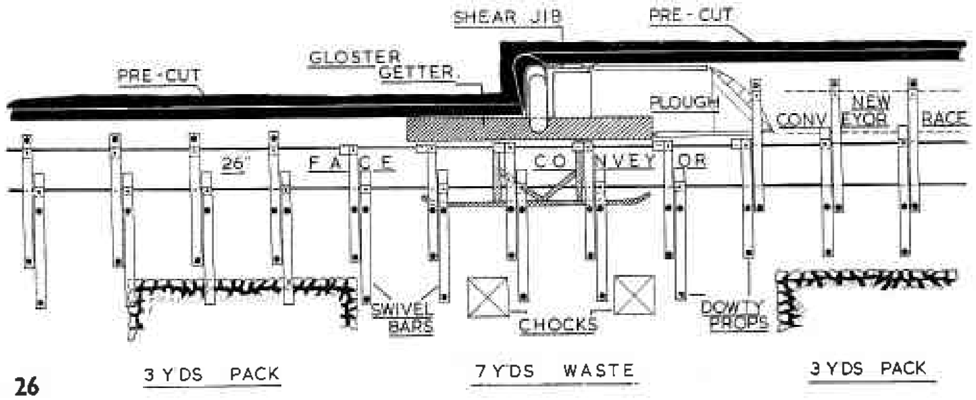
Output per 2 ft. 6 in. cut - - - - - - -	90 tons.
Output per 24 hours - - - - - - -	540 tons.
Estimated face O.M.S. - - - - - - -	8/9 tons.

The face has a stable hole 12 ft. wide at each end, and is carried at least 7 ft. 6 in. in advance of the face. These stables are manned by two men at each end of the face, and the coal is hand filled on to the face conveyor. A longwall coalcutter is used in one stable hole as a precautionary measure in case the face should strike a fault and have to resort, temporarily, to hand filling.

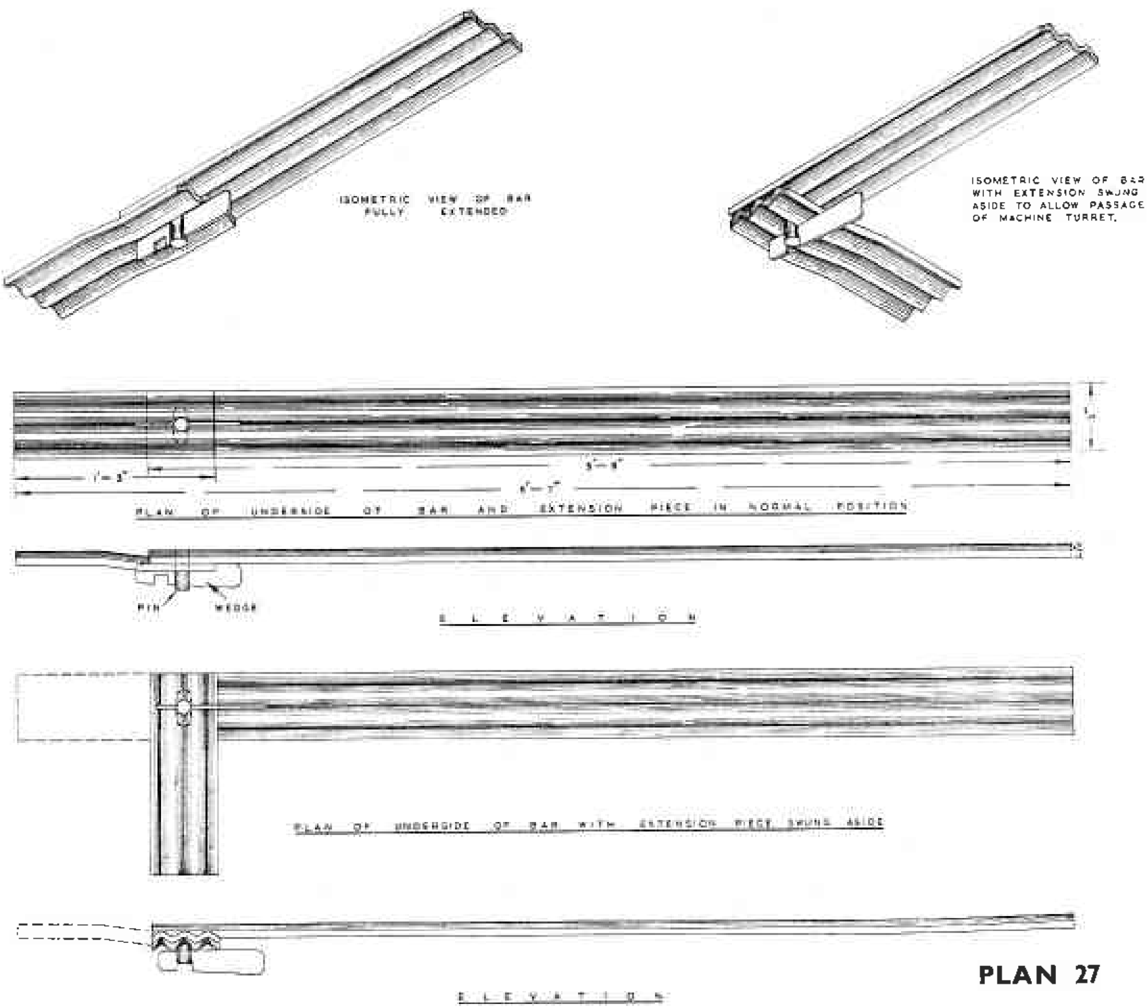
The corners of the stable holes are "chamfered", as shown on Plan 23 (*c*), to facilitate the entrance of the machine into the face termini.

The face conveyor is laid within 18 in. of the solid coal, and the Gloster Getter passes along the face between the conveyor and the coal—there being no intermediate faceside props to obstruct loading. Support of the roof is by cantilever bars whilst the machine is passing.

The timbering system, shown on Plan 26, is extremely close, and the arrangement is such that all props and bars are always set and never



PLAN 26



PLAN 27

lie on the floor. When the overcutting turret is employed it is necessary to use swivel bars to give clearance for the turret. This arrangement is shown on Plan 27.

Packing of the face proceeds as soon as the Getter has passed, so that, as shown on Plan 23 (*c*), the face is completely packed and drawn off when the machine arrives in the stable hole. Thus the time of reversal of the machine (50 minutes) is available for the face conveyor to be moved over, and gobside props to be set along the side of the conveyor.

An estimated time study of the mechanised face operations is as follows:—

Commenced loading - - - - - - - -	7.15 a.m.
Completed loading, packing, and drawing off -	9.15 a.m.
Getter reversed, and conveyor moved over - -	10. 5 a.m.
Completed second cut with packing and drawing off	12.30 p.m.
Getter reversed and conveyor moved over - -	1.20 p.m.

Stable hole filling, ripping and dinting proceed during the shift without interruption.

To achieve the above performance the Gloster Getter must have an average rate of travel of 3 ft. per minute, including the setting of two haulage derricks.

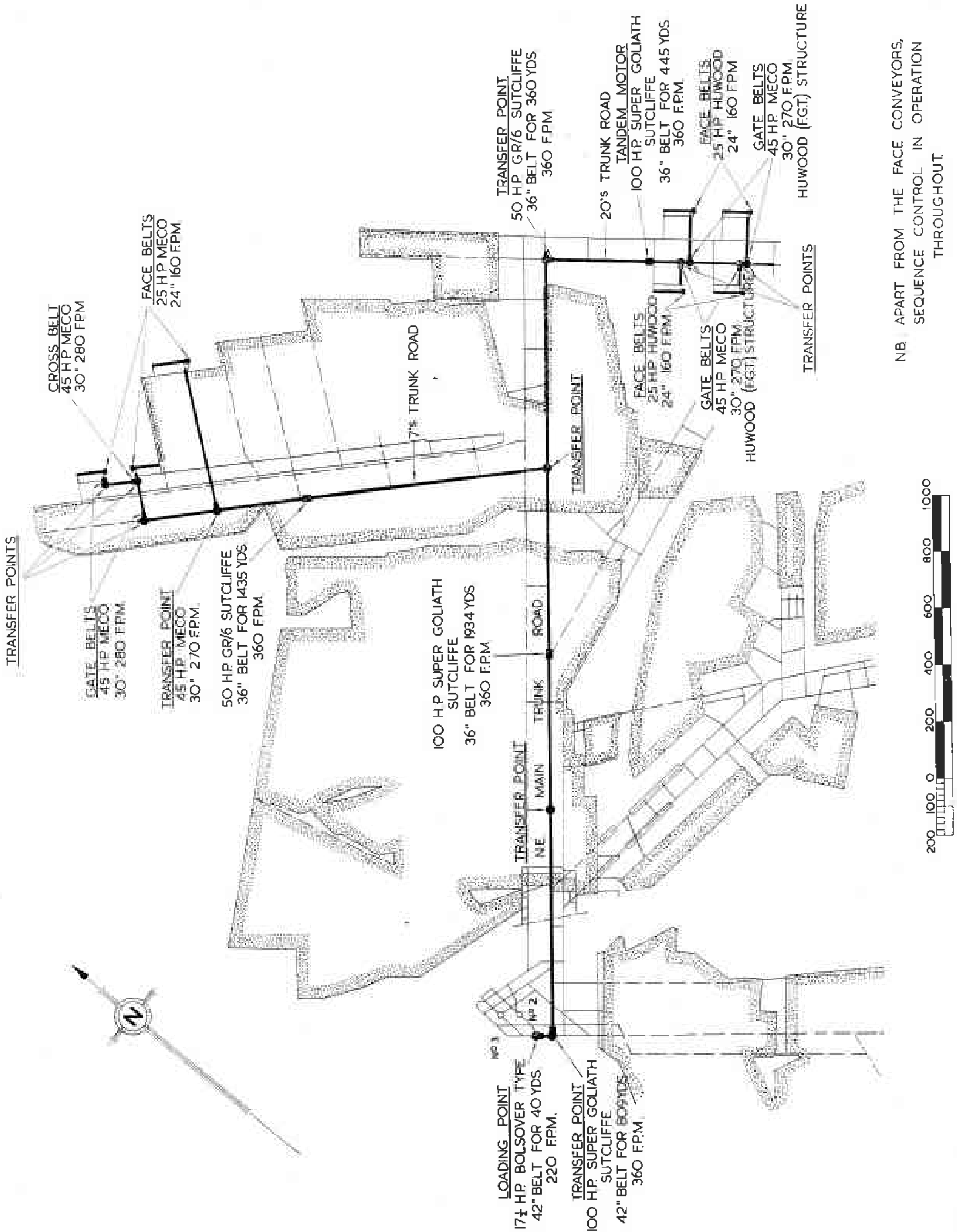
Transport

The transport system for coal is exclusively by trunk conveyors to the Pit Bottom.

Plan 28 shows the trunk conveyor layout with details of the conveyors.

The output from 20's district is conveyed by a subsidiary trunk conveyor to the main trunk system. There are two 36-in. conveyors in tandem on 20's main roadway—a 100 h.p. Sutcliffe 36-in. conveyor operating from the faces to the bottom of the 28-ft. fault, whilst from the bottom of the fault to the main trunk conveyor system, a 60 h.p. Sutcliffe 36-in. conveyor is installed.

3's district trunk system consists of one 50 h.p. Sutcliffe 36-in. conveyor, delivering direct to the main trunk system.


TRANSFER POINTS
GATE BELTS
45 HP MECO
30" 280 F.P.M.
CROSS BELT
45 HP MECO
30" 280 FPM
FACE BELTS
25 HP MECO
24" 160 F.P.M.
TRANSFER POINT
45 HP MECO
30" 270 F.P.M.
50 HP GR/6 SUTCLIFFE
36" BELT FOR 1435 YDS
360 FPM
7's TRUNK ROAD
100 H.P. SUPER GOLIATH
SUTCLIFFE
36" BELT FOR 1934 YDS
360 F.P.M.
TRANSFER POINT
NE MAIN TRUNK ROAD
TRANSFER POINT
TRANSFER POINT
50 H.P. GR/6 SUTCLIFFE
36" BELT FOR 360 YDS
360 F.P.M.
20's TRUNK ROAD
TANDEM MOTOR
100 HP SUPER GOLIATH
SUTCLIFFE
36" BELT FOR 445 YDS
360 F.P.M.
FACE BELTS
25 HP HUWOOD
24" 160 FPM
GATE BELTS
45 HP MECO
30" 270 F.P.M.
HUWOOD (F.G.T.) STRUCTURE
FACE BELTS
25 HP HUWOOD
24" 160 F.P.M.
GATE BELTS
45 HP MECO
30" 270 F.P.M.
HUWOOD (F.G.T.) STRUCTURE
TRANSFER POINTS
NB. APART FROM THE FACE CONVEYORS,
SEQUENCE CONTROL IN OPERATION
THROUGHOUT.
N
No 2
No 3
LOADING POINT
17½ HP BOLSOVER TYPE
42" BELT FOR 40 YDS
220 F.P.M.
TRANSFER POINT
100 HP SUPER GOLIATH
SUTCLIFFE
42" BELT FOR 809 YDS
360 F.P.M.
200 100 0 200 400 600 800 1000
SCALE OF YARDS.

PLAN 28

There are two conveyors in tandem on the N.E. intake road, one 36-in. and one 42-in., both being 100 h.p. Sutcliffe units. These conveyors are both well above capacity, being the conveyors ordered for the original reconstruction scheme.

All conveyors from the loading station to the face are equipped with Huwood sequence control and safe belt protection.

Materials supply to both districts is by separate haulage systems in the return airways, which also provide man-riding facilities. These arrangements are shown on Plan 29.

The loading station is situated in the Pit Bottom, and the general arrangement is shown on Plans 30 (*a*) and (*b*).

The coal is delivered from the main N.E. trunk conveyors on to a "short cross" conveyor running at right angles towards the Pit Bottom. Loading is arranged by a static chute fitted with a hydraulically-operated door. Tub control under the loading point is by hydraulically-operated controllers, and spillage is handled by a specially designed spillage chain conveyor.

The full tubs gravitate to the shaft, being controlled by hydraulic retarders and being marshalled by automatic points.

The empty tubs are elevated by a slow creeper from the shaft side and gravitate to a clipping station, where they are attached to an endless under-rope haulage in sets of 20—thence the empty tubs are automatically unclipped behind the loading station, and gravitate to the loading chute. The under-rope haulage was chosen in preference to a creeper because of the length of haul and to provide stocking facilities.

The existing tubs are being used, and have been increased in height by 6 in. to give an average capacity of 17 cwts.

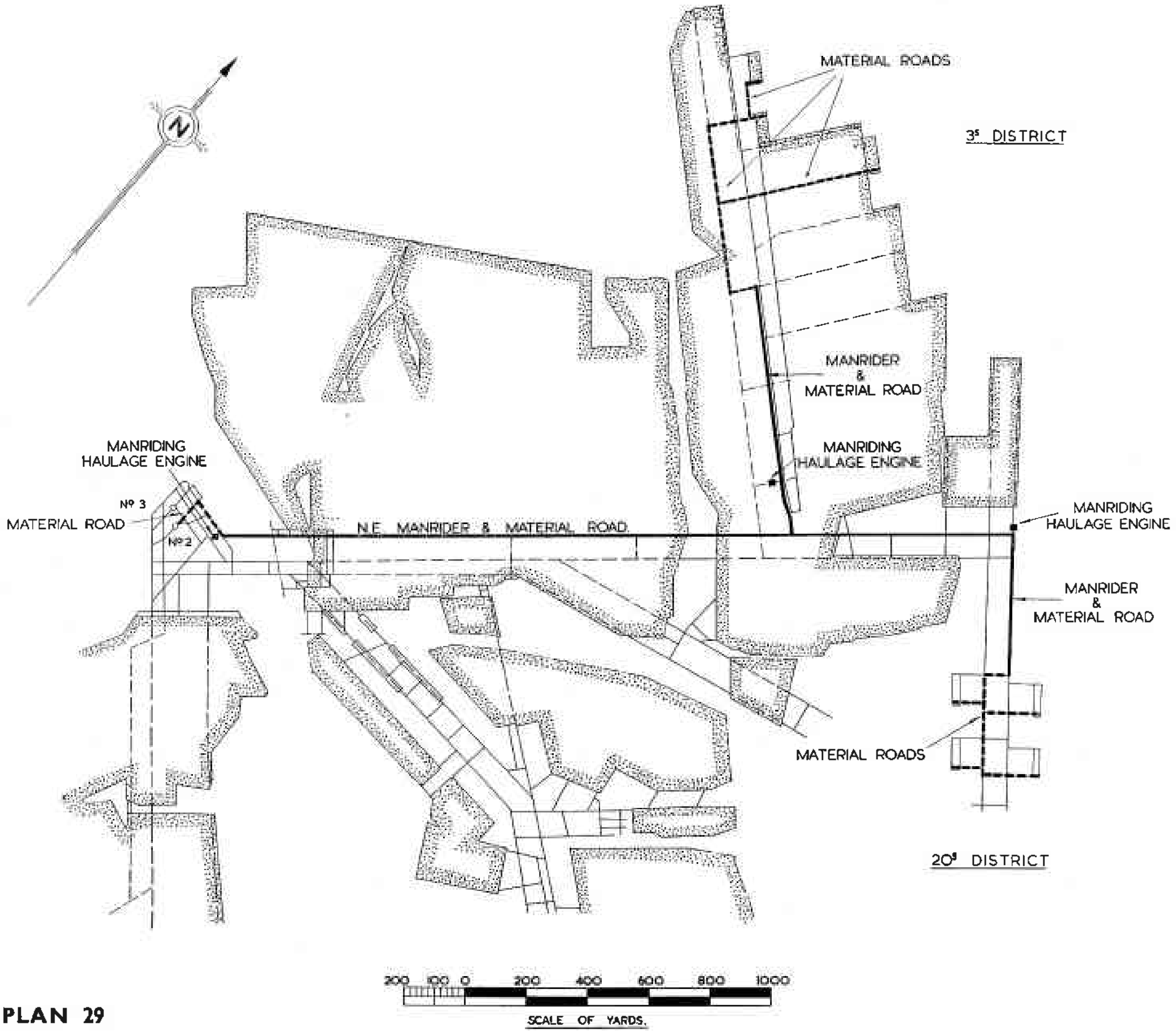
Six tubs per cage are wound, both decks being loaded at the old bottom deck level, where pneumatic rams are to be fitted.

The Pit Bottom circuit, including the loading station, requires a team of six men and a corporal per shift.

ROOF CONTROL

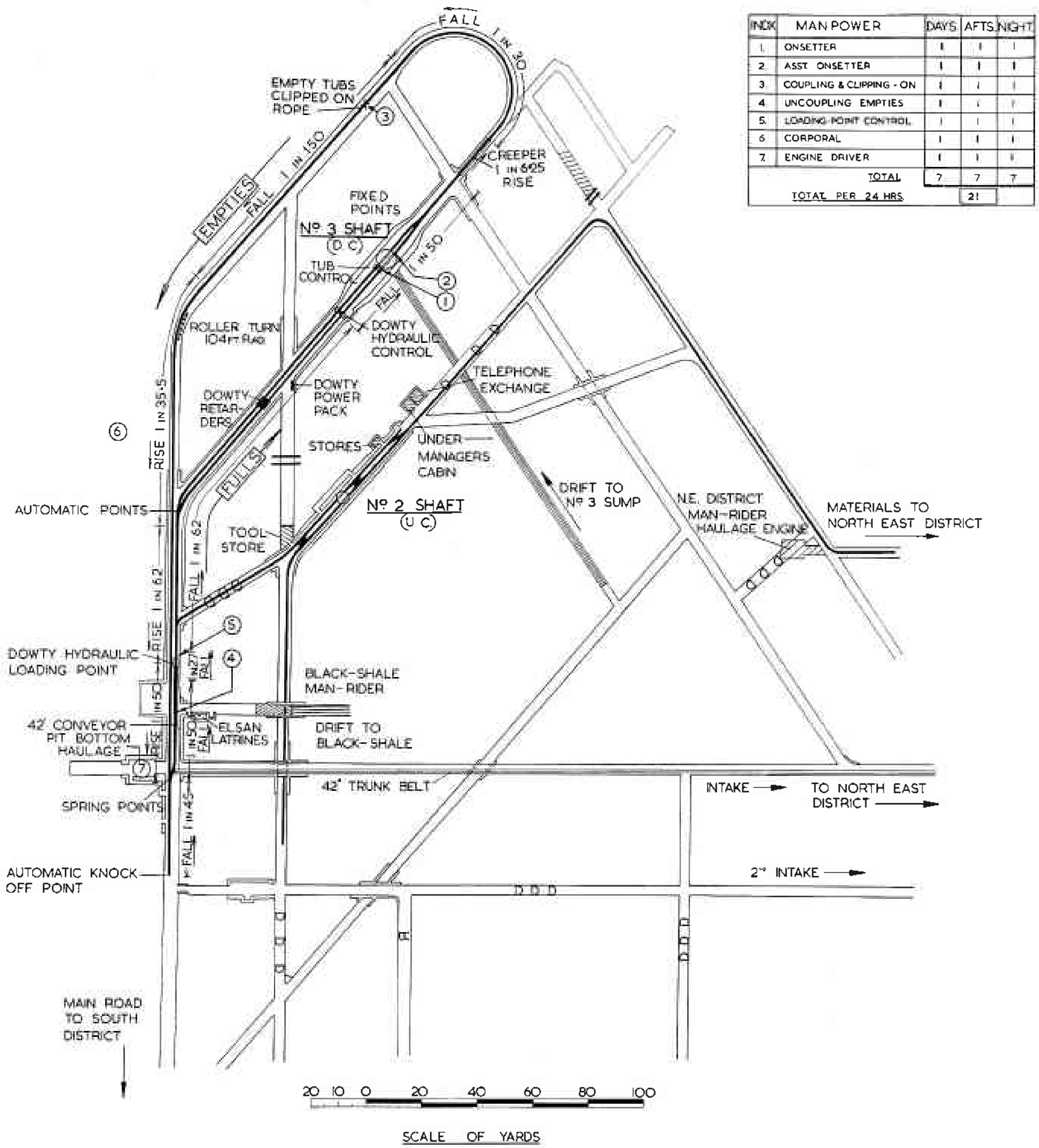
A close study was made of the roof control problem on an experimental 100 yards face at Bolsover Colliery.

MATERIALS AND MANRIDING ARRANGEMENTS

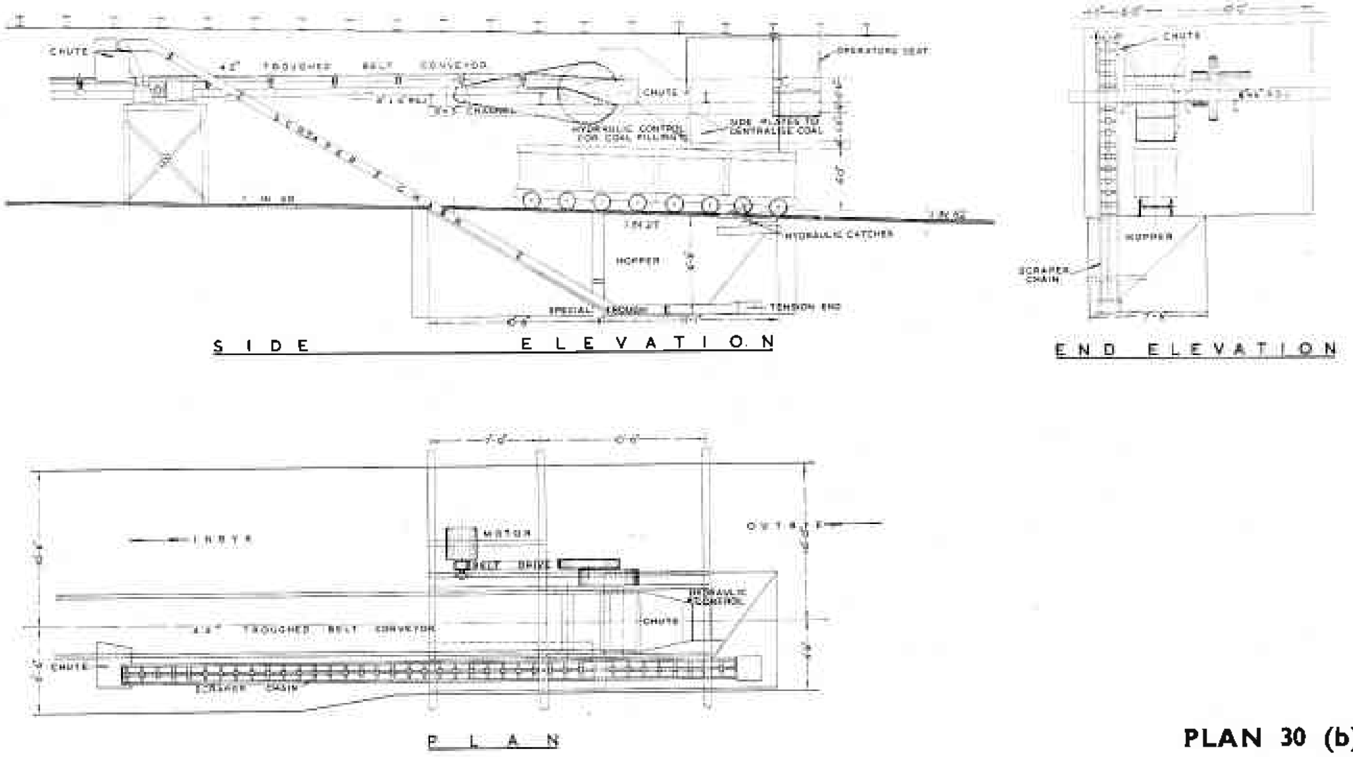


PLAN 29

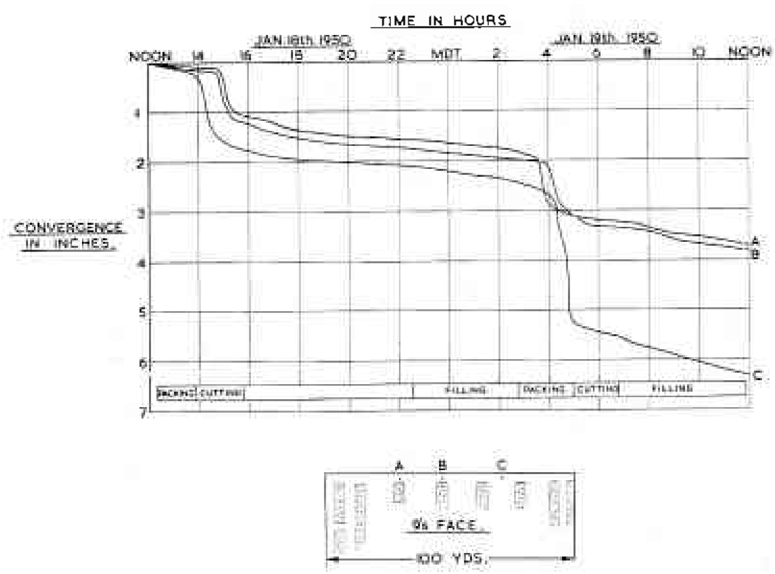
INDX	MAN POWER	DAYS	AFTS	NIGHT
1.	ONSETTER	1	1	1
2.	ASST ONSETTER	1	1	1
3.	COUPLING & CLIPPING - ON	1	1	1
4.	UNCOUPLING EMPTIES	1	1	1
5.	LOADING POINT CONTROL	1	1	1
6.	CORPORAL	1	1	1
7.	ENGINE DRIVER	1	1	1
	TOTAL	7	7	7
	TOTAL PER 24 HRS		21	



PLAN 30 (a)



PLAN 30 (b)



PLAN 31

In the gate roads no difficulties were encountered whatsoever, beyond the breaking of a few wooden props. This damage was cured by "stilting" the props on two wire bags filled with small dirt.

On the face the hydraulic prop was undoubtedly a major factor in controlling convergence which, even when the face advance was 25 yards per week, never exceeded 6 in. over three 5-ft. turnovers.

Plan 31 shows the convergence records taken on the 100 yards trial face, whilst advancing at the rate of 10 feet per day.

Interesting experience has been gained in the control of weak faulted roof. The face passed through an area of small faults accompanied by extremely wet roof conditions and, whilst no working difficulties were encountered during the week, there was evidence of heavy weighting in the faulted area every weekend. This weighting usually occurred within 24 hours of the face ceasing to advance. This condition was cured by "resting" the face for one day (24 hours) during the week, thus controlling the intensity of shock to the roof caused by suddenly halting a sustained rapid advance.

Undoubtedly much remains to be learned of the problems of roof control of rapidly advancing faces, but sufficient knowledge has been gained to produce conditions equally as good as normally experienced on longwall faces. Indeed, it is conjectured that improved roof conditions will follow with the development of the system.

Several types of fixed cap lids have been tried with the hydraulic props, and although to date a satisfactory lid has not been found, the existing types are sufficiently encouraging for the problem to be further investigated. Even with the relatively short life of existing types, the saving in transport and consumption of wooden cap lids is very great.

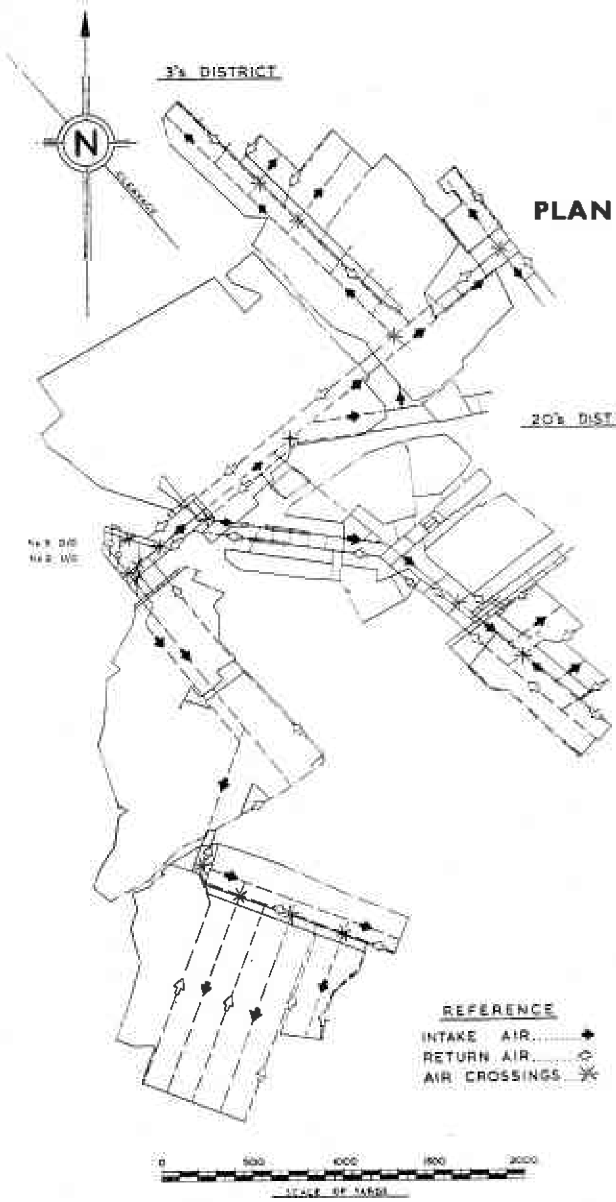
A further application of the hydraulic prop is, with retreating faces the wooden Gate supports can be removed and replaced by hydraulic props, for a distance of some 30 yards in front of the face line.

VENTILATION

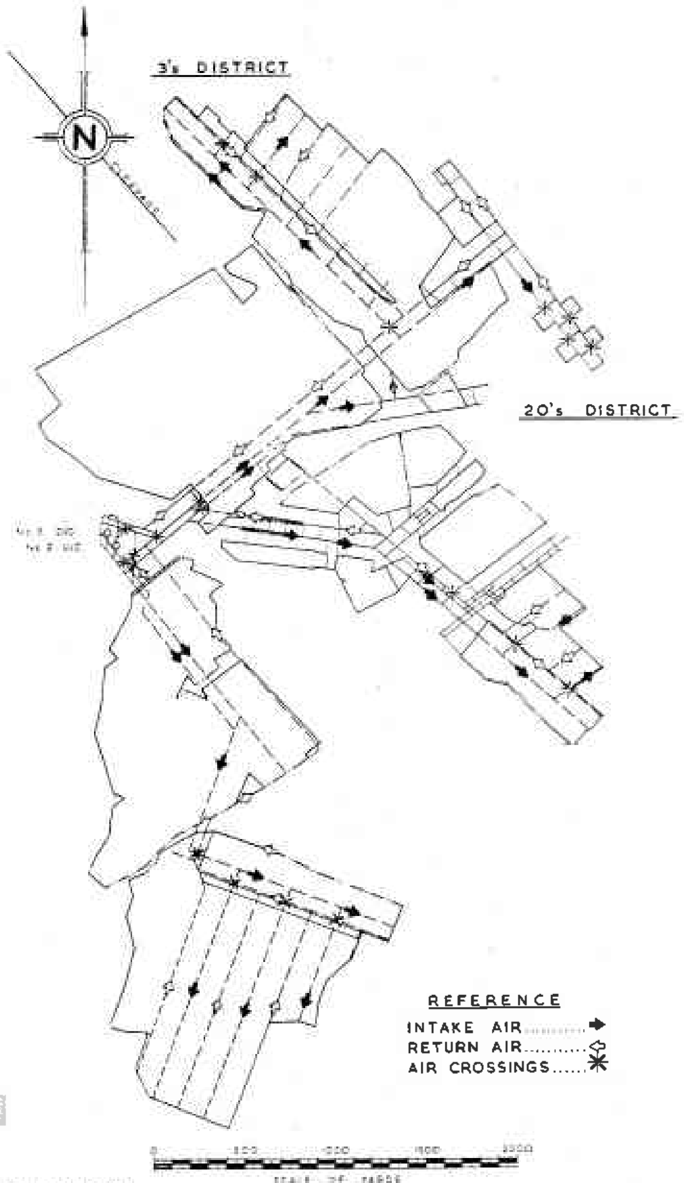
Experience with an experimental 100 yards face in the Deep Hard Seam at Bolsover Colliery proved that a maximum quantity of 10,000 c.f.m. was required for ventilation of a unit. On single shift working

VENTILATION BEFORE REORGANISATION

PLAN 32



VENTILATION AFTER REORGANISATION



PLAN 33

the CH_4 percentage in the face return was 0.25. On three-shift working the percentage only rose to 0.54—these figures being considered safe and satisfactory.

Ventilation arrangements at Bolsover Colliery before and after reorganisation are shown on Plans 32 and 33.

The concentration of face room achieved by the system should simplify the ventilation of large output collieries, but consideration must be given to the following points:—

> The provision of two intakes and two returns to the producing district. This is achieved in the "Bolsover System", 20's district, by preserving the "bearer" pillar edge by loose side heading and dinting.
>
> The design of the surface fan, because, although existing types of fans may be suitable for multi-district ventilation, they may yet be unsuitable for passing high quantities of air through a single district.

At Bolsover all faces are ventilated on the unit system. Due to the comparatively short life of over-casts, consideration was given to the simplest form of air crossing.

Where the face return is carried over the intake, the method used is as shown on Plans 34 (*a*) and (*b*). Two types are illustrated, one with single 3 ft. diameter tube of rolled sections, with no travelling connection between intake and return airways.

The second type shows a combination of the tube air crossing and three door airlock to allow passage of material trams.

Tubes of similar size have, in the past, carried upwards of 15,000 c.f.m. in the Deep Hard Seam at Bolsover Colliery.

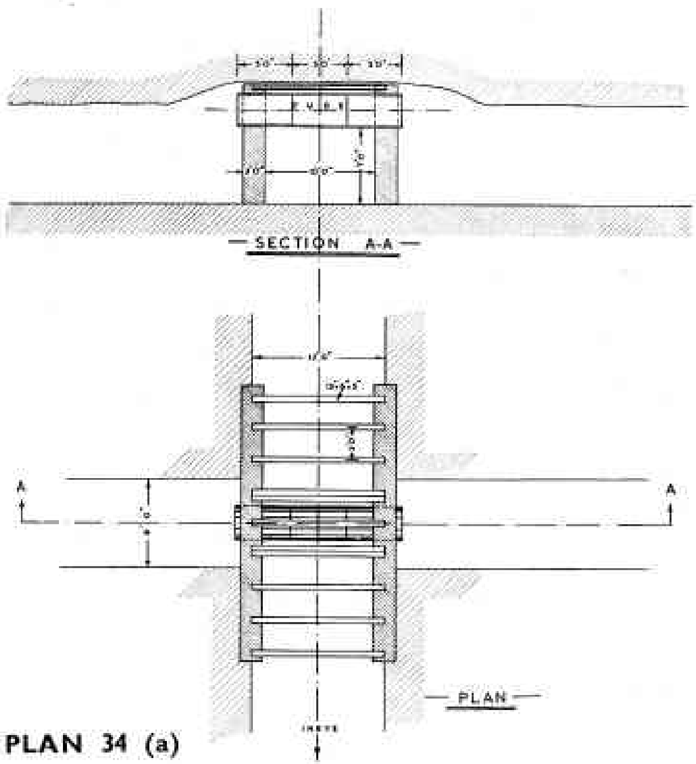
To reduce the amount of masonry involved in building over-casts, all gates, where air crossings are required, are opened out at two-thirds the normal width.

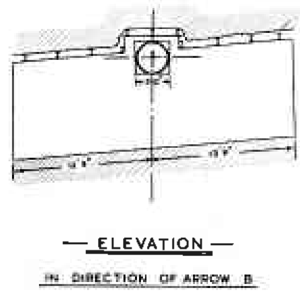
SURFACE ARRANGEMENTS

Surface coal handling arrangements have been made as simple as possible by adapting the somewhat complicated circuits already existing.

Winding is arranged at the bottom deck level, involving decking of the cage for each wind. The cage payload is 5 tons, and shaft capacity is 45 draws per hour, or 225 tons.

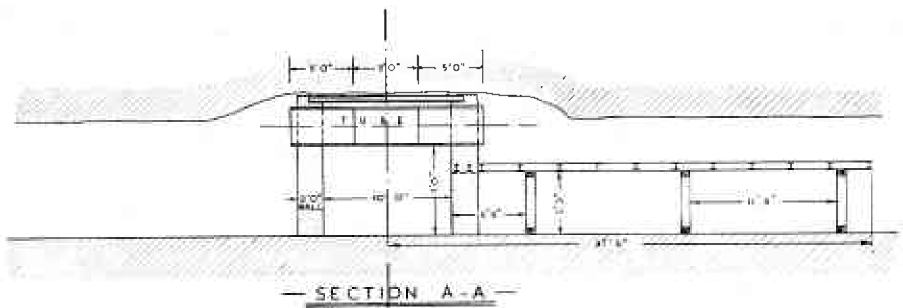
Pneumatic cage rams have been installed on the surface to facilitate cage loading and to overcome cage gradient difficulties, due to the cages being loaded from opposite sides on surface and underground.

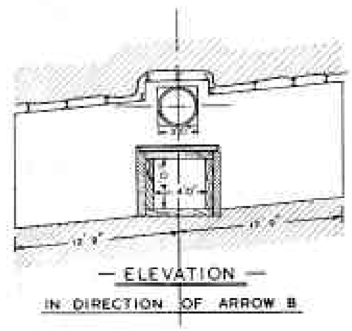




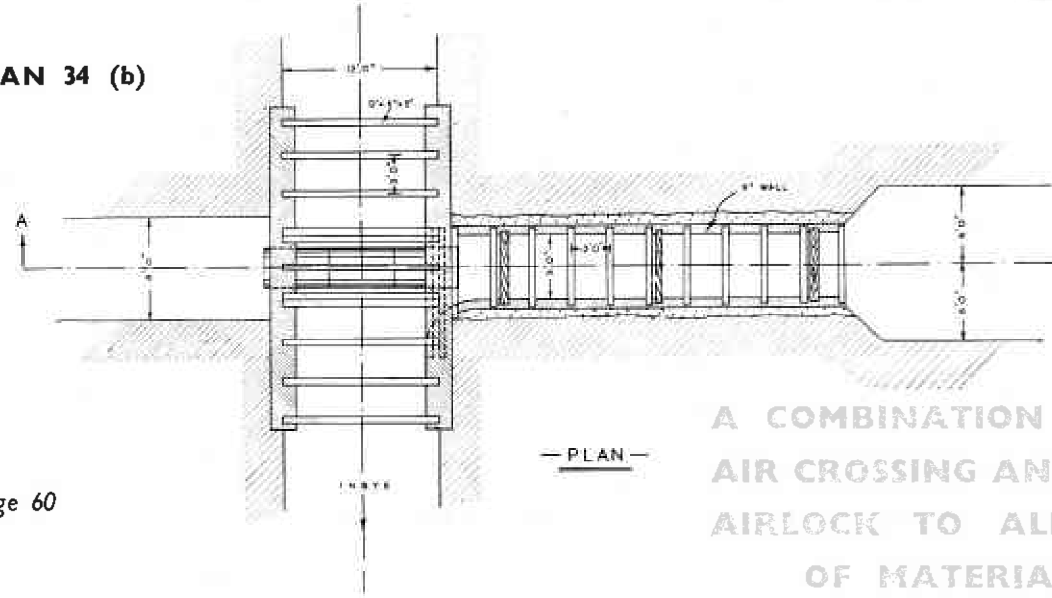
A SINGLE 3-FT DIAMETER TUBE OF ROLLED SECTIONS WITH NO TRAVELLING CONNECTION BETWEEN INTAKE AND RETURN

PLAN 34 (a)





PLAN 34 (b)



A COMBINATION OF THE TUBE AIR CROSSING AND THREE DOOR AIRLOCK TO ALLOW PASSAGE OF MATERIAL TRAINS

The tub circuit incorporates the existing creepers and tippler, hydraulic controllers have been installed at various points for controlling the tubs. Plan 35 shows the surface tub circuit and manpower.

Plan 36 shows the coal preparation arrangements. The coal is conveyed from the tippler to the screens by a 60-in. belt conveyor. At the screens the + 6-in. coal is removed to the picking belt, where four men per shift pick out the large dirt. The large cannel coal is picked out by two men per shift. The 6 in.—0 in. coal passes direct to the washery. The reduced input permits the larger size of coal to be washed efficiently.

After experience with washing the larger size of coal, it is proposed to crush all coal below 6 in. and wash the whole output, thus achieving a manpower reduction of 18 men. The following sizes are produced:—

Hand picked - - - - - - - - - -	+ 6″
Washed - - - - - - - - - - -	6″ × 3″
	3″ × 2″
	2″ × 1″
	1″ × ½″
Washed slack - - - - - - - - -	½″
Filter cake.	

Other surface labour has been proportionately reduced to suit the lower output per shift.

SAFETY

The spread of production over the full twenty-four hours, the intensive concentration, the absence of complicated haulage systems, and the solid coal protection of roadways, should have a beneficial effect on surface and "other underground" accident rates.

On the face, with improved roof control, concentrated supervision, and the team spirit of the men, the system should prove to be one of the safest in mining.

When the project is fully mechanised, with shotfiring reduced to a minimum, a low accident rate should constitute one of the major advantages of the system.

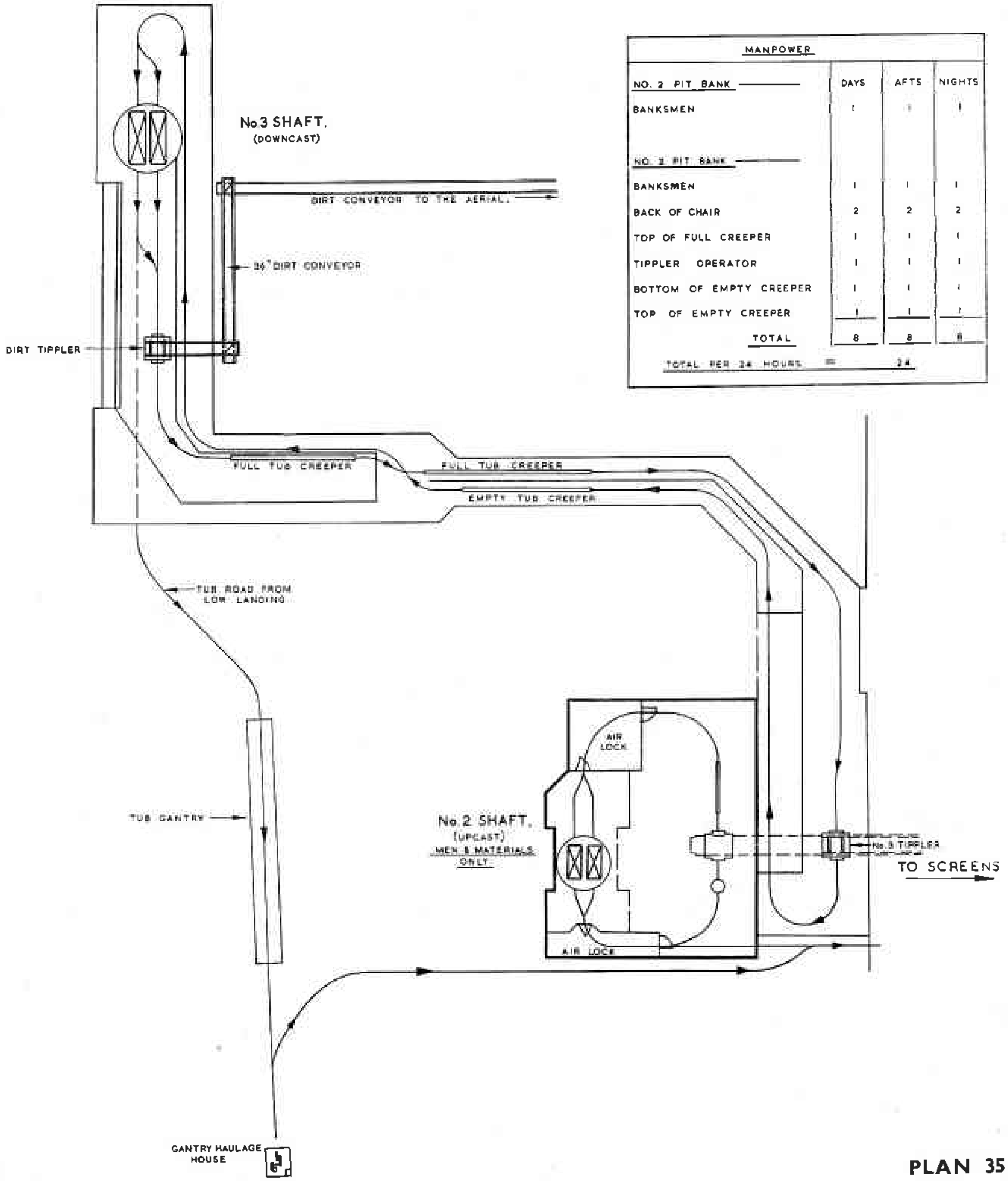
SATURDAY WORKING

At the present time of crisis, the system is admirably suited to "Saturday Working", because, not being tied to a cycle of operations, each shift is a self-contained producing shift.

SURFACE TUB CIRCUIT

MANPOWER	DAYS	AFTS	NIGHTS
NO. 2 PIT BANK			
BANKSMEN	1	1	1
NO. 3 PIT BANK			
BANKSMEN	1	1	1
BACK OF CHAIR	2	2	2
TOP OF FULL CREEPER	1	1	1
TIPPLER OPERATOR	1	1	1
BOTTOM OF EMPTY CREEPER	1	1	1
TOP OF EMPTY CREEPER	1	1	1
TOTAL	8	8	8

TOTAL PER 24 HOURS = 24



PLAN 35

THE NEW SYSTEM AND PRESENT NEEDS

GENERAL

Experience to date with the "Bolsover System" has thrown into bold relief the pressing need for mining machinery manufacturers to concentrate upon certain matters as subjects for immediate research. There is need, also, for careful thought to be given to the initiation and instruction of technical staff. It has already been indicated that this problem is not as difficult as it might appear at first sight, but there is danger in neglecting the simple and the obvious steps. Finally, as far as the application of the system at Bolsover Colliery is concerned, there are aspects where improvement can be made towards even greater efficiency, and these must be indicated.

MACHINERY SPECIFICATION

ELECTRICAL SWITCHGEAR AND TRANSFORMERS

These items of plant must, firstly, be made more easily transportable by reductions in both size and weight. Gate end switchgear, in particular, should be designed to reduce the number of panels per gate, and should be of such a size and weight that units can be carried by one man.

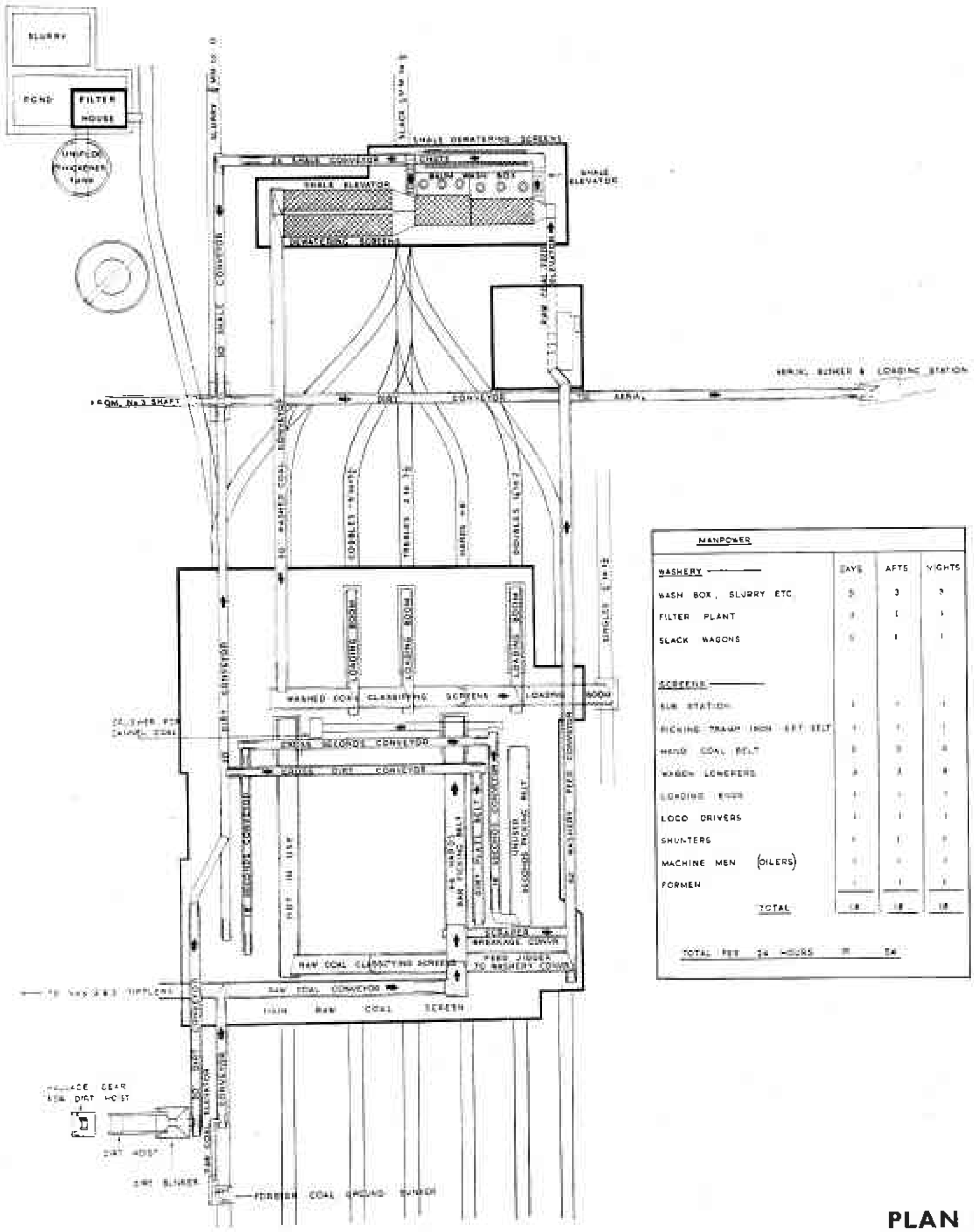
ELECTRICAL MOTORS

Consideration should be given to the heat build-up in face and gate motors consequent upon continuous running for five days. Some means of efficient cooling is desirable.

TRAILING CABLES

There is a tendency to increase still further the size and weight of trailing cables. With increased face mechanisation and fast rate of advance, the trailing cables should be smaller in diameter and more flexible. U.S.A. practice in this respect is worthy of careful study.

COAL PREPARATION ARRANGEMENTS



MANPOWER

	DAYS	AFTS	NIGHTS
WASHERY			
WASH BOX, SLURRY ETC	[illegible]	3	3
FILTER PLANT	[illegible]	1	1
SLACK WAGONS	[illegible]	1	1
SCREENS			
SUB STATION	[illegible]	[illegible]	[illegible]
PICKING TRAMP IRON [illegible] BELT	[illegible]	[illegible]	[illegible]
HAND COAL BELT	[illegible]	[illegible]	[illegible]
WAGON LOWERERS	[illegible]	[illegible]	[illegible]
LOADING BOOM	[illegible]	[illegible]	[illegible]
LOCO DRIVERS	1	1	1
SHUNTERS	[illegible]	1	[illegible]
MACHINE MEN (OILERS)	[illegible]	[illegible]	[illegible]
FORMEN	[illegible]	1	[illegible]
TOTAL	18	18	18

TOTAL PER 24 HOURS [illegible] 54

PLAN 36

CONVEYOR DRIVING GEARS

Face

There is a need for a compact, powerful face conveyor driving gear to be of maximum dimensions, 4 ft. long, 2 ft. high, and 3 ft. wide, and powered by at least a 25 h.p. motor. This driving should be fitted with a suitable jacking system to enable it to be moved forward by one man without undue effort.

Gate

Gate conveyor driving gears should be readily convertible for either top or bottom loading gate structure.

SCRAPER CHAIN CONVEYORS

There is a need for a high capacity, reliable chain conveyor as an intermediary between the face and gate conveyor. This chain should be capable of handling 150 to 200 tons per hour peak loads with freedom from breakdown.

HYDRAULIC APPLICATIONS

Hydraulic control of Pit Bank and Pit Bottom Circuits and loading points has numerous advantages, and should be further developed.

INITIATION AND INSTRUCTION OF TECHNICAL STAFF

THE PLANNING ENGINEER

It is considered that a planning engineer, unaccustomed to the system, should have at least two months intensive instruction, both in the drawing office and underground, in an area where the system is being applied, before he attempts to reproduce the system elsewhere.

THE MANAGER

By discussion and by underground and surface inspections with trained management, a colliery manager could absorb the fundamentals of the system in two weeks of intensive application.

THE UNDERMANAGER

The undermanager must, of necessity, spend at least a month underground with an undermanager trained in the system, in order to absorb the details of the organisation.

OVERMEN

It would be advisable for key overmen to be trained in the system for a period of four weeks, as under the system they virtually become shift undermanagers.

DEPUTIES, SHOTFIRERS AND WORKMEN

It is felt that an experimental face at each colliery, where it is proposed to introduce the system, should be set aside for the training of all deputies, shotfirers, and chargemen faceworkers—indeed as many workmen as possible should be trained before full implementation of the system is undertaken.

FUTURE IMPROVEMENTS AT BOLSOVER

Once a system is established, there should be no stagnation born of complacency, and there should be a constant effort directed towards further improvement of every aspect of the system. There are many aspects of the "Bolsover System" at Bolsover where improvement can be made towards an even higher efficiency, and we have the following in mind:—

The introduction of mechanised ripping and dinting.

Optimum mechanisation of headings and breastings.

The eventual use of a suitable form of mechanised stowing of wastes.

Further advance in coal getting methods at the face.

Improved roadway supports, incorporating non-expendable material together with mechanised means of setting.

Simplified and more flexible man-riding facilities.

Reorganisation of surface steam raising plant to reduce man-power.

Reorganisation of the surface coal circuit to eliminate the screening plant, and to provide for washing of all the output after crushing the large coal down to 6 in.

THE NEW SYSTEM AND ITS ACHIEVEMENTS

The sub-title of this brochure describes the Bolsover Project as "an experiment to reduce the cost of coal production and to alleviate the difficulties arising from the decline in manpower in the coalmining industry". The emphasis was placed, from the very beginning, upon the word "experiment". We had our faith in the system, but it had to be tried before it could be proved successful or otherwise. It has been tried. Is it then too early to speak of results?

The answer is no. There is no doubt at all that the system has been proved successful. There is no doubt at all that the planned O.M.S. will be achieved. These are not prophesies, but conclusions based upon solid achievements to date. The future achievements can, naturally, only be dealt with in the future, and it is proposed to issue an addendum to this brochure early in 1951, dealing with the final results.

The achievements to date, on hand-filling, are best expressed as follows:—

The build up to the full system—five working faces and one spare face—was gradual.

By Monday, 20th November, 1950, four turning faces were ready, and the results obtained were as follows:—

	Tonnage.	O.M.S.	Cumulative O.M.S.
1st Week			
Monday, 20th November, 1950	1,857	37.2	26.5
Tuesday, 21st November, 1950	2,132	41.5	32.8
Wednesday, 22nd November, 1950 - - - - - - -	1,838	35.4	33.6
Thursday, 23rd November, 1950	2,164	41.6	35.5
Friday, 24th November, 1950 -	1,899	36.9	35.7
2nd Week			
Monday, 27th November, 1950	2,059	40.8	33.5
Tuesday, 28th November, 1950	2,034	39.8	36.4
Wednesday, 29th November, 1950 - - - - - - -	2,109	41.6	38.0
Thursday, 30th November, 1950	2,260	43.9	39.5
Friday, 1st December, 1950 -	2,127	41.7	39.8

3rd Week	Tonnage.	O.M.S.	Cumulative O.M.S.
Monday, 4th December, 1950	1,592	31.0	24.4
Tuesday, 5th December, 1950	2,180	41.1	32.0
Wednesday, 6th December, 1950	2,000	38.4	33.9
Thursday, 7th December, 1950	2,058	39.1	35.1
Friday, 8th December, 1950 -	1,787	34.6	35.0

It became clear from these figures that the experiment had succeeded, because, if we could obtain results from a fifth working face only akin to the results on the four faces already working, the desired O.M.S. and output would be achieved. The third week carried an exceptional burden of week-end work, in order, rapidly, to prepare the additional faces.

By Monday, 11th December, 1950, five working faces and one spare face were ready, and the stage was set for a fair trial of the complete system on hand-filling. The results were as follows:—

1st Week	Tonnage.	O.M.S.	Cumulative O.M.S.
Monday, 11th December, 1950	2,365	44.6	37.6
Tuesday, 12th December, 1950	2,472	45.9	41.4
Wednesday, 13th December, 1950	2,582	48.4	43.9
Thursday, 14th December, 1950	2,709	50.6	45.3
Friday, 15th December, 1950 -	2,647	49.9	46.2
2nd Week			
Monday, 18th December, 1950	2,650	53.1	44.2
Tuesday, 19th December, 1950	2,334	46.3	45.2
Wednesday, 20th December, 1950	2,406	47.3	45.8
Thursday, 21st December, 1950	2,296	46.2	45.9
Friday, 22nd December, 1950 -	1,961	41.9	45.2

Thus, at an average British mine, overall O.M.S. has been lifted, on hand-filling, considerably, without large capital expenditure and in a period of twelve months from the commencement of planning.

In 1949 the average weekly output of saleable coal at Bolsover was 11,700 tons, and this output was obtained by a total labour force, on books, of 1,470.

To-day, the average weekly output of saleable coal at Bolsover is 12,500 tons, and this output is obtained by a total labour force, on books, of 1,136.

There is no doubt that, even on hand-filling, these results will improve, and it is confidently expected that the O.M.S. will build up to 55 cwts. overall in the near future.

With the complete installation of coal getting machines, it is confidently expected that an overall O.M.S. of approaching 80 cwts. will result—providing that these machines can regularly perform the reasonable task of two "slices" per shift—and the system will be switched over to machine mining as soon as the machines are available.

INITIAL DIFFICULTIES AND THE LESSONS TO BE LEARNED

In order that others may benefit from the experience gained with the "Bolsover Experiment", the major difficulties encountered, and the methods adopted to overcome them, are set out below.

METHOD OF INTRODUCTION

The "Bolsover System", because of the special significance of the experiment, was applied completely to a whole pit. Because of the anticipated redundancy, some 150 men, the majority of whom were face workers, left the colliery before the actual implementation of the Project. This loss of manpower seriously affected the colliery results for the six months preceding the experiment.

By suitable phasing in a pit, future projects may not suffer any loss from this cause.

METHOD OF IMPLEMENTATION

In order to achieve the desired concentration quickly at Bolsover, it was necessary, urgently, to develop six new faces, and to start these faces simultaneously and advance them rapidly from the rib-side. The consequent first weights, occurring on all faces at the same time (in several cases accompanied by a heavy make of roof water) caused a serious loss of output in the early stages of the experiment.

Planning for future applications should provide for a gradual introduction of the required number of faces, to permit each face to start more slowly from the rib-side.

This would also permit of a more progressive training of workmen and officials.

MAINTENANCE OF EQUIPMENT

An organisation for efficient maintenance of equipment is imperative, and the provision of a spare face to permit the resting and maintenance of main production faces is an essential part of "The System".

A systematic and frequent overhaul of all face equipment (mechanical and electrical) must be carried out, to ensure freedom from breakdowns, it being realised that three shift operating necessitates shorter periods between overhauls.

CONTINUOUS RUNNING OF TRUNK CONVEYORS

Continuous running of trunk conveyors calls for maintenance of the highest order, so that no output will be lost due to breakdowns.

Material benefits have been derived at Bolsover Colliery from time studies and the use of Servis recorders.

MANRIDING

It is vital that manriding facilities should be efficient to permit the faceworkers to spend the maximum number of hours on the coal face. The shift times of faces can be staggered where manriding facilities are limited.

SUPPLIES AND MATERIALS—TRANSPORT SYSTEM

An efficient supplies and materials transport system is essential. At Bolsover Colliery, due to the speedy and wholesale implementation of "The System", the supplies and transport system is not in its finalised form, but this matter is receiving urgent attention. Inbye stockpiling is employed with benefit.

ORGANISATION ON THE COAL FACE

In view of the narrow time margin, it is important that organisation and supervision on the coal face should be sound.

Not only should every step in the programme of events be carried out with efficiency and expedition, but particular attention should be paid to the cleaning up of all wastes. Attention to spillage generally reaps a rich harvest in the way of O.M.S.

SCRAPER CHAIN TROUBLES

Trouble has been experienced due to incorrect alignment and grading of the scraper chain conveyors on the rib-side, causing pins to shear with a resultant loss in output. This trouble has been remedied by better supervision.

NCB

It has been found advantageous to drive the "slits" between the Main Gate and the rib-side at an angle of 45° instead of 90° as originally planned. This has resulted in a smoother transfer of coal from the rib-side conveyor to the little cross conveyor—largely eliminating blockage by large lumps of coal.

GATE CONVEYORS

One conventional face (3B.) was adapted to the system, by shortening its length and using existing gate equipment.

The face was served by a fully troughed and covered top loading gate conveyor. Many troubles were experienced due to reversal of this conveyor for conveyance of materials. No difficulties have been experienced where the bottom loading structure has been employed.