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Human Relations 1951; 4; 3

DOI: 10.1177/001872675100400101

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SOME SOCIAL AND PSYCHOLOGICAL CONSEQUENCES OF THE LONGWALL METHOD OF COAL-GETTING¹

An Examination of the Psychological Situation and Defences of a Work Group in relation to the Social Structure and Technological Content of the Work System

E. L. TRIST AND K. W. BAMFORTH²

I

INTRODUCTION : A PERSPECTIVE FROM RECENT INNOVATIONS

A number of innovations in work organization at the coal-face have been making a sporadic and rather guarded appearance since the change-over of the industry to nationalization. During the past two years the authors have been following the course of these developments. Though differing from each other, they have had the common effect of increasing productivity, at least to some extent, and sometimes the increase reported has reached a level definitely above the upper limit customarily achieved by good workmen using similar equipment under conventional conditions. They have been accompanied by impressive changes in the social quality of the work-life of

¹ The study reported here is one part of a larger project on which the Tavistock Institute of Human Relations has for some time been engaged, concerned with the conditions likely to increase the effectiveness of the "dissemination of information" about new social techniques developed in industry. This project was initiated by the Human Factors Panel of the Committee on Industrial Productivity set up by the Lord President of the Council under the Scientific Adviser to the Government. It has been administered by the Medical Research Council. No responsibility, however, attaches to either of these bodies for the contents of this paper, a shortened version of which has been discussed by the Medical Research Subcommittee of the National Coal Board.

² The field work necessary for this study has been lessened by the fact that Mr. K. W. Bamforth was himself formerly a miner and worked at the coal-face for 18 years.

face teams. Greater cohesiveness has appeared in groups, and greater personal satisfaction has been reported by individuals. Decreases have also been indicated in sickness and absenteeism.

These schemes have been initiated in pits where the quality of technical management and the level of group relationships, both within and with the executive, have been sufficiently high to give the security necessary for undertaking new developments. Many of the workmen concerned in the early stages have contributed substantially to the understanding of the issues. Though it is not uncommon for changes of this character to make their initial appearance in so selective a manner, the *elite* status of the pioneer units necessitates some caution in assessing their suitability for wider application.

For this reason, some of those most concerned regarded the proposed dissemination studies as premature, while the writers found their own first task to be that of making a detailed appraisal of the standard current work system, known as the "longwall" method. Two preliminary hypotheses suggested themselves : that the improvements recorded were to be ascribed to remarkable attributes possessed by the innovations ; alternatively, that a considerable part of their effect was to be accounted for by social shortcomings in the longwall method itself, so that changes, modest in themselves, might easily produce the results obtained.

The content of the innovations suggested the greater likelihood of this second hypothesis ; their common characteristic so far having been to take some step that has increased the group-relatedness of the face-worker in a basic respect, though by a simple means. Some have made use of possibilities of improving group relationships associated with "room-and-pillar" techniques, much advocated recently for work in thicker seams. Others have been concerned with altering the form of the work group at the longwall itself. On the "filling" shift, for example, "group sectionalization" has been tried in place of individual "stints". In the longwall method the total task of coal-getting is spread over three shifts, and the culminating activity of moving the coal on to the conveyor is known as "filling off". It is on this shift that most troubles appear to accumulate ; and it is on this shift that the largest number of men is employed. Changes that might lessen its difficulties would be specially welcome. But steps of the type taken can scarcely be considered as in themselves "remarkable". Both the need to take them and the degree of their success point rather to a lack in the social quality of longwall organization in its present form—and to the importance of group relations in the underground situation.

Most competent authorities appear to be agreed that the "hand-got" methods which preceded the longwall provided the face-worker with a social balance that has since been lost. But the reasons for this have remained obscure. Before nationalization their investigation tended to be side-tracked by the fact that the advent of mechanization coincided with the appearance in the coalfields of economic depression and bitter exacerbation of the struggle between miners and owners. Only medical writers, such as Dickson (1)

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and Halliday (2), concerned with the epidemic incidence of psycho-somatic disorders among miners working under mechanized conditions, stressed the independent importance of the psychological and sociological factors to be discussed in this report. A more recent medical survey has been made by Morris (3). None of these writers, however, has traced in detail the connexion between the health and productivity of the miner and the social structure of the work system that controls his relationships.

Since nationalization, displacement on to the economic struggle of troubles stemming from this source has tended to be replaced by their displacement on to problems of management-worker relationships ; but difficulties in joint consultation are not likely to be lessened by carrying a surcharge that should be placed to the account of the longwall method. Faced with low productivity despite improved equipment, and with drift from the pits despite both higher wages and better amenities, those in authority have increased their interest in the organizational innovations that have been taking place. A point seems to have been reached where the industry is in a mood to question a method it has taken for granted. To assist evaluation of the new developments, the first information requiring dissemination is an account of the social and psychological consequences of the longwall method itself.

In the account to follow, the longwall method will be regarded as a technological system expressive of the prevailing outlook of mass-production engineering and as a social structure consisting of the occupational roles that have been institutionalized in its use. These interactive technological and sociological patterns will be assumed to exist as forces having psychological effects in the life-space of the face-worker, who must either take a role and perform a task in the system they compose or abandon his attempt to work at the coal-face. His own contribution to the field of determinants arises from the nature and quality of the attitudes and relationships he develops in performing one of these tasks and in taking one of these roles. Together, the forces and their effects constitute the psycho-social whole which is the object of study.

The method followed has been to maintain relatively continuous contact over a period of two years with some twenty key informants who represented between them the various coal-face occupations and all of whom had wide and varied experience of the industry. With this group repeated discussions and long interviews have been held. On the management side, similar discussions and interviews have been held with all grades of personnel up to Area Manager. Group discussions were taken over periods of a fortnight at two Divisional schools for Colliery Managers. Other informants have included three psychiatrists with wide experience of miners' problems gathered in medical practice in colliery districts or in public health inquiries.

The earlier situation on the background of which the longwall method originally developed will first be described. Longwall procedure itself will then be discussed. Later sections will be concerned with special problems arising in the various occupational sub-groups.

II

THE CHARACTER OF THE PRE-MECHANIZED EQUILIBRIUM
AND THE NATURE OF ITS DISTURBANCE

I. Hand-got Systems and the Responsible Autonomy of the Pair-Based Work Group

The outstanding feature of the social pattern with which the pre-mechanized equilibrium was associated is its emphasis on small group organization at the coal-face. The groups themselves were interdependent working pairs to whom one or two extra individuals might be attached. It was common practice for two colliers—a hewer and his mate—to make their own contract with the colliery management and to work their own small face with the assistance of a boy “trammer”. This working unit could function equally well in a variety of engineering layouts both of the advance and retreat type, whether step-wise or direct. Sometimes it extended its numbers to seven or eight, when three or four colliers, and their attendant trammers, would work together.⁸

A primary work-organization of this type has the advantage of placing responsibility for the complete coal-getting task squarely on the shoulders of a single, small, face-to-face group which experiences the entire cycle of operations within the compass of its membership. For each participant the task has total significance and dynamic closure. Though the contract may have been in the name of the hewer, it was regarded as a joint undertaking. Leadership and “supervision” were internal to the group, which had a quality of *responsible autonomy*. The capacity of these groups for self-regulation was a function of the wholeness of their work task, this connection being represented in their contractual status. A whole has power as an independent detachment, but a part requires external control.

Within these pair-based units was contained the full range of coal-face skills; each collier being an all-round workman, usually able to substitute for his mate. Though his equipment was simple, his tasks were multiple. The “underground skill” on which their efficient and safe execution depended was almost entirely person-carried. He had craft pride and artisan independence. These qualities obviated status difficulties and contributed to responsible autonomy.

Choice of workmates posed a crucial question. These choices were made by the men themselves, sociometrically, under full pressure of the reality situation and with long-standing knowledge of each other. Stable relationships tended to result, which frequently endured over many years. In circumstances where a man was injured or killed, it was not uncommon for his mate to care for his family. These work relationships were often reinforced by kinship ties, the contract system and the small group autonomy allowing a close but spontaneous connection to be maintained between family and

⁸ Hand-got methods contained a number of variants, but discussion of these is beyond present scope.

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occupation, which avoided tying the one to the other. In segregated mining communities the link between kinship and occupation can be oppressive as well as supportive ; against this danger, "exogamous" choice was a safeguard. But against too emotional a relationship, more likely to develop between non-kin associates, kinship barriers were in turn a safeguard.

The wholeness of the work task, the multiplicity of the skills of the individual, and the self-selection of the group were congruent attributes of a pattern of responsible autonomy that characterized the pair-based face teams of hand-got mining.

2. The Adaptability of the Small Group to the Underground Situation

Being able to work their own short faces continuously, these pair, or near pair, groups could stop at whatever point may have been reached by the end of a shift. The flexibility in work pace so allowed had special advantages in the underground situation ; for when bad conditions were encountered, the extraction process in a series of stalls could proceed unevenly in correspondence with the uneven distribution of these bad conditions, which tend to occur now in one and now in another section along a seam. Even under good conditions, groups of this kind were free to set their own targets, so that aspirations levels with respect to production could be adjusted to the age and stamina of the individuals concerned.

In the underground situation external dangers must be faced in darkness. Darkness also awakens internal dangers. The need to share with others anxieties aroused by this double threat may be taken as self-evident. In view of the restricted range of effective communication, these others have to be immediately present. Their number therefore is limited. These conditions point to the strong need in the underground worker for a role in a small primary group.

A second characteristic of the underground situation is the wide dispersal of particular activities, in view of the large area over which operations generally are extended. The small groups of the hand-got systems tended to become isolated from each other even when working in the same series of stalls ; the isolation of the group, as of the individual, being intensified by the darkness. Under these conditions there is no possibility of continuous supervision, in the factory sense, from any individual external to the primary work group.

The small group, capable of responsible autonomy, and able to vary its work pace in correspondence with changing conditions, would appear to be the type of social structure ideally adapted to the underground situation. It is instructive that the traditional work systems, evolved from the experience of successive generations, should have been founded on a group with these attributes.

But to earn a living under hand-got conditions often entailed physical effort of a formidable order, and possession of exceptional skill was required to extract a bare existence from a hard seam with a bad roof. To tram tubs was "horse-work". Trammers were commonly identified by scabs, called

"buttons", on the bone joints of their backs, caused by catching the roof while pushing and holding tubs on and off "the gates". Hand-got conditions still obtain, for by no means all faces are serviced by conveyors and coal-cutters. In some circumstances this equipment is unsuitable. But hardness of work is a separate consideration from the quality of the group.

3. The Counter Balance of the Large Undifferentiated Collectivity

The psychological disadvantages of a work system, the small group organization of which is based on pair relationships, raises issues of a far-reaching kind only recently submitted to study in group dynamics (4). It would appear that the self-enclosed character of the relationship makes it difficult for groups of this kind to combine effectively in differentiated structures of a somewhat larger social magnitude, though this inability does not seem to hold in respect of much larger collectivities of a simpler mass character. But in pre-mechanized mining there was no technological necessity for intermediate structures, equivalent to factory departments, to make their appearance between the small pair-based primary units and the larger collectivities called into action by situations of crisis and common danger. To meet situations requiring the mobilization of the large mass group, mining communities have developed traditions generally recognized as above the norm commonly attained by occupational groups in our society. This supra-normative quality was present also in the traditions of the small pair-based organizations. But between these extremes there was little experience.

Sociologically, this situation is not atypical of industries which, though large-scale, have experienced delay in undergoing mechanization. The pair-based face teams corresponded to the technological simplicity of the hand-got methods, with their short faces, autonomously worked and loosely co-ordinated on a district basis. The mass collectivities reflected the large-scale size of the pit as an overall industrial unit. Absent were structures at the level of the factory department, whose process-linked, fractionated role-systems, dependent on external supervision, were antithetical alike to the pattern of small group autonomy and to the artisan outlook of the collier.

In the pre-mechanized pattern, the pair-based primaries and the large relatively undifferentiated collectivities composed a dynamically interrelated system that permitted an enduring social balance. The intense reciprocities of the former, with their personal and family significance, and the diffuse identifications of the latter, with their community and class connectedness, were mutually supportive. The face teams could bear the responsibility of their autonomy through the security of their dependence on the united collectivity of the pit.

Difficulties arose largely from rivalries and conflicts between the various pairs and small teams. A common form of "graft" was to bribe the deputy in order to secure a good "benk", i.e. a "length" with a "rack roof", under which the coal was notoriously soft and easy to work. Trammers were encouraged to resort to sharp practices to obtain adequate supplies of

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tubs. As supplies were often short, the amount of coal a working pair could send up depended not a little on the prowess of their trammer. Going early to work, he would turn two or three tubs on their sides in his "gate", maintaining he had taken only one. Ensuing disputes caused frequent fights both underground and in the community. In the common saying, it was he who could lie, cheat, or bully the most who made the best trammer. All this was accepted as part of the system.

Inter-team conflict provided a channel for aggression that preserved intact the loyalties on which the small group depended. In the large group aggression received structured expression in trade union resistance. If the struggle was harsh, it was at least direct and understandable. It was not the insidious kind that knocked the bottom out of life, leaving those concerned without a sense of a scheme in things—the "anomie" described by Halliday (2) after the transition to the longwall. The system as a whole contained its bad in a way that did not destroy its good. The balance persisted, albeit that work was of the hardest, rewards often meagre, and the social climate rough at times and even violent.

4. Mechanization and the Problem of Intermediate Organization

With the advent of coal-cutters and mechanical conveyors, the degree of technological complexity of the coal-getting task was raised to a different level. Mechanisation made possible the working of a single long face in place of a series of short faces. In thin seams short faces increase costs, since a large number of "gates" (see *Figure 1*) have to be "ripped" up several feet above the height of the seam to create haulage and travelling facilities. In British coal, seams less than 4 ft. in thickness are common, so that there was a tendency to make full use of the possibility of working optimally long rather than optimally short faces. For this reason, and for others also, discussion of which is beyond present scope, the longwall method came into being. Applicable to thick as well as to thin seams, it became the general method of coal-getting in the British industry, enabling the average type of pit, which may contain three or four seams of different thickness, to work its entire coal economically, and to develop its layout and organize its production in terms of a single, self-consistent plan. In America, where thick seams are the rule, mechanization has developed in terms of shorter faces and room-and-pillar techniques.

The associated characteristics of mechanized complexity, and of largeness as regards the scale of the primary production unit, created a situation in which it was impossible for the method to develop as a technological system without bringing into existence a work relationship structure radically different from that associated with hand-got procedures. The artisan type of pair, composed of the skilled man and his mate, assisted by one or more labourers, was out of keeping as a model for the type of work group required. Need arose for a unit more of the size and differentiated complexity of a small factory department. A structure of intermediate social magnitude began therefore to emerge.

The basic pattern round which the work relationships of the longwall production unit were organized became the cycle group of 40-50 men, their shot-firer and shift "deputies", who were responsible to the pit management for the working as a whole. Only in relation to this total cycle group could various smaller sub-groups secure function and acquire social form.

This centring of the new system on a differentiated structure of intermediate social magnitude disturbed the simple balance that had existed between the very small and very large traditional groups, and impaired the quality of responsible autonomy. The psychological and sociological problems posed by the technological needs of the longwall system were those with respect to which experience in the industry was least, and towards which its traditions were antithetical. The consequences of this conflict between the demands of the new situation and the resources available from past experience will be taken up in the light of the detailed account, which will now be presented, of the longwall system itself.

5. The Lack of Recognition of the Nature of the Difficulties

No new equilibrium came into being. As was mentioned in the introduction, disturbances associated with industrial struggle and economic depression have tended to mask those associated with the coal-getting method. Though perception of these latter has begun to clarify since nationalization, shortcomings such as those in the haulage system, more readily appreciated in engineering terms, continue to attract the wider attention. It is only since the morale changes accompanying recent face-work innovations have begun actually to be experienced in working groups that the nature of longwall troubles is becoming manifest. That they require understanding in social and psychological terms is something that still remains largely unrecognized. Accounts so far appearing have presented recent changes almost exclusively in engineering terms.

Anyone who has listened to the talk of older miners who have experienced in their own work-lives the change-over to the longwall cannot fail to be impressed by the confused mourning for the past that still goes on in them together with a dismay over the present coloured by despair and indignation. To the clinical worker the quality of these talks has at times a ring that is familiar. Those with rehabilitation experience will recognize it as similar to the quality of feeling expressed by rehabilitees when ventilating the aftermath in themselves of an impairment accepted as irreversible.

Expectation was widespread that something magical would happen as a result of nationalization. But as one filler put it : "My coals don't wear any new look since Investment Day. They give me a look as black as before." When some of these same men take on a new lease of life, perhaps exaggeratedly, after experiencing one of the new group methods and refuse to return to a conventional working having found a new spirit in themselves and their work-mates, strong clues are already to hand regarding the character of longwall deficiencies. But what has been intuitively grasped has still to become

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articulate. So close is the relationship between the various aspects that the social and the psychological can be understood only in terms of the detailed engineering facts and of the way the technological system as a whole behaves in the environment of the underground situation. These points will be taken up in the next two Sections.

III

FEATURES AND DIFFICULTIES OF THE LONGWALL PRODUCTION UNIT AS A WHOLE⁴

i. The scale and Spatio-Temporal Structure of the Three-Shift Cycle

In the longwall method, a direct advance is made into the coal on a continuous front ; faces of 180–200 yds. being typical, though longer faces are not uncommon. The work is broken down into a standard series of component operations that follow each other in rigid succession over three shifts of seven and a half hours each, so that a total coal-getting cycle may be completed once in each twenty-four hours of the working week. The shift spread of the 40 workmen needed on an average face is : 10 each to the first ("cutting") and second ("ripping") shifts ; 20 to the third ("filling") shift. The amount of coal scheduled for extraction varies under different conditions but is commonly in the neighbourhood of 200 tons per cycle. A medium-size pit with three seams would have 12–15 longwall faces in operation simultaneously.

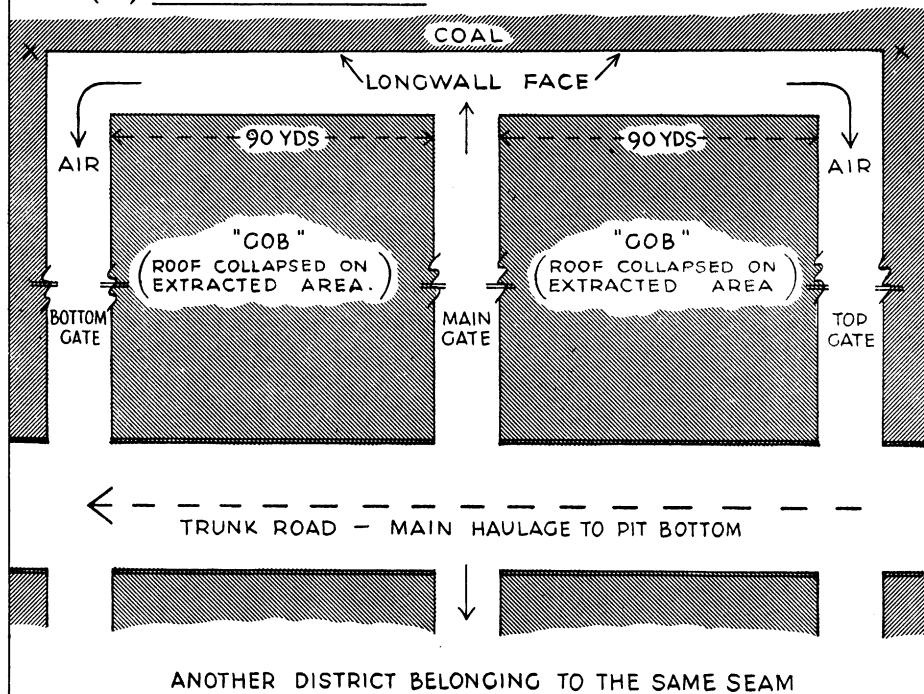
These faces are laid out in districts as shown in *Figure 1*. Since the longwall method is specially applicable to thin seams, *Figure 1* has been set up in terms of a 3-ft. working. The face, extending 90 yds. on either side of the main gate is within average limits for a seam of this thickness. The height of the face area—that of the 3-ft. seam itself—may be contrasted with the 9 ft. and 7 ft. to which the main and side gates have been ripped and built up as permanent structures with cambers and side-packs. By regulation, props must be placed every 3 ft., and the line of props shown in *Figure 1* (b) is that placed immediately against a coal-face waiting to be filled off. The area marked

⁴ The procedure followed both in the text and in *Figures 1* and *2* and *Table I* has been to build up a model of the system in terms of the experience of a group of faces similarly run and well known at first hand. What follows is therefore an account of one version of the system, though the version is a common one. Faces exist that are twice as long as that given. In thick seams these may require 40–50 fillers alone (even more), apart altogether from other personnel. In thin seams with high gates more than twice the number of rippers given may be employed, 8 or more on the main gate and some 6–4 on the side gates respectively. On shorter faces there may be only one borer and at least one gummer. Under some conditions packing and drawing-off are separated from belt-work, and loading-point personnel are included as face workers. There are differences in nomenclature in different areas, e.g. "dinters" for "rippers". Variations arise partly from differences in natural conditions (thickness of seam, hardness of coal, type of roof and floor, etc.), partly from preferences in the matter of lay-out, and partly from the amount and character of the equipment available or judged necessary. Though conveyor serviced, quite a long face may be hand-got if the coal is soft ; alternatively, two cutting units may be employed if it is hard and the face exceptionally long. Belts are of several varieties ("floor", "plate", "top", etc.). Where the seam is thick enough to eliminate ripping an approximation may be made to a two-shift system. Productivity varies widely in accordance with these differences, as does smoothness of functioning and the degree of stress experienced. Nevertheless, all are versions of one method. The basic pattern is the same.

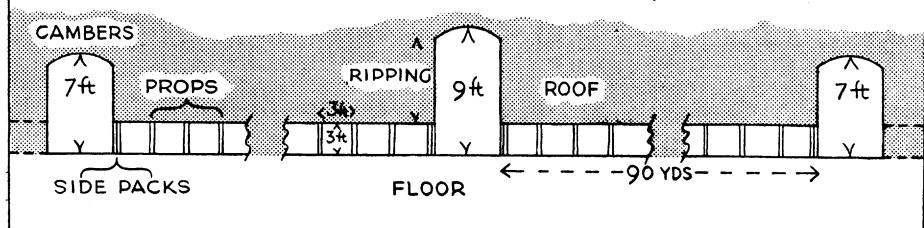
"Gob" (to use a term common in mining vernacular) indicates the expanse from which the coal has already been extracted. On this area the roof is left to collapse. Only the tunnels made by the main and side gates, which are used for ventilation and for haulage and travelling, are kept open. These

FIGURE 1. LAYOUT OF A DISTRICT, LONGWALL METHOD.

(A) HORIZONTAL SECTION.



(B) VERTICAL SECTION. (AT POINT X IN (A) ABOVE)



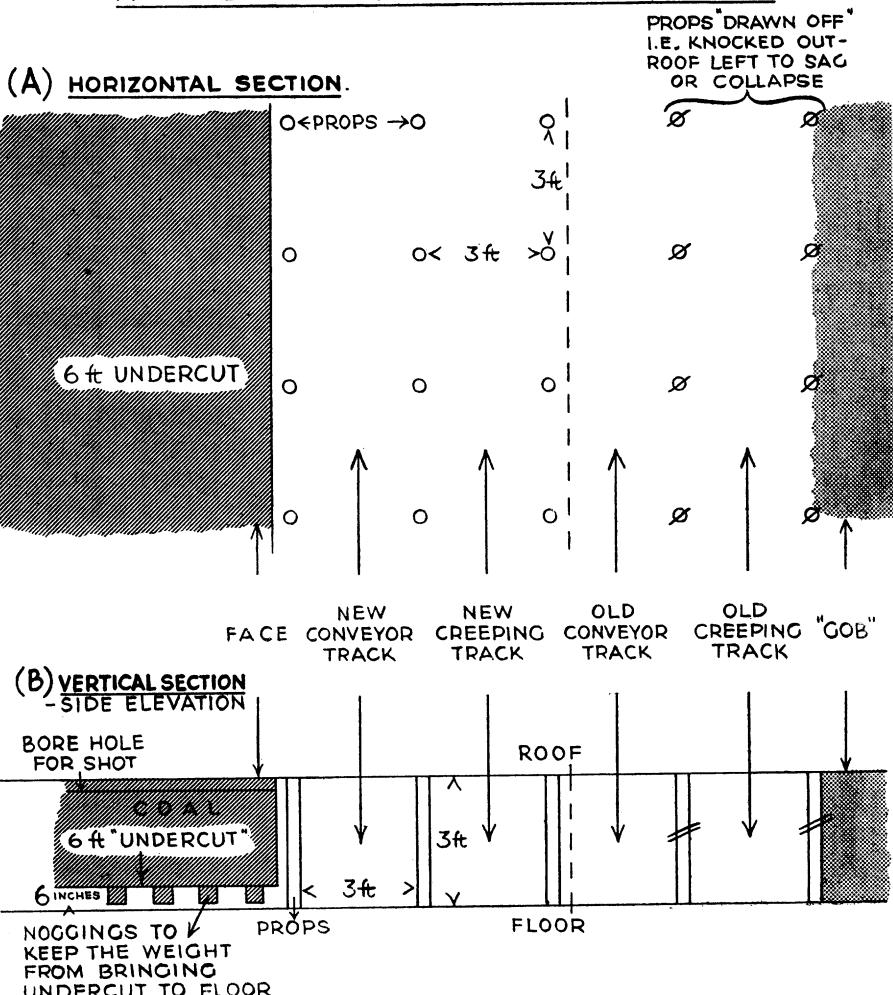
tunnels may sometimes extend for distances of 2 miles, and even more, before the coal face itself is reached from the trunk road leading from the pit bottom.

In each coal-getting cycle the advance made into the coal is equal to the depth of the undercut. A cut of 6 ft. represents typical practice in a thin seam

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with a good roof. All equipment has to be moved forward as each cycle contributes to the advance. The detail in the face area is represented in Figure 2, where the coal is shown cut and waiting for the shot-firer, whose

FIGURE 2. COAL FACE AS SET FOR FILLING SHIFT.



task is the last to be performed before the fillers come on. The combined width of the lanes marked "New Creeping Track" and "New Conveyor Track" equal the depth of 6 ft., from which the coal has been removed by the

fillers on the last shift of the previous cycle. As part of the preparation work of the current cycle (before the fillers can come on again), the conveyor has to be moved from its previous position in the "old Conveyor Track" to its present position, shown in *Figure 2*, in the "New Conveyor Track", against the face. At the same time the two lines of props on either side of the "Old Creeping Track" are withdrawn (allowing the roof to sag or collapse) and thrown over beside the conveyor for the fillers to use in propping up their roof as they get into the next 6 ft. of coal. The term "creeping track" refers to the single, propped, 3-ft. lane, adjacent to that occupied by the conveyor but on the side away from the coal. It allows free passage up and down the face, and is called a creeping track since in thin seams the low roof makes it necessary for all locomotion to take the form of "creeping", i.e. crawling on the hands and knees.

The mass-production character of the longwall operation necessitates a large-scale, mobile layout of the type described. But the spatio-temporal structure imposed by the long face and the shift sequence makes a difficult habitat when considered as a theatre in which effective communication and good working relationships must be maintained between 40 men, their shot-firer and shift deputies. On the one hand, the group is spread over 200 yds. in a tunnel 2 yds. wide and 1 yd. high, cross-cut only by the main and side gates; on the other, it is spread over 24 hours and divided up in three successive shifts. The production engineer might write a simple equation: 200 tons equals 40 men over 200 yds. over 24 hours. But there are no solutions of equivalent simplicity to the psychological and social difficulties raised. For psychological and social difficulties of a new order appear when the scale of a task transcends the limits of simple spatio-temporal structure. By this is meant conditions under which those concerned can complete a job in one place at one time, i.e., the situation of the face-to-face, or singular group.

Once a job is too big for a singular group, a multiple group comes into existence, composed of a number of sub-groups of the singular type. In these differentiated organizations of intermediate social magnitude, problems of inter-group relationships are superimposed on, and inter-act with, the intra-group tensions of the primary components. In the longwall production unit, the scale of the task introduces the contradiction of spatio-temporal disintegration as a condition of multiple group integration.

2. The Differentiation and Interdependence of Tasks

Occupational roles express the relationship between a production process and the social organization of the group. In one direction, they are related to tasks, which are related to each other; in the other, to people, who are also related to each other. At workman level, there are seven of these roles in the longwall system—borer, cutter, gummer, belt-breaker, belt-builder, ripper, and filler—which are linked to the component tasks of the production process. In *Table I* the functions of these seven categories in the interrelated technological and social structures are described in detail in a comprehensive table. For

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analytical purposes, however, it is necessary to treat separately these two different aspects of occupational roles ; and, in this section, consideration will be given to the interdependence of component tasks in the production process, and to occupational roles so far as they are related to this. These tasks fall into four groups, concerned with (a) the preparation of the coal-face for shot-firing, (b) shifting the conveyor, (c) ripping and building up the main and side gates, and (d) moving the shot coal on to the conveyor.

The face preparation tasks are all performed on the first shift. They include boring holes for the shot-firer, with pneumatic or electrically operated drills, near the roof of the seam through to the depth of the undercut, at short distances (within each filler's " length ") along the entire expanse of face ; driving the coal-cutter so that the blade or " jib " makes an even undercut into the coal some six inches from the floor to whatever depth has been assigned, again along the entire expanse of face ; taking out the six inches of coal (called the " gummings ") left in the undercut, so that the main weight of coal can drop and break freely when the shots are fired ; placing supporting " noggings " underneath it so that this weight does not cause it to sag down to the floor while the " cut " is standing during the next shift. These tasks are performed in the order given. Three of the seven work roles are associated with their execution, two men being fully occupied boring the holes, a further two in managing the coal-cutter, and four in clearing out the undercut.

The success of the shots fired at the end of the second shift to make the coal finally ready for the filler depends on the efficiency with which each of these interdependent preparation tasks has been carried out. Bad execution of any one of them diminishes, and may even cancel out, the effect of the shots, with consequent havoc in the lengths of the particular fillers where such breakdowns have occurred. Holes bored too low leave a quantity of coal, difficult to extract, clinging to the roof after the shots have been fired. If the roof is sticky, this gives rise to " sticky tops ". Holes not bored through to the full depth of the undercut create the condition of " hard backs ", the shots having no effect on this part of the coal. The coal-cutter only too frequently has a tendency to leave the floor and " get up into the coal ", producing an uneven cut. This means less working height for the filler, and also less wages, since his tonnage is reduced. When the " gummings " are left in, the shot is wasted ; the coal has nowhere to drop and the powder blows out of the hole (usually up the " cutting break " in the roof) so that the mass to be extracted is left solid. Failure to insert noggings, which leads to the cut sagging down, also renders useless the services of the shot-firer.

The group of operations concerned with the conveyor involves—since forward movement is blocked by props which must be left standing—breaking up the sections of belt in the old conveyor track and building them up in the new. Each of these tasks requires two men : the belt-breakers and belt-builders. The dismantling part is done on the first shift in the wake of the cutting operation. The reasons include the necessity of shifting belt-engines and tension-ends out of the gate areas (where they are positioned when the

TABLE I
Occupational Structure in the Longwall System

Shift Sequence	Occupa-tional Roles	No. of Men	Methods of Payment	Group Organization	Tasks	Skills	Status Differences and Ranking
<i>First (usually called " cutting shift). Either night, 8 p.m.-3.30 a.m., or afternoon, 12 noon-7.30 p.m. (borers start an hour earlier). Though alternating between night and afternoon, personnel on the cutting shift are never on days.</i>	Borer	2	Per hole	Inter-dependent pair on same note.	Boring holes for shot-firer in each stint to depth of undercut.	Management of electric or pneumatic drills, placing of holes, judgment of roof, hardness of coal, etc.	4·5, equal in pair.
	Cutter	2	Per yard	Inter-dependent pair on same note, front man and back man.	Operating coal-cutter to achieve even cut at assigned depth the entire length of the face ; knocking out (front man), re-setting (back man) props as cutter passes. Back man inserts nogginings.	Requires rather more " engineering " skill than other coal-face tasks. Mining skills in keeping cut even under changing conditions, watching roof control.	1, front man senior and responsible for cut ; back man assists ; cutting is the key preparation task.
	Gummer	4	Day wage		Loose group attached to cutters, though front man without supervisory authority.	Cleaning out undercut, so that clear space for coal to drop and level floor for filler. The coal between undercut and floor is called " the gumnings ".	7, equal in group ; some chance of promotion to cutter eventually.
	Belt-breaker	2	Per yard	Inter-dependent pair on same note.		Unskilled, heavy manual task, which unless conscientiously done creates difficulties for filler, for when gummings left in, the shot simply blows out and coal is left solid.	
						Belt-breaking is a relatively simple engineering task ; engine shifting is awkward and heavy ; drawing off and packing involve responsibility for roof control and require solid underground experience.	4·5, equal in pair.

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	Per yard	2	Belt-builder	Second (usually called the "ripping" shift). Either night or afternoon alternating with cutting shift. Rippers may start rather later than builders. None of these personnel go on day shift proper.	Reassembling conveyor in new track ; positioning belt-engine and tension-end in line with this ; testing running of reassembled conveyor ; placing chocks ; packing as required.	As with breaking, the level of engineering skill is relatively simple ; inconvenience caused to fillers if belt out of position. The roof control responsibilities demand solid underground experience.	4·5, equal in pair.
	Cubic measure	8	Ripper	Cohesive functionally inter-related group on same note.	To "rip" "dirt" out of main and side gates to assigned heights ; place timbers and build up roof into a solid, safe and durable structure ; pack up the sides. The ripping team carries out all operations necessary to their task, doing their own boring. The task is a complete job in itself, seen through by the group within the compass of one shift.	This work requires the highest degree of building skill among coal face tasks. Some very heavy labour is entailed. Since the work is relatively permanent there is much pride of craft. On the ripper depends the safety of all gates and main ways.	2, the status of the "main ripper" is next to that of the front man on the cutter, but he is not separately paid. The group usually contains all degrees of experience and is egalitarian.
	Weight-tonnage on conveyors.	20	Filler	Aggregate of individuals with equal "stints" ; all on same note ; fractionated relationships and much isolation.	The length of the "stint" is determined by the depth of the cut and the thickness of the seam. Using hand or air pick and shovel, the filler "throws" the "shot" coal on to the conveyor until he has cleared his length, i.e. "filled off". He props up every 2 ft. 6 in. as he works in.	The filler remains in one work place while conditions change. Considerable underground experience is required to cope with bad conditions. Each man is responsible for his own section of roof. Bad work on other shifts makes the task harder. It is heavy in any case and varies in different parts of the wall.	4·5, equal throughout the group ; "corner" men are envied, reputation of being good or bad workman is important.
3 shifts	40 men	7 roles			Differences in status and weekly earnings are small, apart from the case of the gimmers.	The common background of "underground" skill is more important than the task differences.	

conveyor is working) in order to allow the ripping operation to proceed. The reassembly of the conveyor is the only task performed in the face area during the second shift. Unless the conveyor is properly jointed, set close to the new face, and accurately sighted in a straight line, a further crop of difficulties arise, and frequent stoppages may interfere with filling. The most modern types of belt, e.g., floor belts, avoid the labour of breaking up and reassembling plates. Belt-engines and tension-ends are cumbersome equipment, but they must nevertheless be shifted every day. Similarly, the last two lines of props have to be taken down and thrown forward.

The third group of tasks comprises those that entail ripping up the roof of the main and side gates to the depth of the undercut, and building them up with a stable roof and firmly packed sides so that haulage- and air-ways can advance with the face. Unless this work is expertly done, the danger of roof falls is acute, with the likelihood both of men and equipment being blocked in the face. This work is carried out by a team of 7-8 rippers.

Only when all these operations have been completed, can the shots be fired and the fillers come on. For the filling operation, the entire face is divided up into equal lengths—except that the corner positions are somewhat shorter in view of difficulties created by the proximity of belt-engines and tension-ends. In a 3-ft. seam, lengths would be 8-10 yds., and some 20 fillers would be required, 10 in each half-face of 90-100 yds. Each filler is required to extract the entire coal from his length, going back to the depth of the 6 ft. undercut. When he has thrown his last load on to the conveyor he has "filled off", i.e., finished his "length" or "stint". As he progresses into his coal, he has the additional task of propping up his roof every 3 ft. As well as a hand-pick and shovel, his tool kit includes an air pick, used for dealing with some of the difficulties created by bad preparation, or in any case when his coal is hard.

At a later point there will be a discussion of the differential distribution of bad conditions among the lengths of a face. Here it may be noted that the face is not "filled off" until each and every length has been cleared, and that until this has been done, the new cycle cannot begin. Disorganization on the filling shift disorganizes the subsequent shifts, and its own disorganization is often produced by the bad preparation left by these teams. Every time the cycle is stopped, some 200 tons of coal are lost.

So close is the task interdependence that the system becomes vulnerable from its need for one hundred per cent performance at each step. The most sensitive interaction is between the face-preparation activities and filling, but it is in relation to this that social organization is weakest. This point will be taken up in later sections.

3. The Segmented Quality of the Social Organization

With respect to the way in which the work roles have been institutionalized as regards the persons and groups concerned, a basic segregation of the various categories of workers from each other follows from the fact that it has been the traditional practice for a face-worker to be trained in only one of the seven

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roles, and to spend all or most of his underground life in this one occupation. This basic segregation of roles is intensified by the five different methods of payment described in *Table I*, and by the exaggeration of status differences, despite the common background of "underground skill" and the equivalence of earnings (apart from the rather lower rate received by the gummers).

It is still further reinforced by the segregation of shifts. As will be seen from the shift time-tables, the three shifts never meet. Moreover, the two preparation groups alternate on the so-called "back shifts" while the fillers alternate on "days" and "afternoons", so that a far-reaching community, as well as work, split is effected between the fillers and the others. The "back shift" men are either going to or coming from work in the evening, so that they are cut off from normal community activities during the week. Even at weekends they are down the pit either on Saturday afternoon or Sunday evening.

As regards the primary work groups in which those performing the various roles participate, there are four radically different patterns: the series of interdependent pairs—borers, belt-builders, and belt-breakers; the extended pair organization of the cutters and gummers; the self-sufficient group of eight rippers; and the aggregate of twenty fillers spread out over the 200-yd. face. The uneven social quality of these different types of primary group will be discussed in *Sections V–VII*, both with respect to intra- and inter-group relations. This unevenness, taken together with the role and shift segregation, works against the social integration of the cycle group as a whole. Yet, in view of the close interdependence of tasks, the social integration of the total work group is a first essential of the system.

It is submitted that the non-existence of the cycle group as a social whole in face of the interdependence of the component tasks is one of the major contradictions present in the longwall method. The social organization is a simple reflection of the "job breakdown". Because this latter is reintegrated into a technological whole by the task sequence it does not follow that the differentiated role-groups concerned are also and thereby reintegrated into a social whole. Differentiation gives rise to the need for social as well as technological integration. No attempt seems to have been made in the longwall method to achieve any living social integration of the primary and shift groups into which the cycle aggregate has been differentiated. This, of course, is a common omission in mass-production systems.

IV

THE STRESS OF MASS PRODUCTION IN THE UNDERGROUND SITUATION

1. The Interaction of Bad Conditions and Bad Work

Differentiated, rigidly sequenced work systems, organized on mass-production lines to deal with large quantities of material on a multi-shift cycle, are a basic feature of the factory pattern. Even in the factory situation,

their maintenance at a level which allows full and continuous realization of their technological potentialities creates a difficult problem of industrial management. In the underground situation these difficulties are of a higher order, it being virtually impossible to establish the kind of constant background to the task that is taken for granted in the factory. A very large variety of unfavourable and changing environmental conditions is encountered at the coal-face, many of which are impossible to predict. Others, though predictable, are impossible to alter.

The factory and underground situations are different with respect to the "figure-ground" relationship of the production process to its environmental background. In the factory a comparatively high degree of control can be exercised over the complex and moving "figure" of a production sequence, since it is possible to maintain the "ground" in a comparatively passive and constant state. But at the coal face, there is always present the threat of some untoward activity in the "ground". The internal organization of the task "figure" is therefore much more liable to disorganization. The instability of the "ground" limits the applicability in the underground situation of methods derived from the factory.

Unfavourable natural conditions, as distinct from "bad work"—which is the result of human shortcomings—are referred to as "bad conditions". Some of the most dreaded, such as wet, heat, or dust, are permanent features of the working environment of certain faces. But others, less known outside the industry, may also make the production tasks of the face-worker both difficult and dangerous, even though the seam in which he is working is well ventilated, cool, and dry without being dusty. Rolls or faults may appear in the seam. Control may be lost over the roof for considerable periods. Especially in the middle of a long face, certain types of roof are apt to sag down. Changes may occur in the floor; the condition known as "rising floor" being not uncommon. Since some of these conditions, described in *Table II* and *Figure 4*, reduce working height, their appearance is particularly troublesome in thin seams. If the difference between working in 5 ft. 6 in. and 5 ft. may be of small account, that between working in 3 ft. and 2 ft. 6 in. may often produce intolerable conditions. Loss of roof-control is serious, whatever the working height. In general, bad conditions mean not only additional danger but additional labour. The need to insert packs to support a loose roof is a common example.

Special tasks of any kind, over and above the specific production operation for which a given category of face-worker receives his basic pay, are known as "bye-work". Though many bye-work tasks have gained the status of specially remunerated activities, the rates are such that the overall wage received at the end of a week during which a good deal of bye-work has been necessary is less than that which would have been received had the whole of the five shifts been available for production work. From the face-worker's point of view, bad conditions mean not only more danger and harder work but less pay; and they may also compel overtime. To stay behind an hour

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or sometimes three hours longer under bad conditions may involve a degree of hardship beyond the capacity of many face-workers to endure, especially if they are older, and if overtime demands are repeated in close succession.

“Bad conditions” tend to instigate “bad work”. When they occur, the smooth sequence of tasks in the production cycle is more likely to be disturbed by faulty performance. Bad work can, and does, arise when conditions are good, from personal shortcomings and social tensions, in themselves independent of bad conditions; but difficulties arising from human failings are more readily—and conveniently—expressed when the additional difficulty, and excuse, of bad conditions is also present. The result is a tendency for circular causal processes of a disruptive character to be touched off. Unless rapidly checked by special measures, often of an emergency character, these, once started, threaten to culminate in the fillers not filling off, and the cycle being stopped. The system is therefore always to some extent working against the threat of its own breakdown, so that tension and anxiety are created.

2. The Magnification of Local Disturbances

Under these conditions, the closeness of the functional interdependence of tasks tends to rebound on itself. Mistakes and difficulties made or encountered at one stage are carried forward, producing yet other difficulties in the next. The inflexible character of the succession gives no scope for proceeding with later tasks when hold-ups have occurred earlier, and the temporal extension of the cycle increases the likelihood of interference from unpredictable events, which are provided with twenty-four hours in which to occur. The aspects of mass-production engineering methods (rigid sequence, functional interdependence and spatio-temporal extension), which create vulnerability in the underground situation, all stem from the large-scale character of the longwall cycle. For it is the magnitude of the cycle, produced by the long expanse of face scheduled for clearance, that leads to the segregated treatment of the component tasks—in view of the large amount of work required on each—and thence to their fixed, extended succession. In an organization of this scale, local disturbances at specific points—resulting from the interaction of bad conditions and bad work—resonate through a relatively large social space, becoming magnified for this reason.

Stricter field theory formulation may assist the more dynamic description of this situation. The size of the bounded region in which the system exists as a whole, together with the high degree of differentiation in its unidirectional internal connectedness, first increases the number of points at which small disturbances may occur, and thereafter enlarges the scope of their effects to a scale proportional to the magnitude of the whole. Since these effects must be contained within a closed system, single events are, as the result of induction which takes place from the power field of the whole, endowed with the potentiality of disrupting the cycle. No matter that this potentiality is realized only in the extreme case; disturbance is always experienced to some extent under pressure of this potentiality. Stress arising from this pressure itself

produces fresh disturbances. Measures necessary to prevent these from still further spreading absorb a correspondingly greater amount of the available concern and energy.

3. Variations in the Level of Functioning

It has been mentioned that a characteristic of bad conditions and bad work is their uneven distribution—not only between different faces, but also over different sections and among different tasks within the same face (see *Table II*). The consequence is an uneven level of functional efficiency, more generally lowered also by the magnified resonances and induced pressures described above. The atmosphere of uncertainty thus created arouses the expectation in the individual that bad work done by someone else will increase his own difficulties, or that some untoward event will occur to keep him down at the end of his shift. The resulting attitudes and suspicions are ingrained in the culture of the longwall work group and adversely affect the entire pattern of relationships at the coal-face.

No systematic survey of the incidence of cycle stoppages was possible within the limits of the present study. But on one of the best faces known at first hand by the writers it was a matter of self-congratulation that the fillers had failed to fill off only three times during the past year. Experienced informants gave once in two months, or five or six times during the course of a year, as a more usual frequency, with instances of many more stoppages in "bad faces" in "bad pits". If one week's work is commonly lost in this way during a year, the overall loss in production would amount to some 2 per cent. This relatively low figure expresses the extent of the efforts made to check disturbances short of the point where the cycle is stopped.

4. The Strain of Cycle Control

The main burden of keeping down the number of cycle stoppages falls on the deputy, who is the only person in the face area with cycle, as distinct from task, responsibility. Discussion with groups of deputies readily yields evidence of the strain involved. A common and reality-based complaint is that the authority of the deputy is incommensurate with responsibility of this order. The background to this complaint is the fact, noted in the discussion of the hand-got systems, that, in view of the darkness and the spread out character of the work, there is no possibility of close supervision. Responsibility for seeing to it that bad work is not done, however bad the conditions, rests with the face-workers themselves. But the responsible autonomy of some, especially, of the occupational sub-groups has been impaired in the longwall method. This problem will be taken up in succeeding sections.

As a result, management complain of lack of support from the men, who are accused of being concerned only with their own fractional tasks and unwilling to take broader cycle responsibility. The parallel complaint of the workers is of being driven and tricked by management, who are resented as outsiders—intermittent visitors and "stick" men, who interfere without

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sharing the hard, physical work and in-group life of the face. On occasions, for example, the deputy is reduced to bargaining with the men as to whether they will agree to carry out essential bye-work. The complaint of the men is that deputies' promises are rarely kept, and that they have gone unpaid too often to be again easily persuaded. The deputy's answer is that the under-manager or manager has refused to uphold his case. Whether he presented it, how he presented it, or what reasons may have dictated the managerial view are a type of issue on which effective communication back to the man breaks down. The deputy has equally little chance of increasing the insight of the workmen into their own tendency to drive sharp bargains.

The strain of cycle control tends to produce a group "culture" of angry and suspicious bargaining over which both management and men are in collusion. There is displacement both upwards and downwards of the tensions generated. The "hell" that breaks loose in the under-manager's office when news comes in that the fillers are unlikely to fill off in one or more faces resounds through the pit.

5. The Norm of Low Productivity

In all work at the coal-face two distinct tasks are simultaneously present ; those that belong to the production cycle being always to some extent carried out on the background of a second activity arising from the need to contend with interferences, actual or threatened, emanating from the underground situation. The activity of the "ground" has always to be dealt with, and ability to contend with this second or background task comprises the common fund of underground skill shared alike by all experienced face-workers. This common skill is of a higher order than that required simply to carry out, as such, any of the operations belonging to the production cycle. For these, initial training is short, and may be measured in months ; it is longest for those, such as cutting, where the engineering component is largest. But the specifically mining skill of contending with underground conditions, and of maintaining a high level of performance when difficulties arise, is developed only as the result of several years of experience at the face. A work-system basically appropriate to the underground situation requires to have built into its organisation the findings of this experience. Unless this has been done, it will not only fail to engage the face-worker to the limit of his capabilities, but will restrict him to a level of performance below his potentiality.

The evidence suggests that the longwall method acts in this way. The crises of cycle stoppages and the stress of the deputy's role are but symptoms of a wider situation characterized by the establishment of a norm of low productivity, as the only adaptive method of handling, in the contingencies of the underground situation, a complicated, rigid, and large-scale work system, borrowed with too little modification from an engineering culture appropriate to the radically different situation of the factory. At the time the longwall method developed, there were no precedents for the adaptive underground application of a machine technology. In the absence of relevant

experience in the mining tradition itself it was almost inevitable that heavy culture-borrowing of this kind should have taken place. There was also no psychological or sociological knowledge in existence at that time which might have assisted in lessening the difficulties.

As regards the special difficulties which stem from the large-scale character of the longwall production unit, it may be noted that less acute problems appear to have arisen at equal or even higher levels of mechanization, with room-and-pillar techniques. Here the scale of operations is less, in view of the shorter expanse of the faces ; while adaptability to the changing circumstances of underground conditions appears to have been correspondingly greater. It must not, however, be inferred from room-and-pillar experience that the development of a high level of functional efficiency is impossible in a large-scale mechanized unit ; rather, that the problems presented are more difficult. The difficulties occur very largely in the field of social organization. In the succeeding sections consideration will be given to problems of group relationships in the various occupational sub-groups of the longwall system.

V

THE SPECIAL SITUATION OF THE FILLING SHIFT

i. Isolated Dependence

Relationships between members of the filling shift are characterized by an absence of functional interdependence, which arises from the absence of role differentiation in the twenty identical tasks performed by the shift aggregate. The filler is the modern version of the second collier of the older hand-got systems, whose hewer has departed to the cutting shift. While his former mate has acquired a new partner in the back man on the coal-cutter, and is serviced by a new group of labourers—gummers, as distinct from trammers—the filler is alone in his stint, the dimensions of which are those of the short face formerly worked in common. The advent of mechanization has changed but little the character of filling, except that the filler has, in his air pick, the assistance of one power-driven tool and, instead of a hand-pushed tub, a mechanically driven conveyor on to which to load his coal.

The effect of the introduction of mechanized methods of face preparation and conveying, along with the retention of manual filling, has been not only to isolate the filler from those with whom he formerly shared the coal-getting task as a whole, but to make him one of a large aggregate serviced by the same small group of preparation workers. In place of an actually present partner, who belonged to him solely as the second member of an interdependent pair, he has acquired an “absent group”, whom he must share with nineteen others. The temporal distance separating him from this absent group is increased by the interval of the ripping shift.

The preparation group itself is so loosely organized that its boundaries are difficult to determine. If thought of as centred on the two cutters, the extent

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of the filler's dependence on earlier activities is such that the cutting group must be expanded to include the two borers as well as the four gummers. Since in addition he is dependent on the belt-men, these latter, representing transformed but likewise absent versions of trammers formerly under his own eye, must also be included in his absent group. While, in the time perspective of the present, the filler has no relationships of functional interdependence with other fillers on his own shift, in the time perspective of the past he must contend with a complex set of dependent relationships with the entire series of preparation workers who have preceded him in the face. These relationships are dependent rather than interdependent since, within a given cycle period, they operate only in one direction.

Though, from the filler's point of view, preparation personnel form a total group in virtue of their common relation to him, they do not for this reason constitute an organized group with respect to each other. The structure of their own relationships is that of a series of self-enclosed interdependent pairs, whose connection with each other is small compared with their common connection with him. In this series the cutters form a pair of the extended type with the four gummers loosely attached. But gummings "left in" cause no difficulties for the cutters; and, though antecedent, the work of the borers also causes them no difficulties. On the next shift, the belt-builders complete the second part of an overall conveyor task begun by the breakers, but the work of this team is not affected by the level of performance of those who prepare the coal-face. A series of absent pairs, on each and all of whom one is dependent, but themselves not reciprocating this dependence and remaining relatively independent of each other, constitute a difficult group with whom to enter into a working relationship. This difficulty is increased by the fact that their services have to be shared among nineteen others, who are in the position of rivals for the receipt of preferential attention.

Difficulties are increased still further by the fact that the concern of this succession of pairs is with the entire 180–200 yds. of the face. For them the face is a single continuous region, whereas for the fillers it is differentiated into a series of short adjacent sections. For the individual filler it is the 8–10 yds. of his own length. In the corner of this length he usually chalks up his name, but these chalk marks mean little more than just the name to traversing pairs, to whom individual fillers are personally little known. The structure of the preparation tasks as continuous activities covering the entire expanse of the face gives the succession of traversing pairs no functional relationship with the discrete tasks of individual fillers. The absent, internally disconnected group on which he is dependent takes no functional cognizance of the existence of the filler as an individual. In view of the far-reaching community, as well as work, separation that exists between the preparation and the filling shifts (produced by the time-table arrangements), actual cognizance tends also to be minimal. The pattern of these relationships is shown in *Figure 3*, where the picture presented is one in which, within the period of a given cycle, the fillers are left "alone with each other" and at the mercy of the rest.

FIGURE 3. POSITION AND LOCOMOTION OF SUCCESSIVE GROUPS OF FACE WORKERS ON THE LONGWALL.

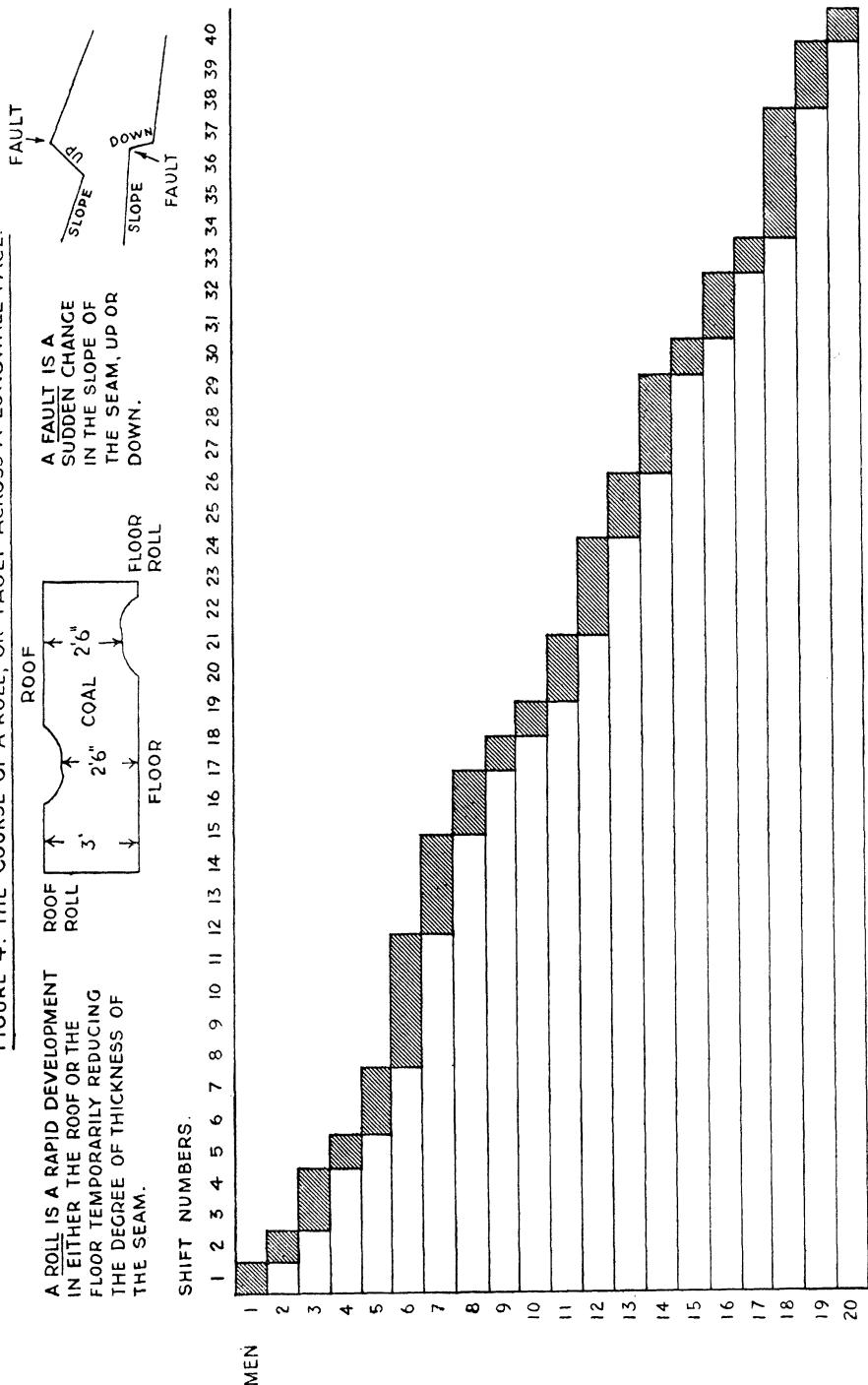
2. Unequal Men with Equal Stints under Unequal Conditions

The fillers, as has been shown, have no secure relationships in face of the differential incidence of the bad conditions they may encounter or of the bad work they may inherit from the preparation workers on whom they are dependent. The men who face these unequal conditions are themselves unequal; but the lengths of face they clear are the same. The detailed implications of this situation are set out in *Table II*, where the differential incidence of some of the most common types of bad conditions and of bad work, in the different lengths of a typical face, is shown in relation to the variations in skill, conscientiousness, and stamina in a typical group of fillers, fractionated into informal sub-groups interspersed with isolates.

The local arrival of certain types of bad conditions, such as rolls that move across the face, can be anticipated, so that anxiety piles up. The passage across a face of a roll that continues for different periods of time in various lengths is shown in *Figure 4*. As regards bad work left by the other shifts, the filler is in the situation of never knowing what he may find, so that anxiety of a second kind arises that tends to produce chronic uncertainty and irritation. There is little doubt that these two circumstances contribute to the widespread

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FIGURE 4. THE COURSE OF A ROLL, OR FAULT ACROSS A LONGWALL FACE.



THE SHADED PORTIONS SHOW THE NUMBER OF SHIFTS DURING WHICH THE ROLL OR FAULT STAYS IN THE LENGTH OF A PARTICULAR MAN.

TABLE II

Cumulative and Differential Incidence of Bad Conditions and Bad Work in the Filling Shift

(This table has been built up as a "model" of the situation from the experience of a group of face-workers who acted as informants. It relates the effect of bad conditions and bad work, traversing the face unevenly, to the unequal personal and group qualities of the fillers.)
 X indicates local distribution of difficulty in typical examples of different kinds of bad conditions and bad work.

Types of Adverse Factor	Positions Across the Face of 20 Fillers																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
<i>Loose roof</i> —roof broken up by weight or natural "slips" (cracks) making it difficult to support; extra time required for timbering reduces that for filling.																				
<i>Faults</i> —sudden changes in slope of seam either up or down, producing bad conditions capable of anticipation, possibly lasting over a considerable period.																				X
<i>Rolls</i> —temporary unevenness in floor or roof reducing working height and producing severely cramped conditions in thin seams. As above for anticipation and duration.																				
<i>Roof weight</i> —roof sagging down—especially in middle positions along the face where weight is greatest; not dissimilar to above in effect.																				
<i>Rising floor</i> —from natural bad stone floor, or from the cut having been made into the coal so that the gas in the coal lifts up the floor, or from naturally inferior coal which is left down but which lifts (gas).																				
<i>Bad boring</i> —holes bored short so that coal at the back of the undercut is unaffected by shot (hard backs); heavy extraction task with air pick at end of shift, when tired; or holes too low, so that shot leaves coal clinging to roof (sticky tops). Both these conditions tend to occur through naturally hard coal and certain types of roof.																				X

* These numbers simply indicate the fact that several different kinds of things often go wrong in the same length. Severity varies. At one extreme there may be a series of minor nuisances, at the other one major interference. When conditions seriously deteriorate the interaction of factors and effects is such that some degree of disturbance is apt to be felt from most quarters at one or other point along the face.

** Plus or minus ratings have been given for supra- or infra-norm group status on the three attributes of skill, stamina and conscientiousness on the job, which represent the type of judgments of each other that men need to make, and do in fact make.

*** Members of the same informal sub-group are indicated by the same letter ; I = Isolate.

incidence of psycho-somatic and kindred neurotic disorders among those concerned.

The degree of stress arising when men experience the full weight of this situation could have been explored only in a therapeutic relationship. But many instances were given of neurotic episodes occurring on shift—of men sitting in their lengths in stony silence, attacking their coal in towering rage, or leaving the face in panic. In a situation of dependent isolation with the odds unequal both as regards his own resources and what is required of him, the individual inevitably erects protective defences, and these are elaborated and shared in the work group. An account of the main pattern of group defences will now be given. These defences are reactive rather than adaptive. Their effectiveness therefore is only partial. But without them life at the longwall would be intolerable for all but those whose level of personal adjustment is rather better than that attained by most individuals in the course of their development.

VI

FOUR TYPES OF GROUP DEFENCE

I. Informal Organization

The functional isolation of the filler within his own group, which leaves him "officially" alone with his "coals", is met by an attempt to develop informal, small-group organization in which private arrangements to help each other out are made among neighbours, in twos, threes, or fours. But these solely interpersonal arrangements are undependable and open to manipulation for anti-social and competitive as well as for mutually protective ends. A number of isolates is left over. The total face group is incapable, except defensively, of acting as a socially responsible whole, since not even private allegiances are owed outside the small informal groups. These in turn are without responsible autonomy; the absence of institutionalized mutual obligation means that there are no statutory group tasks, and each individual can be held ultimately responsible only for clearing his own length. Internal "rows" the more easily break up the informal "coalitions", whose morale tends to be of the clique type.

Examples were, however, given to the writers of stable groups who stuck to each other and worked well over long periods. One informant said of these: "Here things are more like the old times in the pit". Groups of this kind were envied and also criticized for being "too close". They appeared sometimes to be held together by a natural leader, and at others to be made up of individuals of generally good personality. Most informants were agreed that there was a tendency for the extremes to sort themselves out; there were "good" and "bad" faces as well as "good" and "bad" cliques within a particular face aggregate. But all this happened as it might. There was no support from the system.

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Isolates, it appears, are either individualists—who “won’t even share timber”—or men with bad reputations, with whom others refuse to work. Amongst these are the unconscientious—who “won’t help out at the end of a shift” and who are frequently absent—and the helpless—who “cannot learn to look after themselves under bad conditions”. Others, whose stamina is deficient (whether through age, illness, or neurosis) and whose lengths are often uncleared in consequence, are dropped from the informal groups.

Only to a very limited extent, therefore, does his informal group organization meet the filler’s need for a secure role in a primary group within his own shift. In view of the extent of his dependence on the performance of those in the other two shifts, his need for this foundation is greater than that of any of the other occupational groups, while the resources available to him are fewer.

2. Reactive Individualism

His small group failing, the filler is thrown on to himself and against others. The second defence against isolation is the development of a reactive individualism, in which a reserve of personal secrecy is apt to be maintained. Among his own shift mates there is competitive intrigue for the better places—middle positions are avoided ; from these “it is a long way to creep”—and for jobs in workings where conditions are good there is a scramble.

On some faces described to the writers, fear of victimization was rife, particularly in the form of being sent to work in a “bad place”; the deputy being more easily turned into a persecutor in view of the guilt arising from the intrigue and deception which the men practised both against him and against each other. Against the deputy, advantage is taken of the scope afforded in the underground situation for petty deception over such matters as time of leaving the pit, or the “measure that is sent up” (amount of coal filled on to the conveyor). With the deputy, however, men are also prepared to enter into alliance against each other, often for very good reasons—to stop mates from going absent and by so doing throwing more work on to the others.

As regards outside groups, practices of bribing members of the other shifts in the hope of getting a “good deal” in one’s own length were mentioned by several informants. Tobacco is taken to the cutter ; gummers are stood a pint on Sunday. These practices are to be regarded as symptoms of a state of affairs rather than as widespread in themselves.

The effect of this defensive individualism is to reduce the sense of secure identification in the larger pit collectivity, which was the second principle on which the older equilibrium was based.

Nowhere is the mistrust that shift mates have of each other more in evidence than in controversies over bye-work “slipping off the note”. On what is referred to as the “big note” is entered all the contract and bye-work done during the week by the shift aggregate. This note is issued to one man called “the number man” since he is identified by his check-

number. In no sense is this individual a representative appointed by his mates. Only rarely is he an informal leader. Customarily he is a "corner man", whose length adjoins the main gate, i.e., the man most conveniently within reach of the deputy. When asked about bye-work he does not always know what has been done at the far ends of the face and he is under no obligation to stop his own work to find out. But though a number of men will grouse about their pay being short, mentioning this or that item as having "slipped off the note", very few ever bother to check up. There are men who have worked on a face for three or four years and never once seen their own big note. Yet these are among the more ready to accuse the corner man or the deputy. The corner man is suspected at least of never forgetting to make the most of his own assignments. To the deputy is ascribed the intention of keeping the costs of his district down. Conspiracy between the two is often alleged. Only when a major rumpus occurs are such suspicions put to the test, but showdowns of this kind are avoided as apt to peter out in squabbles proving nothing.

The competition, intrigue, unwillingness to put allegations to the test and the reserve of personal secrecy, are parts of one pattern. Whatever their personal wishes, men feel under pressure to be out for themselves, since the social structure in which they work denies them membership in any group that can legitimize interdependence. In this respect reactive individualism makes a basic interpretation of the social structure of the filling shift and is the only form of authorized behaviour.

3. Mutual Scapegoating

Fillers almost never see those who work on the "back shifts", and this absence of contact gives full scope for mutual and irresponsible scapegoating. When there is a crisis, and the filling shift is unable to fill off, the "buck" is passed to the other shifts—or vice versa if disorganization has occurred elsewhere. It is frequently also passed to the deputy, who is blamed for not finding substitutes, and to repair men, brought in, but too old to stand the pace.

For these to pass the buck back to the fillers is fruitless. As they do not exist as a responsible whole, they, as a group, are not there to take the blame, and the individual filler can always exempt himself. Since bad conditions and bad work interact so closely, it is usually difficult to pin blame specifically. Mutual scapegoating is a self-perpetuating system, in which nothing is resolved and no one feels guilty. For all concerned to remain in collusion with such a system is a defence which allows each to make his "anonymous contribution" to the "group mentality", (4) which sabotages both the goal of cycle productivity and the needs of the individual for a membership in a satisfying work-group. So far as this pattern obtains, all strike at each other in a mock war in which no one is hurt yet all suffer.

This defence can also be seen as a "back-handed" attempt to recover the supportive unity lost through reactive individualism in a way that is consis-

tent with it. For all to be "in the bad" together is at least a way of being together. If one's contribution to a group is to help carry the badness of others, the group's contribution to oneself is to allow one to leave some of one's own badness in the group by being granted, for example, the privilege of withdrawal so that one's absence is sanctioned on a fair share of occasions. This "formula" provides a workable scheme since the tacit agreement is only too plausibly maintained that the badness both of the group and of the individual are exclusively effects of the system which the group is compelled to operate without having power to change, i.e., these effects are regarded as "induced" rather than also as "own" forces. The group and the individual can therefore deny and get rid of their own badness by ascribing it to the system. The good of the group becomes its power to preserve the good of individual members by limiting the degree of their exposure to the bad system. The alternative would be constructive limitation of its real deficiencies so that it might be operated with more productive results and a higher degree of mutual satisfaction.

Not that the system is felt as entirely bad since it is the means by which a living is earned. Moreover, under present conditions this living is a good one, both in terms of wages and of community status. But the benefits which these "goods" bring are not realized in the work activities of the group. They lie outside the work system, which is tolerated as a means to external ends rather than accepted also as an end in itself, worthy of whole-hearted pursuit in virtue of the internal satisfactions it affords. When these different aspects of the matter are put together the expectation emerges of a balance being struck which would allow things to tick over, though with a degree of social illness costly alike to productivity and to personal well-being. This expectation accords with reality.

4. Self-Compensatory Absenteeism

Withdrawal is the fourth form of defence, complementing mutual scapegoating, and absenteeism is to be regarded as a recognized social technique within this pattern. For example, one filler, returning from his week's holiday with pay, complained that the first two shifts had "knocked it all out of him". The gummings had been left in. His coal was solid. He had had the air-pick on all day. "I've tried cursing 'em but it's no use, and pleading with 'em but it's no use. I'll take a day off for this."

When conditions on a face deteriorate, especially in ways that are predictable, absenteeism among fillers sometimes piles up to a point where the remainder have to stay down an extra two or three hours in order to clear the face. Should this situation repeat itself for more than a day or two, those coming on shift often meet at the pit-head baths before presenting themselves for work. If less than a certain number arrive, all go home.

Absenteeism of this self-compensatory type, though carried out as an act of aggrieved defiance against a system, felt in these circumstances as persecutory, is an attempt on the part of the individual to prolong his work life at the coal-

face. For without the respite of occasional absences, he feels that he would soon become unable to carry on. In view of the accentuated differences both in wages and in status between face workers and repair, haulage, or surface personnel, the goal of remaining at the coal-face for as long as possible would appear to operate as a powerful motivational force in determining the behaviour of the ordinary face-worker.

The following is some of the material obtained in interviews and discussions. Fear of being "too old for the face at forty", or even thirty-five, was a frequently expressed anxiety, made more acute by personal experience of the painful tensions in miners' families, where a father relegated to the surface at £5 19s. 3d. a week must face a son, still in his early twenties, earning more than twice this wage. Instances were reported of quarrels between brothers, among whom long-standing but mild neurotic rivalries had existed, that severely disturbed the larger family when the older, through sickness, often of a psycho-somatic kind, had been forced to leave the face. In the culture of the mining family a face-worker husband is the object of special care on the part of his wife. There were men who felt that the privilege of this care, the emotional need for which was now stronger, was no longer merited once their *élite* position had been forfeited and their potency as bread-winners reduced. The dilemma of this situation is that fear of the loss of this care and acceptance of its continuing offer are both unbearable.

Absenteeism of this self-compensatory type is a socially structured activity operated in accordance with a complex code that governs both the occasions and amounts regarded as permissible. It is a psycho-social defence motivated by the wish to remain at the coal-face, and is a species of "institutional" conduct with a functional role in the total social system in which the longwall method plays a central part.

This, and the other three defences discussed, play a dynamically interrelated part in forming the culture⁵ of the work group, though naturally the intensity to which the pattern is present varies widely, and there are faces where the group atmosphere remains for long periods relatively immune from these influences. These are apt, however, to be "fair-weather" faces.

The danger is that habituation to working in a bad system has the compensation of enabling those concerned to leave too much both of their own and of their group's "badness" *in the system*. It then ties them to it through the fact that it does this, despite their hatred of it. As well as its faults, it is their own hatred that they hate in the system—and there is usually stubborn refusal to recognize such projections in work—no less than in therapy-groups. A characteristic of faces with a bad group atmosphere is the protesting yet excited

⁵ The concept of "culture" as a psycho-social technique developed by a group in a structurally determined situation has been outlined by Trist, "Culture as a Psycho-Social Process", contributed to a symposium on The Concept of Culture, British Association, Section (H), Anthropology and Archeology, Birmingham Meeting, 1950. This viewpoint develops that of Curle, and Curle and Trist, "Transitional Communities and Social Re-connection", *Human Relations*, Vol. I, No. 1, pp. 42-68, and No. 2, pp. 240-288; and is akin to that of Ruesch, "Experiments in Psychotherapy, II: Individual Social Techniques", *The Journal of Social Psychology*, 1949, 29, 3-28; and Ruesch and Bateson, "Structure and Process in Social Relations", *Psychiatry*, 1949, Vol. XII, 2, pp. 105-124.

collusion of all concerned with the state of affairs. This is in contrast to the more independently critical and realistic attitude of those in groups where the pattern is less complete and less intense.

VII

SOME PROBLEMS OF THE PREPARATION SHIFTS

I. The Absence of Authority in the Cutting Team

As it is on this preparation group—containing the front and back man on the cutter and the four gummers—that the filling shift is most specially dependent, there is special need for social organization to be sound at this point. But the cutting team does not exist officially as a group, since the cutters are on their own note, responsible for, and paid for, their cutting alone. The gummers are not under their authority, and no one except the deputy can take responsibility for any tendency they may have to leave some or all of the gummings in, in certain stints, as they traverse the face. As they are on day wage, they have nothing to lose unless they go too far—so, at least, the fillers feel in their bitterness on this score.

As the lowest paid and lowest prestige group on the face, doing the least skilled task, gummers are both an outcast and scapegoated group. Their work is arduous, dangerous, dusty—and awkward. Hostility in them towards “the system” and towards other face workers is almost inevitable and is most easily displaced on to the fillers, whom they never see but can severely annoy—not necessarily with conscious malice—by leaving in some of the gummings under conditions of fatigue or difficulty. A system that puts this power of interference into the hands of a potentially disgruntled, scapegoated group, with no effective social means of controlling it, fosters the hostile tendencies almost inevitably present. These difficulties are increased by the fact that, among all face workers, status differences are greatest between cutters and gummers and by the fact that the cutters are a closed pair. Tensions within this ambiguously organized group are apt to be sharp.

There are, of course, instances where effective leadership is exercised over the gummers by the front man, and some of these were quoted by informants. But it was stressed at the same time that management could hold the cutters responsible only for the cut, and that to exercise detailed supervision was an impossible task for a deputy, especially on “back shifts” where his territory of responsibility is apt to be more extensive than on day shift. In shift groups where a good spirit of co-operation obtains, the belt-breakers are often willing to help out the gummers. It was suggested that fewer lapses occurred when these interchanges took place. But the pattern of the cutting shift works against such co-operation, consisting, as it does, of four different categories of workers successively traversing the face at their own separately institutionalized component tasks, with no overall goal to bind them together and no functionally defined responsibilities to each other.

So closely tied, however, are the cutting and gumming operations that they cannot in practice be treated as separate. Hence arises the dilemma of the team that is at the same time not a team. Given a work system with a different type of culture there might be no problem, but given longwall separatism there would appear to be no solution—until new conceptions of relationship emerge.

Some instances were quoted of gummers being paid by the front man, who could therefore be penalized for gummings left in by having money stopped out of his contract. But it was pointed out that this sanction could be applied only in cases of the grossest kind which the deputy would in any case pick up, and that it tended to place cutters in the hands of their gummers. This suggests that the persistence or resuscitation of the old forms of contract are not in themselves enough to restore responsible autonomy.

2. The Split-Off Position of the Inter-dependent Pairs

Superficially, borers, belt-builders, and belt-breakers look like pair structures that echo those of pre-mechanized days. But whereas the pairs of hand-got coal-getting had craft status and an artisan type of independence in working their own face, with the satisfaction of seeing through the whole coal-getting job, these longwall pairs are restricted to work tasks of a singularly narrow component character.

The borers are off by themselves ; and as regards the belt workers, since breakers and builders are on different shifts, neither can feel the satisfaction of accepting responsibility for the conveyor system as a whole.

The most fractionated tasks are therefore performed by those restricted to the narrowest relations. It would be difficult to imagine a situation in which they were more completely split off from any sense of belonging to a shift or total production group. But they are at least responsible to each other and are based on a stable, if narrow, relationship.

3. The Social Viability of the Ripping Team

By contrast, the ripping team is a well-organized primary work group of 7 or 8 with an intelligible total task for which it carries complete responsibility. Rippers are frequently referred to by others as a "good crowd" who seldom "go absent on each other". Pride of craft is considerable. A main ripper and—usually—individuals of very varying experience compose the group, but it appears to manage its internal relationships without status difficulties. Here, responsible autonomy persists.

Unfortunately, like the other face-work groups, it is a group by itself and there is as a result no transfer of its more stable morale to other groups in the system. Working, as it does, in the main and side gates, it is felt to be a closed group very much apart from the main interaction between the preparation and filling operations carried out in the face itself.

In all essential respects the ripping team represents a survival of the hand-got past in the mechanical present. For the gates in which ripping parties

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of varying sizes operate are, as it were, their own "stalls", continuously and autonomously worked. All relevant operations are carried out within the group which completes them within the compass of one shift. Rippers have escaped from, rather than become part of, the longwall system, retaining intact their total task, their multiple skills, their artisan independence, and their small group organization. They work in the gates. Though part of the total layout, gates are not like a longwall face. In the gates the scale of the task remains small; the spatio-temporal structure is simple, and methods are unmechanized. Changes consequent on the introduction of power-driven tools, or of steel replacing wood, have been assimilated without essential re-structuring.

In the face, it was the introduction of machines (still foreign to the gates) that caused the appearance of a new order, changing the scale to mass production and bringing fractionation of tasks, extension of sequence, role and shift segregation, small group disorganization and inter-group dependence. In the gates the old order continues in a special setting. To compare the two one needs only to step from gates to face. Those in the face once fared as well as those in the gates.

VIII CONCLUSIONS

The fact that the desperate economic incentives of the between-war period no longer operate means a greater intolerance of unsatisfying or difficult working conditions, or systems of organization, among miners, even though they may not always be clear as to the exact nature of the resentment or hostility which they often appear to feel. The persistence of socially ineffective structures at the coal-face is likely to be a major factor in preventing a rise of morale, in discouraging recruitment, and in increasing labour turnover.

The innovations in social organization of face-work groups, which have begun to appear, and the success of some of these developments, suggest that the organizational changes brought about by nationalization provide a not inappropriate opportunity for the experimental working through of problems of the types which have been indicated. It can certainly be said with some confidence that within the industry there exist the necessary resources and creativity to allow widespread constructive developments to take place.

As regards the longwall system, the first need is for systematic study and evaluation of the changes so far tried.⁶ It seems to the present writers, however, that a qualitative change will have to be effected in the general character of the method, so that a social as well as a technological whole can come into existence. Only if this is achieved can the relationships of the cycle work-group be successfully integrated and a new social balance be created.

⁶ One of the most interesting of these is "An Experiment in Continuous Longwall Mining at Bolsover Colliery", W. V. Sheppard, The Institution of Mining Engineers, Annual General Meeting, Jan. 1951.

The immediate problems are to develop formal small-group organization on the filling shift and to work out an acceptable solution to the authority questions in the cutting team. But it is difficult to see how these problems can be solved effectively without restoring responsible autonomy to primary groups throughout the system and ensuring that each of these groups has a satisfying sub-whole as its work task, and some scope for flexibility in work-space. Only if this is done will the stress of the deputy's role be reduced and his task of maintaining the cycle receive spontaneous support from the primary work groups.

It is likely that any attempts in this direction would require to take advantage of the recent trend of training face-workers for more than one role, so that interchangeability of tasks would be possible within work teams. Moreover, the problem of shift segregation will not be overcome until the situation is altered in which one large group is permanently organised round the day shift and the others round the back shifts. Some interchange between roles in preparation and filling tasks would seem worth consideration. Once preparation workers and fillers could experience each other's situations, mutual understanding and tolerance would be likely to increase.

It is to be borne in mind that developments in room-and-pillar methods appear to be stressing the value of the strongly-knit primary work-group and that the most recent advances in mechanization, such as power loaders or strippers, both require work teams of this kind.

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BIOGRAPHICAL NOTE

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