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ACCIDENTS IN MINES,

IN THE

NORTH STAFFORDSHIRE COALFIELD,

ARISING FROM

FALLS OF ROOF AND SIDES;

THEIR CAUSES, AND THE MEANS OF DIMINISHING THEIR FREQUENCY.

With Detailed Sections of the Workable Seams, and an Account of the System of Timbering in vogue at that Coalfield, and applicable elsewhere.

BY

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PREFACE.

It is well known in the mining profession that more men are killed by falls of roof and sides than from any other cause, but as they are mostly killed singly these fatal accidents do not excite anything like the sensation produced in the mind of the public by a fire-damp explosion, and most of them pass nearly unnoticed.

My intention, besides describing the mode of timbering and of supporting the roof generally, has been to shew how some of these accidents are caused, and to point to different precautions which, in my opinion, would lead to their diminution in the mines of North Staffordshire.

As this object necessitated several illustrations I have taken the opportunity of illustrating a correct section of every one of the numerous coal and ironstone seams of North Staffordshire, and in most cases a typical working place also, to shew the mode of timbering and of packing.

Every Section and Plan has been measured by myself, and I have reproduced them exactly as I found them in the course of working. Though I do not in many cases comment on the methods adopted I do not necessarily thereby regard them as beyond criticism.

The figures of workmen which accompany a few of the illustrations, and which are actual working positions observed by me underground, not only help to shew the manner in which some of these accidents occur, but enable the reader to obtain at a glance a correct estimate of the scale adopted.

A. R. SAWYER.

STOKE-ON-TRENT,
January, 1886.

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* At the end of the book.

ILLUSTRATIONS.

CHAPTER I.

NATURE OF ROOFS.

The strata overlying the coal and ironstone seams, and forming the roof are either siliceous or argillaceous.

The siliceous roofs, which are made up of sand or quartzose grains, are—

1. Sandstone (Rock), dense or open-grained, which occurs occasionally in beds of considerable thickness, notably over the 7 ft. Banbury Coal.

2. Rockbinds, which present a more or less irregular laminated texture, and break down in scales.

3. Conglomerate. Though its occurence is rare, it is occasionally met with in the 7 ft. Banbury roof in part. (Fig. 165).

These measures invariably present a wavy and uneven surface.

The argillaceous roofs, which consist of silica combined with a large proportion of alumina more or less condensed by pressure, are—

1. The clays (fireclay, clod, clunch). They present different degrees of hardness, being at times very hard when first exposed, but they crumble or "weather" to a more or less earthy state on exposure. They contain slips in irregular directions, from which large, rude and heavy lumps break down. Their surfaces usually have a wavy and uneven appearance, and present no trace of lamination. (Fig. 10).

2. The shales. These are more solid and condensed by pressure than the clays. They present various degrees of hardness; they vary in colour from light bluish grey to black, and break in various sized and shaped pieces. The following are the varieties most frequently met with :—

(1) Soft grey clayshale, which has a soapy feel, and breaks very short. It is at times crumbly and loose, owing to its being permeated with small, smooth surfaces. (Figs. 139, 220).

(2) Harder varieties; bluish grey and darker coloured, usually called "Metals." They show more or less regular lamination, breaking in smaller or larger flakes. The dark varieties are called Bass. The latter generally contain one or more sets of parallel joints, and at times numerous small highly-polished surfaces in irregular directions. (Figs. 48, 189).

(3) Cannel, which is black, hard, strong, *more or less bituminous*, sometimes curly (Fig. 139), contains

one or more very well defined sets of joints, *but no trace of lamination; it is usually close to or attached to the coal.*

Shale roofs invariably present a flat surface, which is at times very polished when first exposed. The blackness of shales and clays is due to an admixture of carbonaceous matter; the former being at times highly bituminous.

Where the seam is thick, part of it—the tops—is often left to be got down in part in the wastes. It then forms the roof at the face, and usually in the roadways. (Fig. 186). Where seams have been tilted over, as remarked further on, the floor forms the roof, which then consists of more or less hardened clay.

The following table shews the average weight of one cubic yard of the rock-substances forming the roof:—

Rock-Substances.	Weight in the Natural Bed.				Approximate Weight in the Broken State.			
	In Tons.	In Tons.	In Cwts.	In lbs.	In Tons.	In Tons.	In Cwts.	In lbs.
Coal	·94	..	19	..	·57	..	11	56
Clay and Clay Shale..	1·87	1	17	55	1·12	1	2	56
Shale and Rockbinds.	1·98	1	19	82	1·05	1	1	0
Sandstone	1·81	1	16	18	..	Variable		
Ironstone	..	Variable*			..	do.		

* From 30 to 50 cwts.

CHAPTER II.

DESCRIPTION OF FAULTS, SLIPS, JOINTS AND CLEAT.

All loosening of the cohesion of the roof and of the seam in particular planes plays an important part in the question of timbering, and, when occurring at regular intervals, in laying out the workings. This want of cohesion is produced by faults and slips or dislocations, and by joints, in which case it is complete, and in coal specially by the cleat, when a certain amount of cohesion is retained.

Faults pass through all the strata and displace the seam and the roof, by throwing them either up or down, to however small an extent. They occur at all angles with the plane of stratification. When large they generally occur as a fissure more or less wide, filled with soft fragments.

Slips,* or things, or slipthings, or partings occur both in the roof and in the coal. They are not accompanied by displacement ; the fractured parts still remain in contact, and a fissure seldom intervenes between them. They generally form an angle of from 35° to 70° with the plane of stratification, and, where they are very frequent, lie in parallel directions in all but clod roofs. When occurring in the coal at moderately regular intervals they are made use of by the collier who works by them, or from slip to slip. If they lean towards the collier they are called back slips, and if away from him face slips. The latter enable the coal to be got easier and safer than the former, which are consequently often called "Devil's toes." (Figs. 71, 74). These rents, like faults, often run through both seam and part of the roof. At other times those in the roof are independent of those in the coal, and *vice versa*. When more than one set of these slips occurs in the coal they have the tendency of breaking it up to a considerable extent.

Joints are fractures which have resulted from contraction during solidification. Their presence is specially characteristic of the ironstone seams and of most shale roofs. Ironstone seams present a very jointed structure. The joints, which generally cross each other in one or two more or less well defined directions, are often slightly open, and contain carbonate of lime. The thicker the seams the further the joints are apart, and the more defined and open.

* When occurring in the coal they are called "backs" in the North of England. Slips, like faults, were probably formed after the solidification of the coal.

The joints are usually more defined and regular in one direction; these are called main joints. They run at intervals of from 18″—6′ in the Black Band Ironstones, and of from 3″—8″ in the Lean Clay Band Ironstones, but in the latter parallelism between the joints is sometimes not well defined.

The Black Band Ironstones always contain cross joints, which run at closer intervals than the main joints. They are not always so well defined and parallel as the latter. The Lean Clay Band Ironstones do not always contain cross joints.

Joints usually form an angle of 80°—90° with the plane of stratification. When passing from one band to another in the Black Band Ironstones they sometimes set off, or ride over, or hang over a few inches. The thicker the seam the more arborescent or sinuous is generally the course of the joints, both longtitudinally and vertically. In the Lean Clay Band Ironstone joints present a very straight course.

Main and cross joints sometimes cut each other out entirely, and sometimes throw each other out a few inches, but generally do not influence each others course.

In the thicker seams some of the joints, and especially the cross joints, do not run through all the bands; some bands containing more than others. These are looked upon as chance joints.

Where the seam has been worked off in pillars, and these have stood some considerable time close to the gob, the joints are opened considerably by pressure, and the roof "weights" down along them, giving them the appearance of small faults in the roof. This also occurs where the face of the drift runs parallel to the direction of the joints, where these run into the roof. It is very necessary to keep the face either above or below the joints, so as to cross them, as otherwise it is much more difficult to keep up the roof. (Fig. 1). Secondary joints of small extent, parallel to the principal joints, and branching off from them, become perceptible in old pillars. (Fig. 10). They are called "Pincracks," and occur specially at the top part of the seam. Old pillars are consequently much easier to work off than new ones, so far as getting the stone off is concerned.

The ironstone generally called "Stone" cleaves only in the plane of stratification. The seam, when thick, contains one or more partings, into which wedges and crowbars are inserted, and lumps broken down. These lumps, when large, are broken up only by inserting a wedge parallel to the plane of stratification.

Joints seldom pass from the stone into the roof. Where the roof consists of a band of lean ironstone (grits) it contains joints in the same way as the stone itself.

Perfect parallelism prevails, as a rule, between the sets of joints in seams lying above or below one another. It is also somewhat regular over large areas when the direction of the dip is the same. A change of dip in the seam alters the bearing of joints, and the neighbourhood of faults also disturbs the parallelism to a certain extent. Joints in the stone afford the greatest assistance to miners in their work. Joints in the roof, or in the shale which intervenes between the bands of lean clay ironstone, often run in a different direction to those in the stone. Joints in the roof also often run in a different direction to the cleat planes which occur in the coal, and have sometimes to be considered in laying out the workings. (Fig. 281).

Cleat* planes, which are characteristic of most coal seams, are parallel divisional planes, along which the coal readily divides or cleaves, and these occur as a rule very near to one another, and so far differ from joints. Some of these planes are sometimes coated with carbonate of lime (Fig. 227), and occasionally with pyrites. (Fig. 146). When the face of work lies parallel to these planes the collier is said to be working "face-way," or "on the face." When it lies at right angles to these planes he is said to be working "end-way," or "on the ends;" and if at an angle with it "half on end," or "half on," or "half end and half face."

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* It appears to the writer that the term "cleat" is preferable to that of "cleavage" to designate the divisional planes which occur in most coal seams, as the word "cleavage" is so differently used. Cleavage planes in a geological sense are the result of mechanical changes, brought about by the action of external forces subsequent to the accumulation and consolidation of the rock mass. In a mineralogical sense they are planes of minimum coherence, always parallel to some face of a crystal. The divisional planes which occur in coal, the writer is inclined to think, are like joints, the result of contraction during solidification, an internal change subsequent to the accumulation of the coal. Most coal seams have probably taken much longer to solidify than many of their superincumbent strata, and were consequently exposed to a certain amount of vertical pressure during their solidification, which may have assisted in the formation of the cleat planes. This may account for the immense number of these divisional planes as compared with the smaller number of joints which occur in other strata. Harder coals, like the Hard Mine, probably solidified quicker, and, not being exposed to the pressure of the superincumbent strata during their solidification, shew fewer divisional planes.

These planes are well defined in most seams, and the coal is then called long-grained ; less so in other seams, the coal being called short-grained ; and not clear in a few, when the coal is said to be close-grained, generally stubborn, strong, or hard. Where the cleat planes are not well-defined the coal has usually an equal tendency to break in a transverse direction.

In compact and hard coals and cannel coals the cleat planes run often from ½ inch to 3 inches apart, and in one seam, the Hard Mine, in the Longton District, these planes are from 6″—18″ apart, and are intersected by another set of planes, equally distant as the former from each other. They are traceable in a 3″ bass stratum above. The coal breaks off these planes in hard blocks, in which there is no tendency to subdivide in a direction parallel to these planes. (Figs. 161 and 162). This seems to point to a similarity between the origin of joints and cleat planes.

The presence or absence of a good cleat greatly influences the working arrangements. A good cleat always runs nearly at right angles to the plane of stratification.

There is also a tendency in some coals to break in a direction parallel to the plane of stratification. This is due to what are called "floors," or partings, which the seam contains.

The following is the general direction of the cleat in the North Staffordshire Coalfield. It does not appear to be affected by a change of dip.

Silverdale District:—Where the cleat is distinct, which is not often the case in this division, it runs from 18°—38° N.W.* Where slips abound, as they do in this district, they run in a N.W. direction, and the cleat runs N.E., and is indistinct.†

Longton District:—

N.W.	From due N.S.—9° N.W.
W.	10°—17° N.W.
S.	13° N.
E.	14°—22° N.W.
S.E.	As much as 45° N.W.

Norton District:—

S.	Due N.S.
E.	In places a few degrees N.E.
W.	About 10° N.W.
N.	From 34°—58° N.W.

Kidsgrove District:—Distinct in places, and then N.W., but seldom clearly defined.

The presence of faults is always ascertainable, but slips in the roof are sometimes invisible when first exposed. Numbers of accidents occur from not properly observing the roof, and from a wrong estimation of the danger which dislocations present. Accidents from invisible slips may not be wholly preventible, but those from faults or slips which can be traced are inexcusable.

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* The bearings referred to here and in the figures are the magnetic ones.

† This applies generally to all the districts.

On faults or slips becoming exposed in the roof, posts should at once be set on the upthrow side in case of a fault, and to the corresponding side in the case of a slip. This should never be lost sight of. Many accidents have occurred even after a post has been set, because of its being set on the wrong side, under the downthrow side, which does not support the upthrow side at all. Fig. 84 represents a fatal accident which occurred from this neglect. Although the slip was known to be present, a post was set at the edge of it, so that only a small part of the lid was under the upthrow side, instead of the post being well under it. This was, of course, useless, and a piece of the roof fell off the slip, and killed the collier. A very peculiar form of invisible slip (leaning slip), which tails out near the coal into the plane of stratification, is often met with in the 7 feet Banbury Rock roof. (Figs. 84 and 87). In conjunction with faults or slips in the opposite direction, and even sometimes without them, these slips are exceedingly dangerous. An accident, which proved fatal to two men was indirectly due to this combination. Fig. 87 represents a section of the place where this occurred. The fall took place along a wide face, and covered an area of 500 square feet. It weighed about ten tons. The writer counted twelve posts under the fall, and there were probably more; several were only 5″ thick, and none more than 7″. To that and to the assumption that the posts were mostly underset and not let in at the foot the writer attributed their total collapse.

Overlap faults are sometimes met with in this seam. Fig. 85, which shews one, represents the place where the shot *a* blew out, and thereby caused one of the most extensive explosions which have occurred in North Staffordshire.

What are known as "Goths" often occur in some of the thicker seams. They are sudden burstings from off the face of portions of coal, either from a slip or cleat plane, owing to the tension caused by unequal pressure brought to bear upon it by the roof and floor. They are always accompanied by a loud report. Men have been frequently injured from this cause.

The writer has noticed the same phenomenon in the 5 ft. seam, Silverdale District. A sudden shaking of the roof, like a small earthquake, and called "bumps," is felt over a large area, accompanied by a loud report, which loosens the cohesion of the roof.

The universal practice of ascertaining whether the roof or side is safe is to tap it with some heavy tool. This is done both by officials and men. The hollower (heavy) the sound, the more unsafe the roof or side is. By placing one hand against it, whilst striking with the other, slight vibrations may also be felt. This, no doubt, is a very good practice, but is on no account to be relied upon implicitly. It can be relied upon for coal faces and shale roofs for pieces of moderate dimensions, but is unreliable with rock roofs and large pieces. The writer has very frequently heard witnesses at inquests state that the roof had been previously sounded, either by the person on whom the piece had fallen, or by someone else, and had been considered quite safe. If the roof were carefully examined as well, for the purpose of detecting either natural dislocations, such as faults and slips, or those brought about by working, such as breaks and cracks; and if colliery officials would acquaint themselves with the bearing, the frequency of occurrence, and the inclination of slips, and regulate the timbering in accordance with them, many accidents would be avoided.

The accident represented in Fig. 234 was due to a disregard of the existence and bearing of a set of parallel slips which abound in the roof. A shot was fired, and did not take effect. The collier then knocked at the overhanging mass of roof, and declared it safe. He then, without first setting a post under the mass, started to pick off the loose part of the coal, when it fell upon him, having, no doubt, been shaken by the shot. A proper knowledge of the frequency of occurrence of the slips would have made it clear that the overhanging mass of roof was certain to contain dangerous slips, even if they were not traceable.

CHAPTER III.

METHODS OF WORKING.

The seams worked in the North Staffordshire Coalfield at the present time vary in inclination from 0° to 86°. Some seams, more especially the Bullhurst, 8 ft. Banbury and 7 ft. Banbury, in the Silverdale and Kidsgrove districts, have been known not only to reach the vertical in places, but to surpass it, so as to bring the floor uppermost. The seams now being worked have a thickness of from 20 inches to 14 feet. They consist of coal, marl and ironstone. The latter occur in beds and in bands. The Black Band Ironstones are always accompanied by a substratum of coal The several seams vary in thickness in different parts of the coalfield ; this is especially marked in the ironstone seams, which vary considerably, even over very small areas.

The methods of working under such various conditions necessarily differ, and almost every method is represented.

It is not the writer's intention to enter into this subject to any extent, but it will be necessary to consider it in so far as the question of timbering is influenced by it.

1. The Lancashire, or pillar and stall method, with its several modifications, is very prevalent in steep mines. It is sometimes called the "heading and drifting" method, but the word "drift" is applied to wide work generally.

It consists in driving main levels or headings, two to four yards wide, from which dips are set up at right angles to them, generally about 160 yards apart. From the top ends of these dips headings, seven to twelve yards apart, are again driven out the required distances on either side. The pillars so formed are worked back obliquely, the top places slightly lead, and the gob is thus left behind. These headings are continued one below the other down to the main levels. The area opened out by the dips furthest in should be always completed first.

In the majority of seams the coal is most easily worked in one direction, owing to the prevalence of a cleat or slips. As the coal has to be drifted back to the dips from two opposite directions, one of these will be the least favourable for getting the coal. To obviate this detriment, drifting is, with few exceptions, done in the same sense as on the other side of the dips, but from a fast end, or from a thurling, for a distance of about ten yards or more. (Figs. 72, 74, 79 88, 90, 96). When that distance is worked out a new drift is started, ten or more yards nearer the dips. This is called a "back-way" drift, the opposite or ordinary drift being called "face-way" drift. (Figs. 71, 75).

The coal is not holed to any extent in drifting in the thicker seams worked by this method. It is generally wedged down, or rated down with punches or jobbers in fiery mines, and blown down to slips in a few non-fiery ones. When the seam is thick, part of it, the tops, is often dropped in the gob on the withdrawal of the posts. (Figs. 276 and 277).

The Lancashire method develops into ordinary board and pillar working in seams of moderate inclination. Seams of steep or "stair" inclination, which are called "rearers" when this inclination becomes considerable, are all worked by this method.

Shooting the gob from the top drifts forms an essential feature in rearer workings. It makes the work not only possible, by ensuring a floor for the men to stand upon when at work, but also comparatively safe, by partially filling up the gob cavities, thereby supporting the roof behind the men. The gob either shoots down of itself, or is brought down by a shot at the high side of the drift.

Where possible, and absolutely necessary, posts are set to the roof (Fig. 61), but in several seams the roof is good, and a secure footing for posts is impossible on a moving gob; hence the entire absence of posts in the drifts (Figs. 62, 63), except at the bottom corners and when the drift is first started. In such cases great care is taken to pull off all loose coals to the solid in slicing up the shoulder. If any slips are met with the men draw back and take off another piece.

Little danger is anticipated from falls of coal and roof, which very rarely cause accidents with such precautions ; but the gob has to be carefully watched, and the men have to be constantly on the alert. In some of these seams the men have occasionally to resort to precipitate flight, owing to a sudden total or partial shooting of the gob. This is one of the reasons why too many posts are considered objectionable, as they would be impediments to a hasty flight. It is easily conceivable that rearer working necessitates the employment of a special class of strong and active men. Dips of from 70°—90° are found easiest to work, as the gob shoots down regularly and fills up most of the space. The most awkward dips are from 45°—65°, as the shooting of the gob is partial, and not so regular.

A sudden shooting of the gob dèbris occurred in a drift in the 7 ft. Banbury Seam—Silverdale district—at an inclination of 45°. There were 3—4 rows of posts, several of which were swept down to the bottom of the drift. Two colliers who were at work at the time, were carried down by the dèbris, which was mostly small, and very nearly buried by it. They were both rescued from their perilous position without having sustained any serious injuries. It is supposed that a large fall of roof occurred in the gob above and forced the loose dèbris down.

The dips in rearer workings are usually set up on what is called "three-quarters," *i.e.*, at such an angle as best suits the usual self-acting planes; it being, of course, impossible to jig the wagons on the full dip of the seams. When the dips are set up on the full dip of the seam, as is frequently the case, they are fitted up with a cage and counterbalance. Two, and even three, seams are worked together very frequently by modifications of the Lancashire method. (Figs. 26, 63).

2. The Longwall* method prevails in the flatter mines, with varying lengths of face and depths of holing. The depth of holing has, up to recently, not been great, much reliance having been placed in powder, but since the greater restriction on blasting there is a tendency to improve in that direction, and it is found that proper deep holing not only enables powder to be greatly dispensed with, but that much more round coal is produced thereby.

Modified longwall, with from 20—80 yards face, and a jig or self-acting incline in the middle, is in vogue in some of the thick and in most of the thinner seams of moderate inclination. (Figs. 102, 110). The greatest inclination of a seam worked by longwall is 35°. (Fig. 232). In thick seams the top coal is occasionally left over the packs and cut down in the wastes. (Fig. 106).

What is known as "breasting" is much adopted in some seams. It consists in driving the levels 12 yards

* A description of the longwall method of working in its application to some of the North Staffordshire Mines will be found in a paper read before the North Staffordshire Institute, by Mr. H. Wright.

or more wide, and securing two roads by packing. (Figs. 229 and 105[d]). The roof is found to stand better than it would in "strait" work.

3. The Yorkshire "bank* and pillar" method, with several modifications, also prevails. The bank differs from longwall in that small coal or stone pillars are left in the wastes to support the roof, there being generally no packing material in the seam, and broken roof not being used for that purpose. The sub-divisions into which the face is thrown by the formation of these little supports are called walls. (Figs. 248, 160, 7). The large pillars on either side the "bank," which support a pair of dips, are worked back on reaching the boundary.

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* Sometimes called "benk."

CHAPTER IV.

EFFECTS ON THE ROOF BY THE EXTRACTION OF THE MINERALS.

On being exposed by the extraction of the minerals and the consequent removal of its natural support, the roof has the tendency to break down sooner or later. This tendency is deferred in the working places by the substitution of artificial supports, but comes in operation again whenever these supports are partially or wholly withdrawn. The longer the subsidence is delayed the greater, as a rule, is the quantity of roof detached and the area over which it falls or subsides. These subsidences are called "weights," and the roof is said to be "weighting." Where the supports which are left in the gob cavity are substantial weighting is gradual, and gives ample warning. Where they are insufficient the weighting is more suddenly developed, and the artificial supports are ineffectual on the occurrence of heavy weighting, which often breaks all the timber before it, right up to the working face (Fig

203), and in some cases this occurs even in spite of great attention to timbering. Where the roof is hard, and of great thickness and the floor is soft, the latter often closes the gob cavity before subsidence has had time to take effect. This frequently occurs with the 7 feet Banbury rock roof, also with hard but bending cannels and shales. In the latter case the roof meets the floor half way.

A soft or tender roof breaks as soon as the temporary supports are removed near the face, and forms wastes between the permanent supports left in the gob. (Figs. 220, 186).

The tender strata forming the roof are often topped by a harder stratum, which subsides or weights after a larger area of it has been exposed.

Two weights are usual in some seams, the first preceding the second at smaller intervals.

A bad roof is generally understood to mean one which requires to be systematically well supported, while a good one is supposed to require less systematic support. A roof may be bad in itself. There may be very inadequate cohesion in its particles. It is then called tender or nesh. Under this definition would come some of the clay and loose shale roofs. What may generally be a good strong roof in itself may be full of slips and faults, and form a treacherous roof over a certain area.

The subsidence of the roof is greatly influenced by the method of working, as for instance in the Rowhurst

Seam. (Fig. 206). It is found that where the coal is breasted the roof does not break so readily as where the coal is opened out by ordinary "strait" work. The pressure in strait work is concentrated along one line, but in wide work it is spread over a large surface, and each individual point feels it in a reduced amount. On the other hand the quality of the roof also at times influences the mode of working.

A roof containing joints, as that over the Woodhead Seam (Fig. 281), will be good or bad according as to whether the face is kept more at right angles to the joints, or parallel with them.

It is fallacious to suppose that what are called bad roofs need be productive of more accidents than good roofs. Roofs containing numerous dislocations, lying much in the same direction, necessitate a specially systematic kind of timbering, which will ensure comparative safety; while a good roof, in which dislocations occur rarely, but unexpectedly, may be fraught with danger from the want of a rigid system of timbering, irrespective of whether in individual places posts are absolutely required or not. A good example of this latter is the 7 feet Banbury rock, a very good roof, which gives ample warning before coming down in the gob, but is most treacherous when subject to slips, pieces falling out without any warning, and many accidents having occurred in consequence.

CHAPTER V.

INFLUENCE ON THE ROOFS AND MINERALS OF THE ORDER IN WHICH CONTIGUOUS SEAMS ARE WORKED.

The order in which contiguous seams are worked may affect not only their roofs, but also the hardness of the coal.

It is well known that the pressure exerted on the face of the coal by the gas which it contains greatly assists its extraction. The escape of gas from the coal through the breaks in the intervening strata, which are caused by the extraction of a contiguous seam, either above or below it, and the disturbance thereby produced in the equilibrium of pressure in the strata, makes the coal tougher and harder to get. This disturbance follows the extraction of the coal closely, being perceivable in the roads of a contiguous seam as soon as the drift face passes over them.

Disturbing elements between two contiguous seams act nearly at right angles to the inclination of the seams and not perpendicularly.

In so far as the hardness of the coal is affected, it is entirely a commercial question, and therefore outside the scope of the present subject. Not so the effect on the roofs; for if a roof is injured it presents greater insecurity, which, if not provided against, may cause accidents. But as the increased insecurity which is produced in some cases, can be met by increased care in timbering, the consideration of the effect on the roofs is usually subordinated to that of the effect on the coal. Where the effect is to harden the coal, the cost of holing and cutting is increased, and, in the case of soft coals, the yield of round coals is augmented.

If the increased selling price is greater than the increased cost of getting the coal, which is the case with more or less soft coal, the hardening effect is profitable; coals which are already hard are less profitable to work when still further hardened.

The consideration of profit in working contiguous seams is often subordinated to trade demands.

In considering this subject the following data have to be taken into account :—

1. Distance between the seams.
2. Their thicknesses.
3. The extent to which the gobs are packed.
4. Nature of roof and floor.

5. Nature of seams; whether coal or ironstone.
6. Inclination of the seams.
7. Depth from surface.
8. Rate of working, or distance between the drift faces.

The following table contains some instances of the order in which contiguous seams have been worked, and the effect produced both on the roofs and on the coal or ironstone. It shows that no definite rule can be laid down for the order of working contiguous seams.

	Seams	Distances apart in yards	Total average thicknesses	Extent of packing	Nature of floor	Nature of roof	Coal or Ironstone	Inclination	Depth from surface in yards	Figures	Observations	Remarks
1	Red Shagg ... Red Mine ..	25	5′ 6″ 5′ 0″	½ ½	Soft	Soft	Both	20°	160		On working R. S. over an area of 200 yds. × 250 yds.; about two years after R. M. had been worked out, the floor of R. S., which usually lifts much, ceased to do so, the water which it contained having been drained. The roads, which usually required much timbering, in consequence of the lifting action of the floor, needed no timber. The stone was so loosened that the cost of production was reduced by nearly half.	
2	Blackband ... Red Shagg ... Red Mine ...	12 22	4′ 10″ 6′ 0″	⅙	Hard	do.	do.	4°	150	8	On working B. two years after R. S. had been worked out the coal had set exceedingly hard (cutting it was the same as cutting at a tree root). The cost of production was increased. Neither the roof nor the stone were affected. On B. drift face passing over roads of R. S. the latter were greatly pulled in, and required much timbering. The lower seam being worked ever so little in advance, the coal of the upper seam is thereby hardened over the gob area of the lower seam.	It is considered best to work these three seams simultaneously, and to keep the drift face of the *upper seam 30—40 yards in advance.* The stone is not affected in whichever order the seams are worked.
3	Blackband ... Red Shagg ... Red Mine ...	12 22	5′ 0″ 5′ 6″ 6′ 6″	19/20 9/10 ¾	do.	do.	do.	5°	150	2 6 14	Where R. S. was thick and gob consequently not closely packed, a gob road in B. subsided along a distance of 20 yds. The roads are not affected where R. S. is thinner, and gob consequently closely packed. R. S., where thick, and less packed, was worked 20 yds. in advance of B. The stone and roof of B. were broken. The stone was easier to get, but the increased cost of timber, which was as 3:1, was much greater than the reduced cost of getting the stone. R. M. was worked 30 yds. in advance of R. S. The roof and stone of latter had set and were broken. The cost of production was doubled.	It is considered best to work these seams in *descending order*, the drift face of the *upper seam* being not less than *10 yards in advance* of the drift face of the lower seam.
4	Gubbin Ironstone Great Row ...	11	7′ 9″ 9′ 0″	all ⅖	do. Soft	Hard Heavy	Ironstone Coal	8° 8°	272	184 186	Gubbin was worked several years after G. R. The seam and roof were both more or less disturbed. The seam was "pulled;" the floor had dropped (swagged) as much as 4" in places. The continuity of the seam was interrupted; it was "set on" in places, and caused holing to be stiff in places. The stone was generally better to get.	It is considered best to work G. R. first and the Gubbin as long afterwards as possible.
5	Great Row ... Cannel Row...	15	9′ 0″ 8 3″	⅖ ⅖	do. Hard	Heavy Hard	do. do.	8° 8°	287	186 189	G. R. was worked eight months after Cannel Row. G. R. coal was found very tough (chumpy), and was more expensive to get. The roof was not affected.	It is considered best to work G. R. first and C. R. six months afterwards.
6	Yard ... ... Ragman	6	4′ 2″ 3′ 10″	½ ½	do. do.	do. do.	do. do.	15° 15°	500	223 226	Working Y. first caused R. coal to become exceedingly hard. Working R. too far in advance also caused Y. coal to become hard.	It is found best to work *R. 10—15 yards in advance* of Y.
7	Burnwood ... Twist	6	4′ 6″ 3′ 7″	½ 1	do. do.	do. do.	do. do.	17° 17°	250	212 216	Workng B. first caused the roof of T. to become much broken, necessitating much coal to be left. It also caused the T. coal to become much harder. In consequence of the roof falling more readily there was more dirt than the gob could hold. The cost per ton was increased by 5d.	It is found best to work *T. first.*
8	Top Two Row Bottom Two Row	6—12	2′ 10′ 4′ 0″	⅓ ⅓	Strong do.	Strong do.	do. do.	30° 30°	260	270	On working T. T. R. some years after B. T. R. had been gotten it was found that the coal had set very hard over gob area of B. T. R., and that the roof had become worse. It was more expensive to work. On working T. T. R. completely out before working B. T. R. the latter becomes exceedingly hard, more slack is made. Timbering and the cost of working generally is increased.	It is found best to work the seams simultaneously, keeping the drift face of *B. T. R. 20 yards in advance.* A slight depression of the floor called "snatch," or "swag," is caused in T. T. R., which makes the holing easier than when T. T. R. is worked in advance. More round coal is produced and the roof is less damaged.
9	Bowling Alley Holly Lane ... Hard Mine ...	24 25	4′ 6″ 6′ 9″ 5′ 6″	⅓ ⅓ ⅓	do.	Moderately Strong	do.	30°	400	153 155 159	On working the upper seam first the coal of the lower seam became exceedingly hard. As the drift face of the upper seam passes over the jigs and levels of the lower seam, it pulls them in considerably, necessitating much timbering. For this reason the lower seam should, if possible, be worked out completely before the upper seam is begun.	It is considered best to work these seams in *ascending order*, and, if possible, in conveniently small districts, so that the lower seam may be completely got before the upper seam is begun. Where this cannot be arranged, and the seams have to be worked simultaneously, it is best to keep the drift face of *the lower seam 40—50 yards in advance.*
10	Bowling Alley Holly Lane .. Hard Mine ..	27 26	5′ 0″ 4′ 0″ 5′ 6″	⅝ ⅝ ⅝	do.	do.	do.	14°	650	230 236 241	On working H. L. many years after H. M. had been worked, the coal was found to have set very hard over the gob area of H. M. The drift face of H. L. produced the same effect on the jigs and levels in H. M. as in the preceding case.	
11	Four Feet .. Five Feet ...	25	4′ 9″ 5′ 8″	0 0	do.	do.	do.	40°	250	52 58	On working the Four F. over an area of 80 yds. × 70 yds. more than a year after the Five F. had been worked from under it, the coal was found much harder to cut and hole, but more profitable to work, owing to a greater yield of round coal. The roof was generally improved, less timber was used and more recovered.	
12	Four Feet ... Five Feet ...	20	7′ 0″ 5′ 6″	½ ½			do.	65°	200	120	It was intended to work the Four F. after the Five F. had been worked out, but the coal had set so hard that it could not be worked to profit.	It is best to work these seams on the same level, and to keep the face in each seam close together.
13	Seven Feet B. Eight Feet B.	35	6′ 0″ 7′ 0″	0 0	do. Moderately Strong	Hard, except 2in. bass Strong	do. do.	50°	400	80 89	The Eight F. was worked about 18 months before the Seven F. The latter was found very hard. More round coal was produced, but the extra cost of getting exceeded the increased value of the coal. The Seven F. was worked about two years before the Eight F. The latter had set very hard, making it very costly to get.	It is not advisable to work these two seams separately. They should be worked together, the 7 ft. being a little in advance of the 8 ft.
14	Rider ... ... Ash	7	4′ 0″ 7′ 0″	all ½			do. do.	8°	349	127	R. was worked over an area of two acres, eight years after A. had been worked. Where the A. pillars were left (near shaft) R. coal was found very hard, and the roof too; but over the A. gob the R. coal was crushed and was consequently soft to work, but more slack was made. There were occasional pockets (depressions) in the R. floor which contained gas.	

CHAPTER VI.

GENERAL DESCRIPTION OF THE METHODS OF SUPPORTING THE ROOF.

The roof has generally to be supported, not only to ensure the safety of the workmen, but also to enable them to pursue their work at all. This is done in a variety of ways, according to the nature of the seam worked.

1. By packing the gob area entirely, and timbering at the face—in longwall, when the seams contain many bands, or when the floor has to be taken up.

2. By partial packing of the gob area by stone cogs, pinnings, or packs, with intervening wastes—in longwall and the most general way.

3. By timbering at the face and leaving small coal or stone pillars behind in the gob as supports. This is usual where no packing material can be obtained

from the seam, and it is customary in some of the bank and pillar workings, and in the case of one seam worked by the Lancashire method, and in a few stone seams which are worked by board and pillar.

4. By timbering alone, without any packing whatever, as in the Lancashire method, board and pillar and longwall homewards generally.

5 By self-packing of the gob in "Rearer" workings after it has been "shot." In some of the Rearer seams timbering is occasionally put up, but in others, notwithstanding their great thickness, no timber whatever is set, as already explained above. In some instances in the Kidsgrove district, where the roof is very bad, and the dip 65°, packs are built systematically. (Fig. 274).

CHAPTER VII.

CLASSIFICATION OF TIMBER SUPPORTS USED EITHER IN SINGLE PIECES OR IN COMBINATIONS.

The following single pieces and combinations of timber are set to support the roof and sides in travelling roads and working places in the Mines of North Staffordshire :—

1. Sprags :
   (*a*) Without lids :
      1. Top sprags or short posts. (Fig. 141).
      2. Bottom sprags. (Fig. 19).

   (*b*) With lids. (Fig. 182).

2. Cockers, cockermegs, cocker-sprags, or knee-joints. (Fig. 107).

3. Stretchers :
   (*a*) Set against posts. (Fig. 134).
   (*b*) Set against cogs. (Fig. 178).

4. Posts :
   (*a*) With lids. (Fig. 23).
   (*b*) Without lids. (Fig. 187).
   (*c*) With footlids. (Fig. 114).

5. Posts and bars :
   (*a*) One bar and three posts. (Fig. 119).
   (*b*) One bar and two posts—bond-timber. (Fig. 137).
   (*c*) One bar and one post. (Fig. 120).
   (*d*) Single bar, also called stretcher. (Fig. 51).

6. Chocks, or wooden cogs. (Fig. 254).

7. Slabs :
   (*a*) At the back of posts—lagging. (Fig. 287).
   (*b*) Over bars—runners. (Fig. 54).

8. Other single pieces or combinations :
   (*a*) Topping "riflemen." (Fig. 4).
   (*b*) Stays. (Fig. 3).
   (*c*) Gibs,* or block sprags. (Figs. 46, 126).
   (*d*) Brackets, in combination with—
      1. Stretchers. (Fig. 83).
      2. Bars. (Fig. 286).
   (*e*) Lacing. (Fig. 287).
   (*f*) Struts. (Fig. 165).
   (*g*) Slab bar. (Fig. 220).

* This word is also used for a small sprag (Fig. 214) and for a stretcher. (Fig 247).

Arrangements other than supports, with a view to protect the workmen :

(*a*) Slab posts. (Fig. 97).
(*b*) Gluts. (Fig. 256).

The pieces which are used specially for the support of the face are : bottom sprags, cockers and stretchers, in combination with posts or cogs, and slabs at the back of posts. Those used specially to support the roof are posts, stretchers, posts and bars, chocks, slabs, over bars, though some of these occasionally support the sides as well.

It is the writer's intention to deal exclusively with this class of timbering in connection with the mines of North Staffordshire.

CHAPTER VIII.

HOLING, WITH A REFERENCE TO SPRAGS, COCKERS AND STRETCHERS.

Holing is done in the top, in the middle, or in the bottom of the seam, but generally in the latter; in thick and in thin seams; in flat seams and in those inclined as much as 35°; on the rise or full dip, on half-dip and on the level or strike. Under these various conditions a rule to determine generally the proper inclination of a sprag is valuable.

1. Holing on the rise or full dip.

When the coal or ironstone generally is coherent and free from slips, and where the end of the holing is next the floor, and not horizontally above the point of the coal to which the sprag is applied the tendency of the coal is to fall round arcs of circles, of which the centre is the end of the holing. The pressure of the coal on a sprag at A (Figs. 297 and 238) acts consequently at right angles to line AC, in the direction of the tangent of arc AR at A. The intensity of this force is more or less increased by the pressure of the roof on the coal. The resisting force of the floor acts at right angles to line BC, the dip of the mine. To meet these two forces equally the sprag should form an equal angle with each of them, consequently it should assume a position at right angles to line CD, which bisects angle ACB, or: Where the end of the holing is horizontally under that part of the coal to which the sprag is applied, the latter should be set so as to form a right angle with a line drawn through the end of the holing and the centre of that part of the sprag, which stands above a line drawn through the end of the holing and parallel to the dip of the mine. Where the holing is next the floor this last line will lie in the floor itself. By determining the inclination of a sprag supporting the coal at E (Fig. 297) according to this rule it will be found that EF is nearer the vertical than AB, and that the longer the sprag the more it should be inclined. If this rule were applied on first starting to hole (Fig. 298), the inclination of a sprag at AB would be much greater than when the holing is completed, as in Fig. 297. It will be apparent that if a sprag were to be constantly in the most efficient position it would have to pass gradually from inclination AB in Fig. 298 to that of AB in Fig. 297 as the holing advances. The force at A will, however, not only be altering its direction, but also its intensity, so that a sprag which cannot in practice be reset over and over again as the holing advances will have to be set from the first to act most effectively when the holing has reached its termination, as in Fig. 297. Where the end of the holing is horizontally above that part of the coal to which the sprag is applied, or where the coal is loose, or contains slips in particular directions, it has the tendency to fall in the sense of gravitation, and a vertical force alone has to be considered. The proper position for a sprag in such cases is one forming an equal angle with the vertical coal pressure (Fig. 155) and the direction of greatest resistance of the floor. The same applies to Figs. 21, 232 and 264, etc. Where sprags are well let in at the foot they may be set leaning slightly more towards the face, as AS in Fig. 297 (Fig. 69), but any deviation from the above rule would be wrong with hard floors, such as in Fig. 143, where sprags can hardly be impressed into it.

2. Holing in a level direction or on the strike of the seam, as shewn in Figs. 18—20.

In this case the pressure of the stone is in a direction corresponding to the resultant of two forces acting in planes at right angles to each other (along the line of strike and that of dip), and to the plane of stratification. The direction of the first of these two forces, that in the line of strike, which is the direction of the holing, is determined in the same way as in 1. The direction of the other force, that in the line of dip, is either (*a*) that of gravitation, or (*b*) that of one of its resultants, the one at right angles to the plane of stratification. The full force of gravitation comes into play when the stone is holed at the cutting end, where it is unsupported by adjoining stone, and the one resultant only, when a long face is holed, and the stone supports itself partially. In (*a*) the sprag should be set in a plane determined by the line of strike and a line which forms an equal angle with a vertical line E (Fig. 20), representing the force of gravitation, and a line at right angles to the resisting force of the floor F. In (*b*) the sprag should be set in a plane at right angles to the plane of stratification along the line of strike. The inclination of sprags in those planes is determined by 1. (Fig. 19).

3. Holing on half-dip.

In this case the direction of the pressure is also the resultant of two forces acting in planes at right angles to the plane of stratification, but these planes are not at right angles to each other. The one plane, as before, is in the line of dip, but the other is at right angles to the face of the holing, and the direction of the pressure in that plane is determined as in 1. The same observation made as regards the force in the line of dip in 2. applies here.

In order to determine the position of the foothole of a sprag in this case, the position of the footholes of sprags set to meet each of these forces separately may be determined, and the point against which the sprags are applied projected on to the floor. A fourth point produced by a parallelogram of which these three points are the other points determines the proper position of the foothole.

In 2. this parallelogram becomes a rectangle.

In seams in which slips occur frequently, or in thick seams where the coal or the stone hangs over, or where the holing is deep, or where the dip of the seam is considerable, one of the following combinations should be used :—

1. Double sprags, or two rows.
2. Cockers and sprags.
3. Posts and stretchers, and sprags.

The stretchers are sometimes supported by chocks or by stone cogs. Cockers are extensively used ; they are very efficient, and cannot be reeled out of position. The crosspiece between the top and bottom sprags is usually 4′—5′ long, presenting a large surface of resistance. They contain the principle of the knuckle joint, for the greater the pressure of the coal the stronger is the grip at the roof and floor, and this also helps to support the roof.

In steep mines (Figs. 237 and 238) it is preferable not to trust to sprags entirely, as there is a probability that they may not be correctly set. Several accidents have occurred from this cause. The sprag has either not been stamped sufficiently and has given way at the foot, or has not been properly notched into the coal, and has slid up along its face, or the sprag not being placed at the right inclination has been reeled over by the falling coal. In such cases stretchers set from a post to the face are indispensable. The post should be placed as near the face as possible, thereby reducing the length of the stretcher. These posts and stretchers are much used, especially in the thicker seams. (Fig. 89).

Sprags should be well stamped whenever it is possible. This applies especially to the steeper seams, in which from want of this precaution fatal accidents have occurred; the sprag has sprung out at the foot, and the coal has fallen on the collier.

A peculiar mode of spragging deserves to be mentioned. The seam—Brown Mine (Fig. 46) is holed in the middle, a depth of 18″, and tapering wooden wedges, 1′ long, called "gibs," are hammered in about 3′ apart. Further north, where the section of the seam is slightly different, the holing is from 2′ to 2′ 3″ deep, and short sprags are set under the top band. These sprags cannot be stamped, owing to their resting on a band of stone. Fig. 44 represents a place where a fatal accident occurred to the holer. He was holing extra deep, 3′ under a detached piece supported by a sprag. As the holing reached a joint the piece was liberated, it slipped the sprag, and fell on to the holer's head. It would be advisable in cases of this kind to use sprags not thinner than 8″, or to apply thick wedges, as above; and to set stretchers off the posts when holing deeper than the ordinary distance. Spragging in the ironstone seams generally requires the greatest care, as they contain so many joints. Several accidents have occurred from persons passing along the face after the sprags had been drawn, when the coal or stone has fallen upon them. This is such a needless risk to run that accidents from this cause ought never to occur.

Where the roof is exceedingly soft and crumbly, as in Figs. 219 and 220, the coal is holed in patches, and slabs used even whilst holing.

Where the coal is holed in the top, sprags assume the nature of small posts, and should be set regularly, as accidents have occurred from falls of roof at the face from a neglect of this very necessary precaution.

CHAPTER IX.

POSTS, WITH ESPECIAL REGARD TO THEIR POSITION IN WORKING PLACES.

The tendency of the roof is to fall in the direction of gravitation, in line BG (Fig. 56). But where the roof is solid, and holds together, like that in Fig. 56, this force of gravitation represented by line BG is resolved into two forces, represented by line BO, parallel to the dip of the seam, and line BV, at right angles to the dip. As the line BO is equalized by an opposing force inherent in the roof itself, the only force or pressure to be provided against is that represented by line BV ; and as the resisting force of the floor is greatest in a direction at right angles to its inclination, it follows that the most effectual position for posts and all props to support the roof is at right angles to the dip of the seam, or square under the work.

In practice posts are not set in this position except in nearly flat seams ; the greater the dip of the seam the more the posts are underset or inclined upwards.

Fig. 302 shews the manner in which the writer made these observations, with a rough wooden clinometer, 16 in. long and ½ in. broad. By applying it first to the roof and then to the post the difference between the angle of the dip of the seam at that point and the angle formed by the post and a vertical line, is easily determined, and this gives the number of degrees that the post is underset.

If the angles are equal the post is square with the dip, or fully on the set.

There are other points to be considered in setting posts, besides the most effectual position to resist the pressure of the roof. Posts which are fully on the set are likely to be reeled out if struck by pieces of roof or coal. If slightly underset a blow on the head will tighten them still further, or break them ; whilst they should not give way by a blow at the foot, if sufficiently stamped. The greater the dip of the seam the more frequent are falls of coal from the face. The formation of the face, however, may in some cases be such that coal falling from it may hit a post more or less sideways, and knock it out, even if well set. A fatal accident occurred from this cause in the Ash Seam. (Fig. 127). A large lump of coal fell from off a slip and reeled a post out, behind which the collier stood, and killed him. The post having just been set, had not been subjected to the tightening action of the roof.

The adjoining post, which had been set longer, was broken by the fall. A similar accident occurred in the Cockshead Seam. (Fig. 250). There is at times a tendency to set posts slack, relying on the tightening action of roof, or floor to fasten them, as they are then in some cases not so soon broken. This may account for posts being frequently so easily knocked out by a blow when only recently set. In some seams the colliers set their last posts slack and find them set fast the next morning. Long posts are easily displaced by a fall in steep mines unless set very fast, and this is especially the case if the roof is slippery.

Unless posts are underset in very steep mines they are apt to fall out before the pressure of the roof has tightened them. Posts are sometimes too much underset, owing to their being too long. Being well knocked down in the head and yet found to be too much underset they are often left in that condition because some trouble is incurred by deepening the foothole and resetting them, as setting posts, especially when long, in steep mines, is a tedious operation.

The more posts are underset the easier they are to draw; this may account for the fact that posts are generally considerably more underset than is justified by the foregoing remarks.

The more posts are underset the less resistance do they offer to the roof. They also require to be longer, and are consequently weaker, and in many cases are liable to being displaced by the heaving action of the floor. When cut "askew," and not straight, posts may be considerably underset and yet appear to the colliers to be "on the set," from their fitting to the lid all round.

The writer has made out the following table, which shews the maximum and minimum angles at which posts should be set in varying inclinations of the seam :—

Dip of Seam.	Set or Underset of Posts.	
	Minimum.	Maximum.
6°	0°	1°
12°	0°	2°
18°	1°	3°
24°	1°	4°
30°	2°	5°
36°	2°	6°
42°	2°	7°
48°	3°	8°
54° and upwards.	3°	9°

A liberal margin is allowed for the practical difficulties of setting posts at stated angles, and the angles given should not be surpassed. The gradual loss in the useful effect of posts, which results from their being more underset as the inclination of the seam increases, according to this table, and carried out in practice, is accompanied and balanced by a decreasing pressure of the roof. By comparing Figs. 56 and

61 it will be seen how much the force BV is reduced by a steeper inclination. Where the roof in a drift is loosened or cracked by the fall or subsidence of a contiguous part, and consequent removal of its partial self support, or of force D (Fig. 56), the full force of gravitation represented by line BG comes into operation. A post assumes then the character of a sprag; its proper position is as shewn in Fig. 95, in which one of its sides CG halves the angle formed by line BG and line RG, which represents the resisting force of the floor. As with sprags, the deeper the posts are stamped the more parallel may they be set to line BG.

These observations apply also to a treacherous roof like that shown in Fig. 82, which is very uneven. Should a post be incorrectly set under this roof from a wrong estimation of the length required, it may be unsafe to remove it so as to reset it without previously setting another near it. In cases like that represented in Fig. 252 the inherent resisting force of the roof vanishes more and more as the posts approach the gob, and the vertical force of gravitation comes fully and more intensely into play. The posts which were originally set at the face, with a view to meet the one resultant of this force, are borne down and occasionally broken like post P by its other resultant on approaching the gob.

The same remarks apply to Fig. 107, which represents the section of a waste in which the top coals are dropped some distance behind the face, and are consequently affected by the breaks in the roof. These are very distinct near the edge, and cause entire separations in the coal. The posts which are originally set at the face, and eventually find their way to the edge of the top coal are not set with a view to resist the full force of gravitation. It is therefore essential in such cases to set several posts, in accordance with the altered conditions, under the edge of the top coals before cutting them at the sides of the pack (as A). Not only should these posts be set more on the sprag, but with due regard to the position of the breaks, and directly under the centre of gravity of semi-detached pieces. A piece of coal, 5 yards in length and 2 feet wide fell and killed a collier, though it was supported at the edge by two posts, but these the writer concluded, had not been set in accordance with the foregoing remarks.

Though there are many considerations which decide the proper set of a post, or, as the colliers say: "many things to look to," the knowledge of the forces which come into play as described above should underlie them all.

Posts against which stretchers are set require to be a little more underset than if intended to support the roof only. The same applies to jig-posts, which require to be well let in at the foot, and well underset or notched in the roof.

In very thick seams, which require long posts, these should not be too thin, as they will then easily bend and break. The strength of two posts of equal sectional area and density is inversely as their lengths. Posts are invariably set with the thick end upwards. In respect of efficiency one end is as well upwards as the other, as resistance equals pressure, and the strength of the post corresponds to its thinnest sectional area. By placing the thinnest end of posts in the floor a smaller foothole is required, which will consequently take less time to cut out. Posts are easier to draw when tapering upwards. Being more solid and stronger at their thick ends, posts, when being set, are better able to bear the blows on their heads, when set with their thick ends upwards.

Posts are usually sharpened or rounded at the foot to fit into the footholes, which are necessarily rather smaller at the bottom. A sharp edge also increases their tendency to split. Posts are rounded with heaving floors to prevent them "mopping," as this would make their withdrawal more difficult.

Where the floor is very hard, and a foothole difficult to cut, a slight incision only is made to receive the posts, which are then slightly pointed at the foot. (Fig 97).

In seams of moderate inclination which have a hard floor and a good roof, posts are sometimes neither sharpened nor stamped, but set slack on pieces of bass. (Fig. 139). The pressure soon grinds the pieces of bass down and they form cushions for the posts. Footlids are sometimes used instead.

Wherever the floor permits posts should be properly stamped. This is well attended to in steep mines, as shewn in Fig. 265, where it is necessary to get to a firm bottom. Stamping is often neglected in seams of moderate inclination, and several accidents have occurred in consequence, from the posts slipping out at the foot.

Posts should be set from above, or from the side, and not from below, and this is especially necessary in steep seams.

In very steep seams, when, from want of room, a post has to be set from below, another should be set from above as soon as there is room. A well-set post, well driven home, gives out a clear sound when knocked, especially when the roof has tightened it.

In some seams there is very little pressure on the timber; in others (Fig. 300) there is a gradual grinding action, and the weaker posts shew signs of giving at the weakest points in two or three days.

Where the roof is fairly solid, single posts with ordinary lids suffice, but where loose and jointy, either bars or strong lids (Figs. 124 and 211) are necessary, and in some cases slabs should be placed over the bars.

CHAPTER X.

LIDS.

Lids are indispensable adjuncts to posts. Their primary use lies in wedging posts tightly to the roof. They also extend the supporting area, if they are thick enough, and project fairly beyond the posts. They are of great use as cushions, into which the posts can squeeze when subjected to weight. They enable the posts to last longer without cracking or bending.

Fig. 299 shews some lid arrangements which are frequently met with in steep mines.

Posts are sometimes sawn slanting, or askew, and the lids, as in C, are of uniform thickness. This enables the posts to be slightly underset, whilst retaining a good crowning. Posts which are sawn too much askew require tapering lids, as in A. Where this is overdone there is a tendency to underset posts considerably when a good crowning is principally looked to and lids of uniform thickness are used. Posts which are considerably underset are often considered well set by the colliers, because their surfaces are in close contact with those of the lids.

In the other arrangements the posts are all cut straight. They are not always driven down enough at the head, as in B. This is faulty and unfinished, and leaves a cavity or "hollow" between the posts and the lids, which, in some cases, is filled in by a thin wedge (glut), as in D. Posts should be driven down properly, instead of resorting to such expedients.

E represents a good arrangement. The lids are wedge-shaped, and form a good crown on straight-sawn posts, allowing for a slight underset. H is also good, and the most usual arrangement. The lids are of uniform thickness, and the posts which are straight-sawn require to be sufficiently hammered down at the head, so that their lower edge may be squeezed into the lids. The weight of the roof soon completes any slight defect in the fit. Posts are sometimes too short, as in F, and necessitate an undesirable arrangement. Lids of uniform thickness are sometimes used with straight-sawn posts. The posts have to be set at right angles to the inclination of the seam for the surfaces to be in close contact. The lids are wedged down at their lower ends to make up for the posts not being underset, and to enable them to bear a blow from the head side. This arrangement is not to be recommended; it is preferable to underset the posts slightly. The cavities over the lids should be filled in by short pieces of wood, as in I.

Posts are said to be "on the set," or well set, when they are well "crowned," *i.e.*, when the roof, lids and posts all fit well on to each other, and when the latter are neither too much underset nor necessarily at right angles to the dip of the seam. Posts, as in C, E, H, are said to be well under their work.

Lids should project over the posts, so as to more than cover them all round. F represents an arrangement sometimes met with, and L its inevitable result.

Fig. 300*a* shews the effect of slow grinding pressure on a post which was set without a lid. In *b* and *c* the posts have been squeezed fully into the lids before giving way themselves, and consequently they have lasted longer than they otherwise would have done. Good lids are specially advisable where the floor is very strong. (Fig. 50). The posts are squeezed into the lids, which bend over and save the posts.

With jointy roofs, lids should be placed, if possible, so as to cross the joints.

Broken bars are sometimes used as lids (Fig. 211) where the roof is full of slips and breaks readily ; they are 5″—6″ square, rather long, and the unevenness of the roof is filled in with small wedges (timps), or larger pieces of wood.

Lids are sometimes placed on sprags, especially in ironstone seams, (Figs. 14, 182), to extend the surface, when fractures or joints occur at the points at which the sprags are set.

Footlids are sometimes placed under posts where the floor is soft or broken. (Fig. 114).

CHAPTER XI.

NUMBER OF POSTS REQUIRED IN WORKING PLACES.

The number of posts required in working places, and the order in which they should be set, is principally dependent on the nature of the seam and the roof, and on the method of working. This subject is consequently closely connected with the matter treated of in Chapters III. and VI.

The following are the customs prevalent in the different methods of working in the North Staffordshire district.

1. LANCASHIRE METHOD.

Except in "Rearers"* and in back-way drifts there are never less than three rows of posts at the face. (Fig. 22). The usual number is four, and sometimes five rows. (Figs. 51, 55, 71, 272, 276).

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* See Page 22.

In "back-way" drifts, which are worked from a fast end, as many as eight rows are usual, (Figs. 72, 74, 79, 88, 90). There were as many as thirty rows in one instance which came under the writer's notice (Fig. 96); but such a long drift is not to be recommended.

There is usually very great regularity observed in setting these rows of posts, with occasional exceptions. (Fig. 26). The rows are kept from 27″ to 5′ 6″ distant from each other; the posts in each row being from 3′ to 5′ 6″, and sometimes 6′ apart.

2. LONGWALL METHOD.

There are some seams in which the roof is so good, and the gob so completely packed, that no timber is set in the drifts. (Figs. 28, 36, 38, 41, 46, 47, 68). Others there are in which a few posts are occasionally set. (Figs. 39, 204). In one seam a row of posts is set whilst holing only. (Fig. 43). In a few seams a row of posts on the gob side of the rails is considered sufficient. (Figs. 133, 231). In others two rows are kept in the wastes, and an occasional post between the top rail and the coal when too wide. (Fig. 120). The usual way is to keep either one (Figs. 113, 125, 138, 225) or two rows of posts (Figs. 130, 136, 163, 206) on the waste or pack side of the rails, and to place one row between the face and the rails. In one case two rows are placed between the rails and the face, and one in the waste. (Fig. 213). In some cases as many as four rows are set between the rails and the face. (Fig. 142).

Where the longwall face is carried forward in a level direction (Fig. 3), or where the face or "buttock" is kept wide (Figs. 49, 64, 66, 217), the same number of rows are set as in the Lancashire method. The rows of posts are usually from 4′ to as much as 6′ apart, and so are the posts in each row. The timbering is not everywhere so systematic as in the Lancashire method. In one or two instances, where only one row of posts is kept on the gob side of the rails, the posts are as near as one foot to each other. (Figs. 181, 281 and 194).

A special manner of setting the rows of posts is shewn in Fig. 210, and appears to recommend itself.

3. BANK AND PILLAR METHOD.

In one instance the roof is so good that no posts are placed next the face. (Fig. 8).

The rails are usually shifted every 5—6 yds., which necessitates 4—5 rows of posts between the rails and the face in each wall There is usually one row of posts on the gob side. (Figs. 146, 150, 160, 251).

The distances between the rows and the posts are as in the longwall method.

There are many cases, especially in the longwall method, in which bars, in combination with one (Fig. 118), two (Fig. 15), or three posts (Fig. 119), are set in drifts. In some cases where bars are necessary, room for a post to support it cannot always be made soon enough on the coal side of the rails. In such cases a temporary—foreset—post (Fig. 222) requires to be set.

Some workings (Figs. 33, 127, 230) require an assortment of posts of various lengths.

Too many rows of posts in a drift lessen the security, as will be explained in Chapter XIII., when dealing with timber drawing. It is possible to support a large loose mass of roof by a sufficient quantity of properly set posts, but the strength of the total support is equal to that of the least well timbered point in the drift, for the roof having once got a start at that point may catch the other posts sideways, and knock them out, however well they may be set. This is one amongst other reasons why falls of roof occur in drifts which are apparently sufficiently timbered, as in Figs. 156 and 157, and in Fig. 92.

The accidents described in Figs. 87, 92, and 257 shew that the number of posts, as ordinarily set, is in some cases not sufficient to keep up the roof.

A number of posts which would in some cases be adequate to support the roof when the drift is advanced quickly, prove insufficient when delays occur. Any prolonged cessation of work is detrimental to the timber, which is soon affected by roof and floor.

CHAPTER XII.

CHOCKS, STONE COGS AND PACKS.

CHOCKS.

These are wooden erections for supporting the roof. They are made either of round timber from broken or damaged posts (Fig. 234, 257), or of specially square cut pieces (Figs. 5, 106), laid, in pairs, crosswise over one another. They are used in gob roads and in drifts. The timbers forming chocks in gob roads are from 2′ 6″ to 5′, and even 5′ 6″ long. The inner space formed by them is filled with mine dirt.

The timbers forming those which are set in drifts are seldom longer than 3 feet. They have been, however, as long as 6 feet. The first pair is laid on a small heap of mine dirt, which facilitates the removal of the chocks, as it can be dug into. The space formed by the timbers is not filled with mine dirt.

Chocks which are built at the side of gob roads are left in, but those built in drifts are usually taken out and moved forward. (Figs. 102, 106). In one case some are left in the gob. (Fig. 5).

Chocks are extremely efficient supports, and a freer use of them would tend to reduce a certain class of accidents, such as the one described in Fig. 92, and the fall described in Fig. 271. The one illustrated in Fig. 257 would not have occurred had the chock been nearer the face.

Chocks are not often used in the steeper mines, except at the high side of levels, to assist the packs, and in jigs. (Fig. 154). They are then built against a post, which is removed after the chock is fastened by the roof. The same remarks as to the inclination of posts in steep mines apply to chocks.

STONE COGS.

Small cogs, usually called "Riflemen," are built as supports in some of the ironstone seams. They are made of pieces of stone or oilshale. (Figs. 3, 18, 258). Where the inclination of the seam is considerable a post is first set, and the stones then erected against it. They are topped with pieces of timber, to ease the pressure. (Fig. 4). The post is eventually removed and the stone recovered.

They are usually erected in conjunction with posts. (Fig. 254), but occasionally alone. (Figs. 11 and 12). They are generally from 18″—2′ 6″ square, but sometimes larger. (Figs. 175 and 178). These "Riflemen" do not give one the appearance of very strong supports; but where they are used the roofs are generally strong, and no accidents have occurred through their giving way.

PACKS.

Packs, which are chacteristic of the longwall method of working, are broad solid walls, built of rubble stone, at regular intervals to support the roof and to delay its subsidence. The intervening cavities are called "wastes." The number and size of the packs depends on the material available for the purpose. Where the seam itself does not produce "builders" they are often got from the roof when it breaks in the wastes. Where there is a scarcity of builders in a drift at starting, walls and cross-walls are sometimes built, as in Fig. 188, until the first weight occurs, which then supplies further packing material.

In flatter mines the first builders are sometimes brought from adjoining levels or other places in which suitable material is produced. At other times the roof is partly blown down to obtain the first builders, as shewn in Fig. 153.

Where builders are plentiful the packs should not be built too far apart. The accident illustrated in Fig. 157 occurred partly in consequence of the waste being so wide. Packs should be regularly formed and kept up to the face systematically.

CHAPTER XIII.

TIMBERING IN LEVELS AND DIPS.

Timbering in levels and dips requires to be more permanent than in drifts. In some cases, where the roof has to be stripped (or ripped) for height, or to get at a more solid stratum, it is allowed to settle first before the permanent timber is put in; some temporary timbering being put in meanwhile.

As in the drifts, so in the roads, the purpose of timbering is often not only to protect the workmen, but also to prevent the roads from closing in and interfering with traffic; this is especially the case in the softer strata.

The greatest pressure is usually from the roof; where the floor is soft a side pressure often accompanies the heaving action of the floor.

The ordinary combination of timbering consists of two legs (posts or stoops) and a bar (cap). It is known as "bond timber."* One leg is often dispensed with, and occasionally both, when the bar is called a "stretcher."

The bar is jointed to the posts in a variety of ways, more or less influenced by the direction of the pressure. The joints met with in North Staffordshire are represented in Fig. 285.

In C, E and K no provision is made for side pressure, except a slight spragging of the leg. In the other figures various ways of providing against side pressure are shewn.

A. The bar is cut so that the surfaces may rest closely on those of the pointed leg.

B and C. These are the same as A, except that the bar surfaces are independent of those of the leg, which is considerably spragged.

A, B and C are deteriorations of an efficient joint represented in Fig. 287 A, and frequently adopted where there is much side pressure. These arrangements are occasionally met with in the Kidsgrove district, and are not to be recommended.

D. The post is slightly lipped, or notched. This is the usual way throughout North Staffordshire.

E. The bar is slightly flattened, and the post soon squeezes into it. This is also usual where there

* Bond timber is often set in drifts, but without any jointing. (Fig. 223).

is no side pressure. In some cases the post is the least bit "hollowed out" and the bar untouched. Where there is a slight side pressure a bracket is sometimes fastened to the bar, as in M, until the post has been slightly squeezed into the bar by the roof pressure, when the bracket is generally removed.

F. The leg is hollowed out to receive the bar. Unless it is carefully cut, so as to ensure an even bearing, there is a possibility of the leg splitting. This plan is not usual.

G. This is the same as D, with the addition of a "stay" to resist side pressure. It is placed between the legs and soon fastened by the pressure, but is only occasionally met with.

H. Where the pressure is not great, and the roof breaks "short," large bars are frequently split; each half being used separately, and holding like "leather." This plan is not to be recommended, except in some cases to gain height.

I. The leg is here set back or spragged (6″ for a 6′ post), and the bar flattened to receive it.

K. Occasionally both leg and bar are cut slanting. This is a good joint, as neither bar nor legs are weakened by further cutting. It is well calculated to resist pressure from both roof and sides.

L. In a main road, where a thick bar is required, a hard lid is sometimes placed between the bar and the post, to prevent the latter being squeezed into the former.

M. This is the same as I, with the addition of a bracket secured to the bar by two spike nails when a slight side pressure is expected.

N. The bar and the legs are here cut rectangularly. This joint is in vogue in ironstone mines in the Silverdale district.*

O. This shews the influence of side pressure on the legs when not set back enough, or with a lifting floor.

As a rule, the simpler the joints are and the less cutting is done the better in every respect. Where a little cutting is advisable great care should be taken to make the surfaces bear evenly on each other. Iron nails should not be used for jointing.

Injured bars are often made serviceable a little longer by arrangements as shewn in Fig. 286, A, B and C.

A. Shews a "break" in the bar due to "lipping;" a foreset post is set to keep it up. This arrangement is possible only where the road is broad enough.

B. Explains itself.

C. A post is set in the middle of the bar. This is possible in a broad road; usually at "shunts."

D. A middle post is often set before the bar is affected; as in a junction between an engine dip and a level in the Cockshead Seam—Longton district.

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* The common method in the Freiberg metalliferous mines.

Fig. 287. A and B shew a complete bond timber arrangement. The legs are set back, owing to the heaving action of the floor.

A small plank or footlid is sometimes placed under the legs. (Fig. 287, C).

Bars and legs should fit closely against the roof and sides, except where the side pressure is considerable, when it is preferable not to place the bar "end tight," as they will last longer.

Bars should be tightened to the roof at the ends rather than in the middle.

Where the roof has come in there will often be a space over the bars. All such spaces, whether above the bars or behind the legs, should be closely packed (Fig. 287), or, if too large, there should be some further timbering above the bars. (Fig. 291). Where the space is not too large, as in Fig. 287, slabs (runners, coverers, lagging, poling) are placed over the bars, and the space filled with mine dirt. In some cases two or three layers of slabs (either round or flat) are placed crosswise above one another. It is also usual in some cases to lace the legs of two consecutive bond timbers together to prevent their moving. This is done by nailing an inch board near the top, called "lacing," which is either removed after a while or left. Where spaces intervene behind the legs boards (lagging) are placed behind them, to prevent their flying back.

Broken bars are generally left in for a time, but they are "lined" by new ones close to them.

When a leg has either to be replaced or reset, from its having been moved out at the foot or broken, another post (foreset) is first set under the bar, and afterwards removed. An accident described in Fig. 195 was caused by neglecting this precaution.

Bars supported by a post at one end only (Fig. 290, B), or by a short post (Fig. 290, C), are often sufficient. They are sometimes supported by two short posts. (Fig. 54).

Single bars or stretchers are much used. They are usually stamped at the lower side, as in Fig. 288, which represents a level. The thin end (*a*) of the bar is slightly sharpened and stamped, and the thick end (*b*) then knocked in sideways and wedged until it fits closely.

The bars are occasionally stamped in at the high side, as in Fig. 289, A and B, which represents elevation and enlarged plan of heading F, in Fig. 51.

Owing to the badness of the roof the headings are driven narrow, so that there is no room for a post on the high side. But as a post will be needed under the top end of the bar when the drifting reaches it, provision is made for this by stamping the bar at the high side at least 6″. A post may then be placed under the bar without removing it when the coal is drifted.

In a dip single bars are usually knocked in sideways from the high side (Fig. 290 A); where one leg is set, as in Fig. 290 B, it is often knocked into its place upwards.

The same considerations which apply with regard to the inclination of single posts in drifts also apply in the case of legs of bond timber, with this difference, that in dips the legs should be but very slightly underset. If too much underset the heaving action of some floors, to which they are exposed for a considerably longer period than posts in drifts, will gradually heave them straight up.

Fig. 292 represents the timbering of an air and travelling dip.

Where a wide dip is driven at a steep inclination, as in the Seven Feet Banbury, Silverdale district, two rows of posts are usually set. When the dip is completed, bond timber is set against each pair of single posts, on the high side, and these help to support the bars until the weight has fastened them. The single posts are generally left in after that object is attained, as they support the sleepers of the jig rails.

In the case of plumb rearer seams (Fig. 293), in which the seam is vertical, the timbering of dips has to be regulated by the fact that the weight of the coal roof acts vertically, or in the direction of gravitation. The legs *a* are consequently much underset, and in case a good foothole can be secured, as at *b*, nearly upright.

The protection of the sides, especially the high side, is very important where the seams are much inclined. This is usually done by setting posts at the high side, and placing slabs (lagging, Fig. 287) behind them. Fig. 84 shews such an arrangement. In this case the post is so long that, unless supported in the centre by a stretcher stamped in the rock roof, it would bulge out in the middle. Fig. 53 also shews how part of the side has to be slabbed. It was from a want of this precaution that the accident illustrated in Fig. 101 occurred.

Fig. 294 represents a method of keeping back the high side in a level with a strong roof.

A good arrangement for saving timber, in vogue in the Sheath Mine, Silverdale district, is shewn in Figs. 295 A and 296 A, in which a stone cog has to be supported on the high side of a level. The roof is very strong and the floor lifts and breaks the posts set to support the cog. (Fig. 295 B). By setting every second post as shewn, 12 inches from the roof, and supported by a stretcher well stamped into the roof, they are gradually heaved up into permanent position (Fig. 296 B) without breaking.

Posts are stamped considerably more in dips and levels and all permanent places than in drifts.

CHAPTER XIV.

DRAWING TIMBER.

Timber drawing, and that which goes hand in hand with it, cutting down the tops in thick seams and removing or loosening coal posts in some seams, is attended with more risk than any other underground occupation. There are seams in which, owing to their nature and the method of working which it is possible to adopt, the risk is reduced to a minimum, but ordinarily the risk is great, and under some conditions, and with methods of working which certain seams necessitate, it is considerable

The principal object in drawing the back timber in most coal seams, and of partially recovering or breaking up coal posts which are left behind in some methods of working, is to enable the roof to settle equally and to relieve the weight at the face, which would otherwise become excessive.

Where the back timber is drawn, and the roof thereby allowed to weight in the wastes, it acts as a lever, of which the fulcrum lies over the end of the holing (underholing), and exerts a slight, but beneficial pressure at the face of the coal. But if the back timber is not drawn the weight is thrown back on to the face in considerable excess, and holds the coal fast, making it more difficult to get. In some instances it will cause the roof to break above the end of the holing, thereby removing the beneficial leverage off the next lift.

Accidents have occurred from the back timber having been left in too long (Figs. 156 and 157), and though timber drawing is dangerous, if the timber were left the danger would increase considerably, quite irrespective of the waste of timber which this would entail.

Timber which has been drawn can generally be used again several times, and, if broken, serves for lids and, in some cases, for chocks.

The effect of the weight being thrown on to the face is felt more in some seams than in others, according to the nature of the roof. It is, as a rule, not only necessary to take the back timber out, but the removal should be made as quickly as possible, always allowing sufficient timber at the face where the men are working.

In working some of the ironstone seams the timber is left and not drawn, and there is no appreciable effect felt at the face. (Figs. 7, 5). In working the Sheath Mine (Fig. 36) the weight of the roof helps to get the stone.

If posts are left in the waste too long they become difficult to draw, as the combined action of the floor and of the roof tighten them very soon. Posts nearest the gob require much longer time to draw, as they have been longer exposed to this action ; this applies still more to bond timber.

In the face-way drifts (Silverdale district) the timber can be drawn regularly, and a back row drawn after a front row has been set ; but in back-way drifts the timber has to be all drawn after the drift is completed, and this operation is considered the most dangerous.

It requires great judgment and experience to know in what order the posts in particular wastes should be drawn. It may be necessary to leave two or three behind, for the purpose of recovering the others with a little more safety. A damaged post, very tightly stuck, is generally left. The timber is not drawn where the roof is too dangerous. Sometimes taking out one post starts the roof, which then falls, bringing a number of other posts with it. Thirty have been known to come down in this way in the 7 ft. Banbury Seam. In seams of steep inclination, and worked by the Lancashire method, the lowest posts in each row are usually drawn first. Not more than one post should be drawn at a time, and there should be complete silence whilst this is being done. There should never be less than two or three men to draw timber, or to be present whilst this is done.

It is very interesting to watch two or three experienced men drawing timber together; they work with remarkable readiness and quickness, and well into each others hands; they know when to make a push and when to hold back.

A certain percentage of timber is lost throughout, which is as high as 50°/。 in the bank and pillar work, shewn in Fig. 251. It is lowest in pure longwall.

Timber is drawn in several ways. The tools and appliances used for this purpose are shewn in Fig. 301. The first thing is to loosen the post This is done either at the foot or at the head, according as to which is easier. The pick is used for this operation, and sometimes a crowbar or drill. If the foot is not too much buried the floor is generally removed all round it. In case the foot is difficult to get at, the roof is cut along or over the lid, or the lid is split. Some posts require very little loosening. After the post has been loosened the actual drawing takes place. With a pretty safe roof, the post is knocked out with a hammer, after all loose pieces have been pulled down from the roof, and removed by hand. Where the roof cannot be trusted the man jumps back immediately after having dealt a blow at the head of the post. If unsuccessful, he repeats this until the post falls, waiting and listening a little between each try. He or his mate then generally sticks his pick into the post and drags it out, and in this way he avoids placing himself under the portion of roof which is now unsupported. The lid, if possible, is recovered in the same way. In many cases the post, after having been loosened with a pick, is loosened still further by hammering, after which a dog and chain is applied from another post at a safe distance, and the post levered out with safety. In some cases, where the foot is inaccessible, from its being surrounded with pieces of broken roof, or where the floor has lifted all round it to a considerable height, the post is cut with a sharp axe where exposed, if this can be done without shaking the roof. In others, if the head of the post only is accessible, a dog and chain is applied to it in such a way as to draw it up. The chain is slung round the post and forms a noose, into which the end of the dog is inserted. The dog rests on a post placed horizontally near the one which it is intended to draw. The greater the force exerted to lift the post out the tighter is the grip of the chain.

An additional help is in use at a large colliery in the Norton district, and the writer thinks might be used in many cases with advantage. It consists of a rope 7 yds. long, with a hook to it. The end with the hook is lashed round the post which is to be drawn, and the other end is securely fastened to a firmly-set post at some distance to the rise. (Fig. 252 and 301). After the post has been sufficiently loosened, or whilst it is being hammered, or whilst the dog and chain are being applied, a sudden jerk produced by one or two men throwing their weight on to the tightened rope will materially help to draw the post, and drag it out immediately whilst the men are out of danger.

In the Silverdale district in some seams of an inclination of about 45°, where the floor is pretty soft, the foot of the post is exposed on the high side by removal of the floor with a pick, and the post knocked at the head upwards with a wooden mallet. (Figs. 81 and 301).

Timber drawing in connection with falling and cutting down top coals requires more care than ordinary timber drawing, inasmuch as the object is not only to draw the timber, but also to get out as much coal as possible.

In the Bullhurst Seam in the Silverdale district (Figs. 96 and 97), the tops are cut up to the roof on the high side next the small rib which is usually left, and on the lower side for a distance of a few yards, generally to a slip. The lids are loosened by picking the coal around and above them, and the posts are then sometimes battered out from a distance, by throwing a post against them. If the removal of the posts does not bring down the tops a wedge is applied in the roof at a slip, and hammered in until they drop. In some cases a plug and feathers are used for this purpose. Volumes of dust are produced by even a small fall of tops. The tops are not dropped at a greater rate than about one yard a day.

Bond timber is more difficult to draw than single posts. The legs have often to be sawn at the foot before hammering at them, and ringers have to be applied between the bar and the roof to get it down.

CHAPTER XV.

CUSTOMS WITH REGARD TO SETTING AND DRAWING TIMBER.

There are four distinctive systems of immediate supervision over the men, with which the custom of drawing and setting timber is more or less interwoven.

1. The whole pit, if small, and each seam or large district in an extensive colliery, is let to a set of butties, usually by the ton.

The butties generally sublet each drift or other working place to two or three colliers, who either employ a loader only, as in the Lancashire method of working; or several hands, as in the third system, which is usual in the longwall method of working.

The butties, or men in their pay, perform the duties of firemen; they are expected, not only to look to the forwarding of a large output, in which they are immediately interested, but also to look to the safety of the men.

At some collieries a few main air road men are kept, and paid by the owners, but the butties are responsible for the air ways in the workings.

The butties pay their men by the ton or by the day. Yardage is paid either by them or by the owners. In difficult places, where colliers or driftmen are unable to make an ordinary day's wage, they are occasionally paid day wage, about 4/- at present, but drift work is generally paid by the ton, except at a few collieries in the Kidsgrove district.

2. Districts are let to a set of butties, much in the same manner as in 1, but there are one or more firemen appointed and paid by the owners, who are independent of the butties. In such cases the butties do not act as firemen, but they are expected to assist the firemen in seeing that the work is carried on safely.

3. Drifts or walls and other places are let directly by the owners to two or more colliers, who contract for the work, and are called contractors or driftmen. They employ their own holers, loaders and other hands, and in a few places the taker off at the jig.

One of these contractors is considered the leading man or chargeman of the drift, and it stands in his name. The contractors are paid by the ton, and at some collieries they receive allowances for moving the landing and for building "carving" or air road packs, but these are now being much discontinued. The contractors pay their men by day wage and the holers generally by stint.

4. There is little, if any, gang work. Each man or couple of men are paid separately for work done.

In the two last systems the firemen are appointed and paid by the owners, as in the second system.

These systems predominate in the order in which they are placed.

The driftmen and colliers are supplied with timber at the face, either by the owners or the butties. Where the butty system prevails the butties are either supplied with timber at the pit bank free of cost, or it is sent down to them. In some cases they have to buy their timber, which they usually do from the owners, from whom they can buy small quantities at a time cheaper.

In all these systems it is customary for the timber to be set in working places by men who are also engaged in coal getting. At collieries where the first or second system of supervision prevails, and where the Lancashire method of working is in vogue the two or three colliers in a drift each set their timber equally. Where there are more men in a drift, and the third system prevails, as in the longwall method of working, the coals are fallen by the chargeman (buttocker) or another contractor, who also sets the necessary timber as they go along; the holers set their sprags only, occasionally assisting to set posts when working by day wage. For this purpose they have axes, saws and other tools near at hand, which enables them to shape the timber to their requirements; this however will not often be necessary, as suitable lengths are generally sent down.

Though it would seem as if there must be some occasional reluctance on the part of colliers who are paid by contract to have to stop getting coal for the purpose of setting timber, there is remarkably little evidence to that effect, except where the roof is very strong and timber seems unnecessary. Setting timber is a change of occupation and position, which is generally looked upon as a relief. The cause of any reluctance to set timber is, of course, removed where the men are paid day wage.

Considering the great variety in the character of the seams, in their thickness and inclination, and in the methods of working which they entail, as well as the difficulty of travelling the steeper seams, the custom which prevails for coal getters, who are usually leading men, to set the timber in working places, appears to the writer to be the best for this coalfield.

Single posts and sprags are set without any remuneration in the drifts and working places, but an allowance is usually made for setting bond timber.

In systems 1 and 2 the butties timber the roads (dips and levels), the necessary timber for this purpose being generally found by the owners, and engage colliers to help them, paying them specially for it. At some collieries there are a few datallers paid by the owners, who help the butties in exceptional places. At others the butties keep a few special timberers (datallers) to set timber, and they occasionally assist the men to set timber in the working places.

In the other systems the owners employ a special staff of road timberers. The timber is generally drawn either during working hours when coal-getting from the particular drift ceases for the time, or after working hours At some collieries under the first system the butties draw the timber themselves, or help the leading men to do so.

It takes about 5—6 hours and more to draw the timber in a wall, as in Fig. 251. If the leading men of the wall are not available some other good men are chosen to help the butties. They receive extra pay for timber drawing when working overtime.

CHAPTER XVI.

GAS PRESSURE IN THE COAL AND IN THE ROOF IN RELATION TO THE CLASS OF ACCIDENTS IN QUESTION.

Gas often occurs in coal seams in such a condensed condition that it issues out of the coal with considerable force, accompanied by detonation and projection of fine coal dust, and in some cases of pieces of coal large enough to slightly injure men at the face. The issue of gas from the face of coal may be so rapid as to become what is called an "outburst." Outbursts of gas from the face are often accompanied by projection of coal, which may cause serious injuries to the workmen.

An outburst or sudden expansion of carbonic acid gas (an exceedingly rare occurrence with that gas, but frequent with firedamp) occurred in a French colliery,* and was accompanied by the displacement of 75 tons of coal, under which one of the three men who were killed on that occasion was found buried.

* The accident referred to has been described by the writer before the North Staffordshire Institute of Engineers.

The pressure exerted on coal seams during or subsequent to their solidification may have forced gas out of them into their roofs or floors in proportion to the porosity of these strata, and to the occurrence in them of joints or cracks, or other openings favourable to its admission. As the coal is removed in the workings this gas exerts a downward pressure on the rock substances which contain it and form the roof, and so tend to hasten their fall. This pressure may be increased, or solely produced, by the gas in an overlying seam of coal or layer of carbonaceous shale. On the rocks being exposed this pressure gradually diminishes, according to the facility which they present to the egress of the gas. Any hindrance to the outflow of gas due to the presence in the roof* of a stratum which, by reason of subsequent changes imparted to it, becomes more or less impervious to gas, will cause an accumulation of gas pressure above it which may result in sudden falls of various sized portions of roof, accompanied by outbursts of gas.

Holes, from 3′—6′ deep, are frequently bored in the roof† in fiery seams, with a view to diminish its tendency to break down from this cause. By liberating the gas the pressure is relieved, and the roof is less liable to break down. This has been done at times in the Ash, Moss, Four Feet and Ten Feet Seams, with greater or less success.

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* The same remarks apply to the floor in which outbursts of gas have caused upheavals, often so sudden as to occasion projections of pieces of the floor, which in a few cases have injured workmen who were within reach.

† In the floor too occasionally, but then exclusively, with a view to guard against sudden outbursts of gas.

CHAPTER XVII.

ATMOSPHERIC INFLUENCE ON ROOFS AND SIDES.

The action of the atmosphere must be regarded:

1. As to its disintegrating or "weathering" effect on the roof.

The action of moisture on some strata is best understood when it is known that holing is facilitated by water being thrown on to the holing dirt, and that this is pretty often resorted to. In the same way atmospheric vapour condensed by coming in contact with strata colder than the air which conveys it may have a loosening effect on them. This is more likely to be the case in summer with shallow mines and unextended workings, as the air then contains more moisture, and becomes rapidly cooled on entering the mine; nor does it regain its former temperature in the workings, as it would do if they were more extended.

2. As to the pressure exerted by it on gas-containing strata.

Atmospheric pressure is so small compared to the pressure exerted by gas on the strata which contain it that any diminution in its amount can have very little influence in determining either a projection of the face or a fall of roof. It is, however, conceivable that a sudden diminution of atmospheric pressure may, in cases where gas pressure has accumulated in the roof, as mentioned in Chapter XVI., produce falls of roof sooner than under ordinary circumstances.

CHAPTER XVIII.

CONCLUDING REMARKS ON ACCIDENTS.

The following table shews the number of accidents and deaths which have resulted therefrom in North Staffordshire during the last four years.

It appears from these statistics that a yearly production of 6,402,782 tons of coal, fireclay, ironstone and shale entails at present the loss of 12 lives by explosions, 17 lives by falls of roof or sides and 17 lives from other causes, as well as more or less severe injuries to 8 persons by explosions, to 126 persons by falls of roof and sides, and to 149 persons from other causes. This shews that falls of roof and sides are a far greater source of accidents even than explosions.

NORTH STAFFORDSHIRE.

Year	Total persons employed in and about the Mines	Tons of Mineral Wrought.					Total fatal Accidents	Deaths caused by them	Fatal Accidents by falls of roof & sides only	Deaths caused by them	Fatal Accidents by explosions of firedamp only	Deaths caused by them	Fatal Accidents from other causes	Deaths caused by them
		Coal	Fireclay	Ironstone	Shale	Total Tons								
1881	15,580	4,074,800	4,000	1,622,500	19,000	5,720,300	31	66	14	15	4	38	13	13
1882	18,267	4,892,000	12,000	1,887,120	17,500	6,808,620	39	41	17	18	1	2	21	21
1883	17,993	4,862,000	20,110	1,682,600	21,000	6,585,710	30	38	12	12	2	9	16	17
1884	16,717	4,667,700	19,500	1,783,800	25,500	6,496,500	37	38	22	22	...	...	15	16
Total	68,557	18,496,500	55,610	6,976,020	83,000	25,611,130	137	183	65	67	7	49	65	67
Yearly Average	17,139	4,624,125	13,902	1,744,005	21,750	6,402,782	34	46	16	17	2	12	16	17

PERSONS INJURED BY NON-FATAL ACCIDENTS.

Year	Total persons injured	By falls of roof and sides			By firedamp explosions	From other causes
		Roof	Side	Total		
1881	292	43	64	107	12	173
1882	265	49	80	129	7	129
1883	306	Not made out		136	7	163
1884	270	72	60	132	4	134
Total	1,133	..	...	504	30	599
Yearly Average	283	...	...	126	8	149

Accidents from falls of roof and sides occur in various ways, of which the principal are the following, some of these having already been remarked upon :—

I. FROM SIDES AT FACE.

1. Whilst holing—

By insecure spragging, under peculiar conditions ... ... Fig. 45

By insufficient stamping of sprags ... ,, 94

By improper setting of sprags in steep mines ... ... ,, 237

By breaking of overhanging coal over sprags ... ... ,, 130

By passing in front of the coal after having drawn the sprags ... ... ,, 268

By dislocation of adjoining piece of coal through concussion produced by a shot ... ...

Whilst resetting a sprag ... ...

By a fall of bottom stone whilst preparing to hole, and neglecting to sound the face ... ... ,, 10

2. Whilst pulling down coal or stone at a steep inclination ... ... ,, 98

By injudiciously standing in front of the coal ... ... Figs. 83 & 250

By working at the coal when only half fallen ... ...

2. FROM ROOF AT FACE.

From visible slips... ... ... Figs. 231 & 267

,, invisible (leaning) slips ... ,, 87 & 269

From beginning to hole without previously securing the roof	Figs. 10 & 172
,, slips, whilst pulling down an unsafe piece	,, 24
,, insufficiently supporting the roof when starting a longwall drift from pillars	,, 174
,, not setting foreset posts as soon as there is room ...	,, 222
,, not properly posting top coal	,, 106
,, incautiously cutting top coal	,, 169
,, not supporting the roof at top of jig	,, 135
,, not immediately supporting the roof after firing a shot	,, 233
,, removing a post without previously setting another	,, 282
,, insufficiently supporting the roof whilst finishing a drift near faulty ground and by the giving way of the posts	,, 257
,, not setting posts nearer to the face than 6 ft. whilst slicing an old pillar with gob on three sides ...	,, 253

From reeling out of several posts whilst slicing a pillar ... Fig. 92

,, not drawing the back timber, owing to the waste being too wide ... ... ,, 157

Whilst timber drawing ... ...

,, robbing gob pillars in post and thurl ... ... ,, 161

,, incautiously entering a gob for examination or for getting stones to pack with ... ...

,, setting timber ... ...

3. FROM SIDE IN ROADS.

From not protecting high side of level or dips in steep mines ... ... Fig. 101

4. FROM ROOF IN ROADS.

Whilst loosening a post in a level without previously setting a foreset post under the bar ... ... Fig. 195

,, robbing coal in a dip near a fault to make up a load ... ...

,, setting timber ... ...

,, riding in an empty or upon a full tub by its getting off the rails and striking a post with sufficient force to draw it from under the bar ...

There are fewer accidents from falls of side in the flatter than in the steeper seams, but more accidents from falls of roof. There are more accidents from falls of roof whilst robbing pillars than when working a longwall face in the flatter mines.

As regards the use of candles or good glass lamps* in connection with falls of roof and sides, there are quite as many accidents with the former as with the latter. Where Davy lamps are used it may be more difficult to see slips in the roof owing to the small amount of light which these lamps give.

Bad trade and other causes leading to partial cessation of work and consequent slow extension of the face in working places may account to a small extent for an increase of accidents from falls of roof and sides and a diminution of those by explosions, as was the case in the year 1884. Gas does not issue into the workings at so great a rate, but the men do not get under new roof so fast.

Though the greater the depth the greater is the weight and crush of the roof, which often necessitates frequent renewal of timber in permanent roads; the writer has been unable to trace an increased number of accidents from falls of roof with an increase in the depth.

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* Typical Mueseler or Marsaut.

CHAPTER XIX.

RULES FOR TIMBERING.

From many years' observation of the nature of accidents from falls of roof and sides the writer is of opinion that the only way to reduce the number of these accidents is to establish rules for timber setting at every colliery, prescribing definite maximum distances and other matters in connection with timbering and packing. The only definite rule in connection with timbering in force in North Staffordshire is the one prescribing a maximum distance of six feet, which is not to be exceeded in setting sprags. This rule has worked admirably; the accidents from falls of coal and stone which occurred so often formerly whilst the men were holing being now considerably reduced in the flatter mines. The writer rarely finds this distance exceeded.

All rules in connection with timbering must be based on the method of working, the nature of the roof and the inclination and thickness of the seams. These differ considerably, even at the same colliery and at times in the same seam.

These rules should be made by the manager, to the best of his ability, in conformity with the experience which he gains of the seam, and should be liable to alteration at any time in accordance with altered conditions or evidence of insufficiency. On the occurrence of an accident, measures of precaution which would have prevented it should be incorporated in the rules, and the frequent repetition of accidents from the same causes in other parts of the mine would thus be avoided. They should specify, as far as possible, the manner in which the timber is to be set; the number of rows of posts; the maximum distance between these rows and between the posts, and the occasions when temporary posts are required whilst dressing the face. They should describe, if possible, the manner of drawing the back timber and state the time during which it should be drawn. Posting at or near slips and faults should be compulsory, and a post should not be removed at the face without another being previously set near it. Rules to this effect have lately been established at a few collieries, and found to work well. A few of these are appended to show the manner in which they were written out.

RULES IN RED MINE. (Fig. 258).

1. One row of posts to be kept between the face and the chocks.

2. The distance from one post to another not to exceed eight feet and from the posts to the face not to exceed six feet.

3. If a post is knocked out it must be reset at once.

4. Where packing material is scarce wooden chocks are to be placed along the roads at distances not exceeding four yards from each other.

RULES IN HOLLY LANE. (Fig. 236).

No portion of the roof is to be further than three feet from a support; the following to be considered as supports :—

1. The centres of the posts.
2. The unholed face.
3. The edge of a close pack.
4. The sides of a timber chock.

RULES IN HARD MINE. (Fig. 247).

There shall never be less than three rows of posts next the coal face, not more than 4′ 6″ apart. Immedately a web* of coal has been got out the back row of posts shall be knocked out and set between the two front rows, or next the coal face, according to the directions given by the manager, underviewer, or deputies. Each post to be set with a good lid next the roof.

The stallmen shall carry on and maintain their stalls in a thoroughly safe and proper manner, and according to the directions given to them by the

* Buttock.

manager, underviewer and deputies. They shall build gate or jig packs three yards wide on each side, and waste packs every four yards.

RULES FOR MOSS SEAM. (Fig. 217).

In going in:

1. Stretchers must be placed from the top posts to the face before holing.

2. There shall be a row of posts on either side of the rails, not more than 4′ 6″ apart. The posts in each row shall not be more than 5′ apart.

3. Where slips are seen in the roof, or if it otherwise appears dangerous, bars shall be set against it at intervals of not more than 6′; and a post shall be set half way between the bars on either side of the road. The bars may be either stamped in the coal or supported by a post, or both, at the face; but they must in every case be supported by a post on the lower side.

4. A temporary post, not more than 3′ in advance of every bar (3), or set of posts (2), shall be set in every case in the middle of the road. It shall not be removed until (in 3) the next bar and the two posts on either side of the road or (in 2) the further set of posts have been set.

In coming out:

5. There shall be three rows of posts on the high side of the rails, not more than 3′ 6″ apart. The posts in each row shall not be more than 5′ apart. The

topmost row (which supports the stretchers, in going in) shall not be more than 1′ from the face at the floor.

6. Packs shall not be less than 3 yds. wide, and not more than 5 yds. apart. The edge of the pack shall not at any time be more than 12′ from the face.

7. There shall be lids on all the posts, not less than 18″ long.

The enforcement of such rules, which should be posted up in a conspicuous position, accessible to all workmen, would not only ensure regularity and discipline, but would indicate to fresh workmen the best and most approved manner of keeping themselves safe in seams in which they may perhaps have had no experience.

Only maximum distances can, of course, be prescribed. It will frequently be necessary to set timber over and above the requirements of the rules. The erection of these additional supports must be left to the discretion and judgment of those immediately employed, who alone are cognisant of the momentary changes which the roof and sides present. They should, however, be subjected to a thorough system of supervision on the part of qualified firemen.

CHAPTER XX.

DIVISIONS OF THE NORTH STAFFORDSHIRE COALFIELD, WITH MAP.

The following are the five divisions which a clear arrangement of the seams necessitates.

1. Silverdale. The western division, which extends to the large fault (90—100 yds.) running from Butt-lane, near Talke, by Bradwell Wood, east of Newcastle, and known as the High Carr fault. This division consequently includes the following collieries along its eastern boundary:—

1. Bunkershill.
2. Jammage.
3. High Carr (Williamson's).
4. Park House.

2. Longton. The southern division, extending to the 90 yds. fault, running from east to west, south of

Hanley. This division consequently includes the following collieries on its northern boundary :—

1. Ubberley.
2. Holly Greaves.
3. Berry Hill.

3. NORTON. The eastern division, lying between :

1. The last-mentioned fault.
2. The large fault forming the eastern limit of the Silverdale division.
3. The sudden turn of the measures to the north in the Biddulph Valley, which is accompanied by dislocations, faults and roles and a change not only in the direction but in the amount of dip.

This division consequently includes the following collieries :—

At its southern boundary—

1. Lillydale.
2. Northwood.
3. Shelton.

At its western boundary—

1. Shelton.
2. Grange.
3. Brownhills (in part).
4. Tileries (old pits).

At its north-western boundary—

1. Clanway.
2. Turnhurst.
3. Newchapel

4. Thursfield (in part).
5. Wedgwood.
6. Brown Lees.
7. Black Bull.
8. Bradley Green (in part).
9. Yew Tree.
10. Two small collieries adjoining,

4. Kidsgrove. The northern division; bounded to the west by the High Carr fault, and to the east by the bend formed by the sudden turn of the measures which forms the north-western boundary of the Norton division. It consequently includes the following collieries:—

At its western boundary—

1. Woodshutts.
2. Hollinswood.
3. Mitchells Wood.
4. High Carr Co.

Along its south-eastern boundary—

1. Brownhills (in part).
2. Tileries (new pits).
3. Chatterley.
4. Tunstall.
5. Goldenhill.
6. Trubshaw.
7. Thursfield (in part).
8. Stone Trough.
9. Tower Hill.
10. Bradley Green (in part).

5. Cheadle and Ipstones.

MAP OF THE

NORTH STAFFORDSHIRE

COALFIELD.

SCALE: 1 inch = 2 miles.

NAMES OF WORKABLE SEAMS IN THE FOUR DISTRICTS PLACED IN APPROXIMATE JUXTAPOSITION.

SILVERDALE DISTRICT

Group	Workable Seams	Approximate distance between the seams in yards
Blackband carbonaceous Ironstones	Blackband Ironstone	
		12—13
	Red Shagg do.	
		19—22
	Red Mine do.	
		40
	* Bassey Mine do.	
		40
	* Peacock Coal	
		42
	* Spencroft Coal	
		26
	Black Bass Ironstone	
		0
	Cannel Mine do.	
		0
	Cannel Mine Coal	
		23
Lean Clayband argillaceous Ironstones	Little Mine Coal	
		8
	* Gubbin Ironstone	
		7
	Sheath Mine do.	
		0
	* Blackstone do.	
		14
	* Rusty Mine do.	
		19
	Chalky do. do.	
		13
	Little Mine do.	
		13
	New Mine do.	
		23
	* Brown Mine Coal	
		0
	Brown Mine Ironstone	
		40
	* Thick Band do.	
		21
	Gold Mine do.	
		20
	* Ash or Rowhurst Coal	
		18
	* Burnwood Ironstone	
		0
	* Burnwood Coal	
		9
	* Twist Coal	
		125
Open burning House Coals	Single Four Feet Coal	
		14
	Single Two Feet Coal	
		9
	Single Five Feet Coal	
		24
	Ragman Coal	
		7
	Rough Seven Feet Coal	
		4
	Hams Coal	
		74
	Ten Feet Coal	
		18
	Top Two Row Ironstone	
		0
	Top Two Row Coal	
		13
	Bottom Two Row Coal	
		102
Bituminous Coals	Seven Feet Banbury Coal	
		37
	Eight Feet Banbury Coal	
		51
	Bullhurst Coal	

LONGTON DISTRICT

Workable Seams	Approximate distance between the seams in yards
Bassey Mine Ironstone	
	20
* Peacock Coal	
	7
Spencroft Coal	
	27
Great Row Coal	
	14
Cannel Row Coal	
	60
* Deep Mine Ironstone	
	20
Chalky Mine Ironstone	
	58
Ragmine do.	
	28
Knowles Coal	
	44
Knowles Ironstone	
	41
Rider Coal	
	15
Ash Coal	
	26—40
Little Mine Ironstone	
	0
Little Mine Coal	
	20
Twist or Gin Mine Coal	
Moss Coal	
	67—69
Yard Coal	
	28—33
Birches Coal	
	80—85
Ten Feet Coal	
	33—38
Bowling Alley Coal	
	23
Holly Lane Coal	
	21
Hard Mine Coal *A*	
	12—15
New Mine Coal *B*	
	47
* Little Mine Coal	
	38
Banbury Coal	
	36
Cockshead Coal	
	60
Bullhurst Coal	
	23
* Winpenny Coal	

NORTON DISTRICT

Workable Seams	Approximate distance between the seams in yards
Half-yards Ironstone	
	20
Red Shagg do.	
	41
Red Mine do.	
	53
Hoo Cannel { Coal, Ironstone, Marl }	
	30
Bassey Mine Ironstone	
	9—17
Peacock Coal *K*	
	21—36
Spencroft Coal *L*	
	16—19
Gubbin or Cannel Mine Ir.	
	0—11
Great Row Coal	
	11—13
Cannel Row Ironstone *C*	
	0
Cannel Row Coal *D*	
	40
Pennystone Ironstone	
* Chalky Ironstone	
* Chalky Coal } New Chalky Ironstone }	38
Bungilow Coal	
	80
Lady Coal	
	1
Winghay Coal	
	15
Winghay Ironstone *E*	
Big Mine Coal	
Chance Band Ironstone	
	12
Brown Mine do.	
Rider Coal	
Rowhurst Coal	
	55
Burnwood Ironstone *O*	
	0—2
Burnwood Coal	
	6—7
Twist Coal	
* Birchenwood Coal	
Mossfield Coal	
Yard Coal	
	6
Ragman Coal	
Old Whitfield Coal	
Stoney Eight Feet Coal *F*	
Ten Feet Coal	
	47
Bowling Alley Coal *G*	
	12
Holly Lane Coal	
	34
Hard Mine Coal	
	121
Banbury Coal *H*	
	63
Cockshead Coal *J*	
	120
* Bullhurst Coal	

KIDSGROVE DISTRICT

Workable Seams	Approximate distance between the seams in yards
Half-yards Ironstone	
	20—21
Red Shagg do.	
	18—25
Red Mine do.	
* Oil Shale }	76
Bassey Mine do.	
	13
* Peacock Coal	
	24
* Spencroft Coal	
	26
* Great Row Coal	
	10
* Cannel Row Coal	
	25
* Blackstone Ironstone	
	43
* Chalky Ironstone	
	32
* Little Mine Ironstone	
	16
Winghay Coal	
	13
* Winghay Ironstone	
	19
* Big Mine Ironstone	
	19
* Brown Mine do.	
	34
Green Lane Two Row Coal	
	27
New Mine Ironstone	
	20
* Pottery Coal	
	108
* Birchenwood Coal	
	13
* Little Row Coal	
	12
* Yard Coal	
	22
* Four Feet Coal	
	6
* Ragman Coal	
	12
Rough Seven Feet Coal	
	31—41
Stoney Eight Feet Coal	
	24—38
Ten Feet Coal	
	31—65
Two Row or Big Row Coal	
	2—12
Bottom Two Row Coal *M*	
	19—40
* Bowling Alley Coal *N*	
	85—110
Seven Feet Banbury *H*	
	25—40
Eight Feet Banbury *J*	
	93
Bullhurst Coal	
	22
* Winpenny Coal	

CHEADLE AND IPSTONES DISTRICT

Workable Seams	Approximate distance between the seams in yards
Two Yard Coal	
* Yard Coal	
* Letley Coal	
* Four Feet Coal	
Cobble Coal	
Woodhead Coal	
* Stinking Coal	
	24—30
Red Hydrate Ironstone (Haematite)	

* are not being worked at present.

A also called Sparrow Butts.

B ,, ,, Stinkers.

C ,, ,, Half-yards.

D ,, ,, Little Row.

E ,, ,, Rusty Mine.

F ,, ,, Bellringers.

G ,, ,, Magpie.

H also called Froggery or Frogrow.

J ,, ,, Newpool.

K miscalled Spencroft } in places.

L ,, Ten Feet } in places.

M also called Little Row.

N properly Hard Mine.

O includes New Mine Ironstone.

TABLE OF INCLINE MEASURES.

No. of Degrees	Inclination per yard in inches	One in
1	·63	57·29
2	1·26	28·63
3	1·88	19·09
4	2·51	14·29
5	3·15	11·42
6	3·78	9·51
7	4·42	8·14
8	5·06	7·11
9	5·70	6·31
10	6·34	5·67
11	6·99	5·14
12	7·65	4·70
13	8·31	4·33
14	8·97	4·01
15	9·64	3·73
16	10·32	3·48
17	11·00	3·27
18	11·69	3·07
19	12·39	2·90
20	13·10	2·74
21	13·82	2
22	14·54	2·47
23	15·27	2·35
24	16·02	2·24
25	16·78	2·14
26	17·56	2·05
27	18·34	1·96
28	19·14	1·88
29	19·95	1·80
30	20·78	1·73
31	21·62	1·66
32	22·49	1·60
33	23·37	1·54
34	24·28	1·48
35	25·20	1·42
36	26·15	1·37
37	27·12	1·32
38	28·12	1·28
39	29·14	1·23
40	30·21	1·19
41	31·29	1·15
42	32·41	1·11
43	33·56	1·07
44	34·76	1·03
45	36·00	1·00

SCALE OF FIGURES.

1. From Figs. 1—284.

   Plans : 8 yards to 1 inch.
   Sections : 44 inches to 1 inch.*

2. From Figs. 285—300.

   44 inches to 1 inch.*

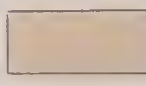
3. Fig. 301.

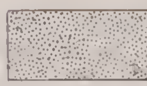
   11 inches to 1 inch.

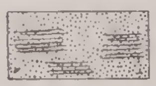
INDEX OF COLOURS.

COAL. { Full Thickness 

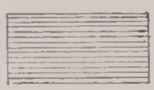
COAL. { Part 

IRONSTONE. 

SANDSTONE. 

ROCKBINDS. 

CONGLOMERATE. 

SHALE. 

CLAY. 

* The divisions of this scale are as on the 2 chains to 1 inch scale.

SILVERDALE DISTRICT.

FIGS. 1—101.

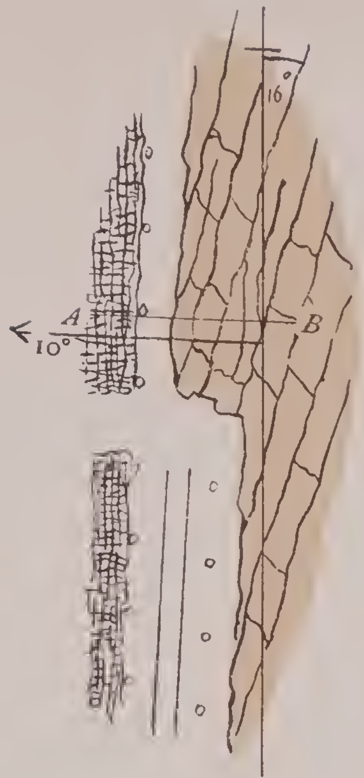


FIG. 1.

Figs. 1 and 2. Plan and Section S.E. Longwall with as long faces as possible. Gob almost entirely packed with dirt and coal. Joints pretty regular from 3′—4′ apart run through roof, hence direction of face of drift (page 13). Westwards the stone has a uniform thickness of 16″ and the coal of 20″—21″, the roof above the shale is hard and gritty.

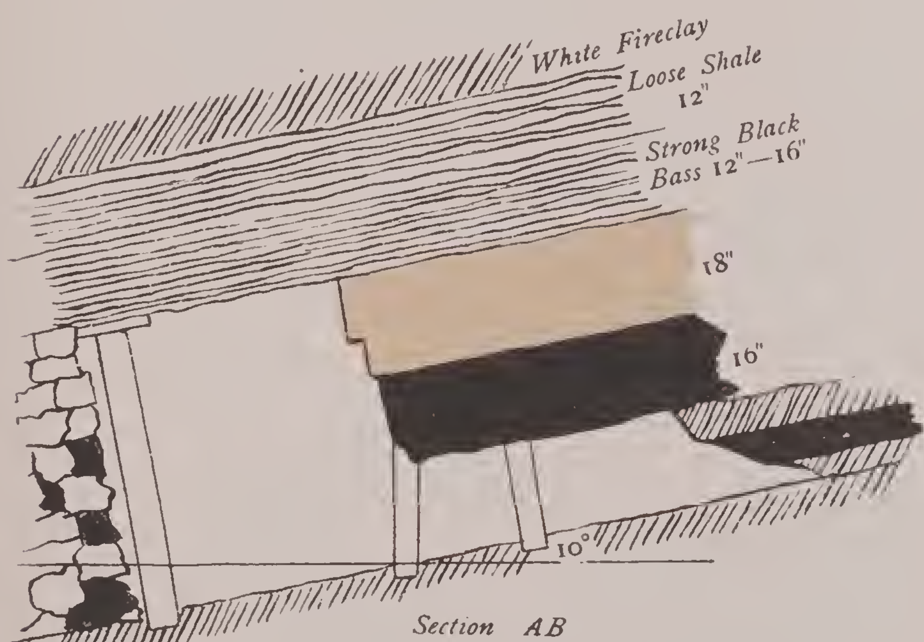


FIG. 2.

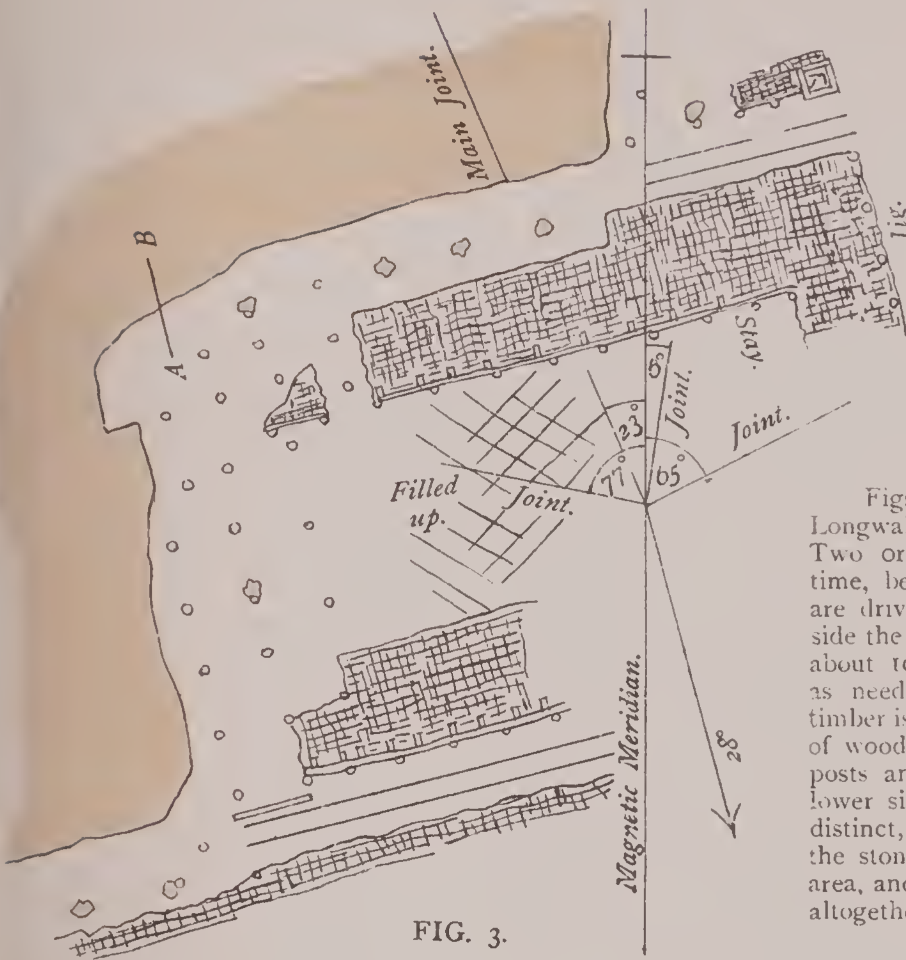


FIG. 3.

Figs. 3 and 4 Plan and Section E. Longwall in steps in a level direction. Two or three steps are worked at a time, beginning at the bottom. They are driven from 40—50 yds. on either side the jig-dip; the latter being driven about 100 yds., but a length at a time, as needed. Almost all the gob-road timber is recovered. Stays, small pieces of wood, are used in combination with posts and round slabs, to support the lower sides of the packs. Joints very distinct, cut each other out. Eastwards, the stone thins out to 6" over a large area, and has been known to thin out altogether.

NOTE.—The meridian shewn on all the plans is the magnetic meridian.

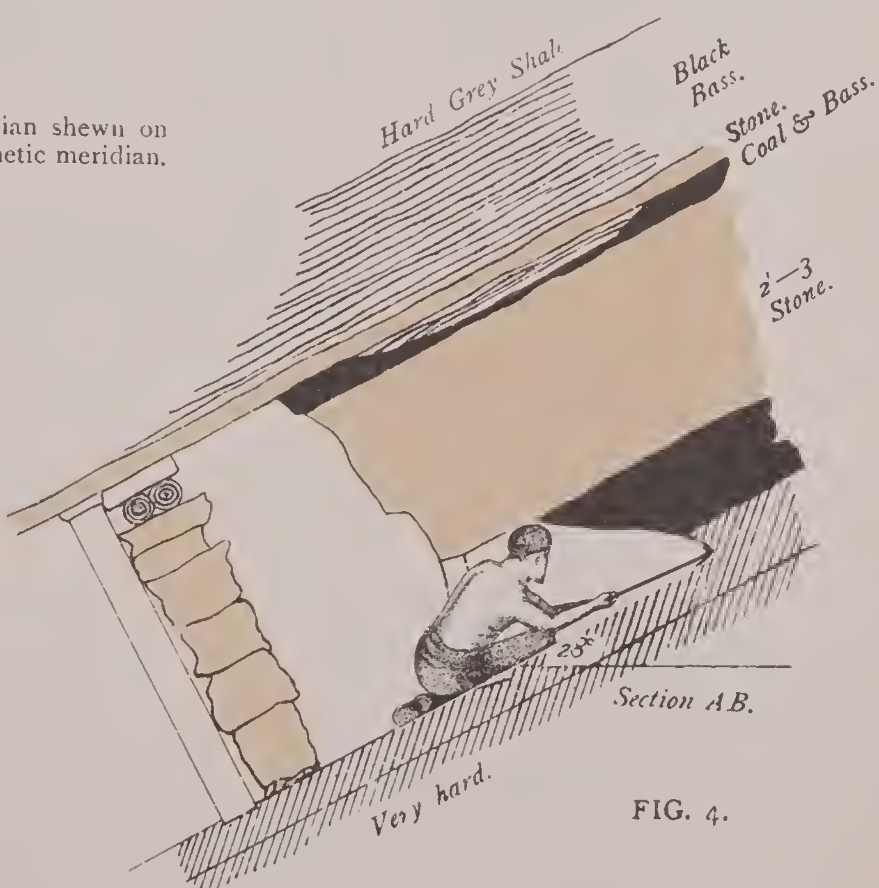
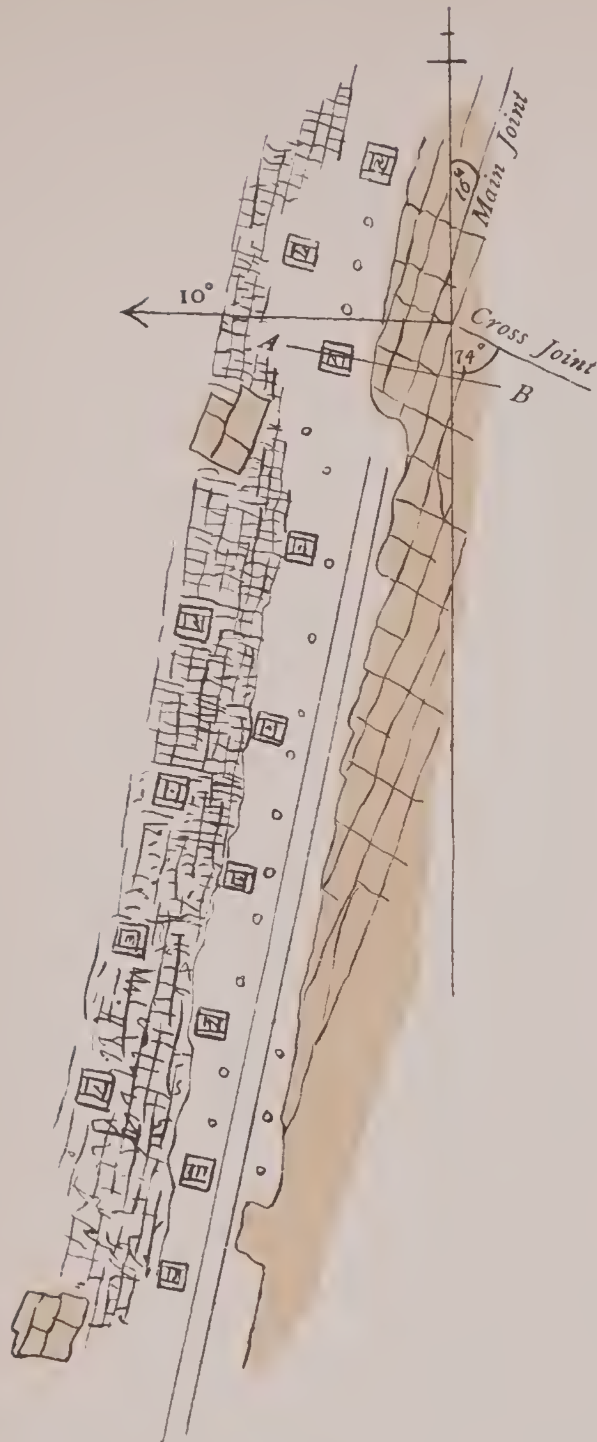


FIG. 4.



Figs. 5 and 6. Plan and Section S.E. Bank and Pillar, with 30—40 yds. banks and about 8—20 yds. pillars. The face is kept slightly off the joints as the roof then weights less readily. Dressings are from 4′ 6″—6′ according to the joints; two being often coupled together. The stone is all in one band when thin; it lies in two bands when thicker than a yard. Where the stone is thin the grits are taken down and used for packing, the roof above being strong. Two sprags are set where the stone is affected by the last shot. About half the number of chocks are recovered.

The main joints run very regularly from 2′—3′ apart; they occasionally send offshoots to the next joint. The cross joints are not quite so regular and run from 3′—6′ apart.

FIG. 5.

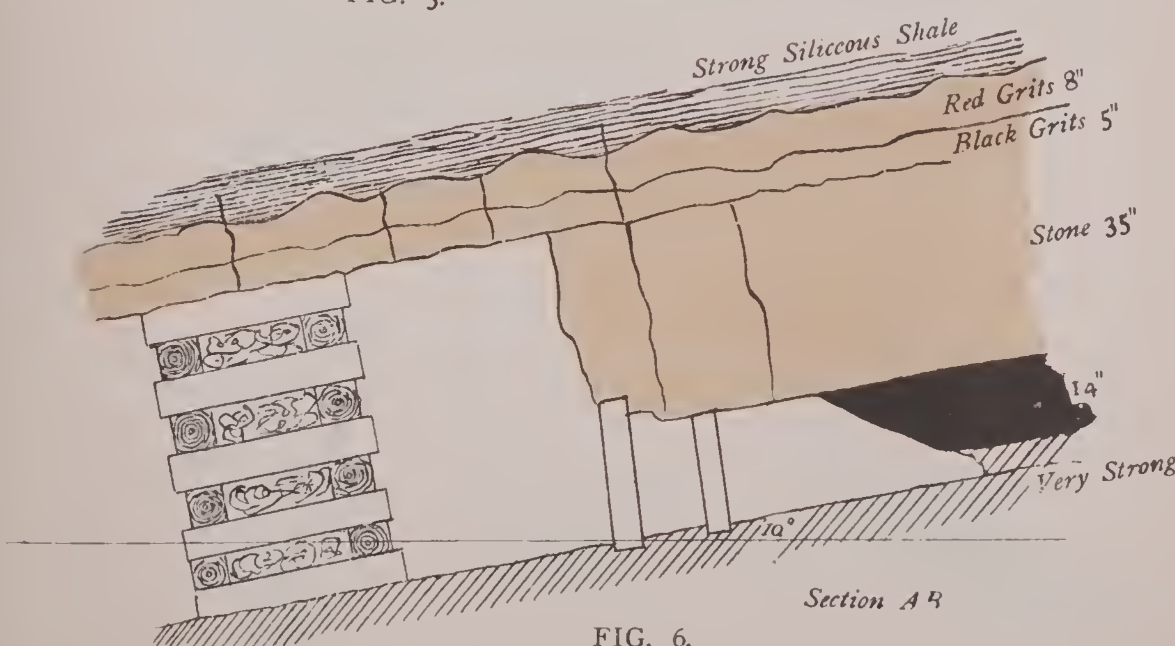
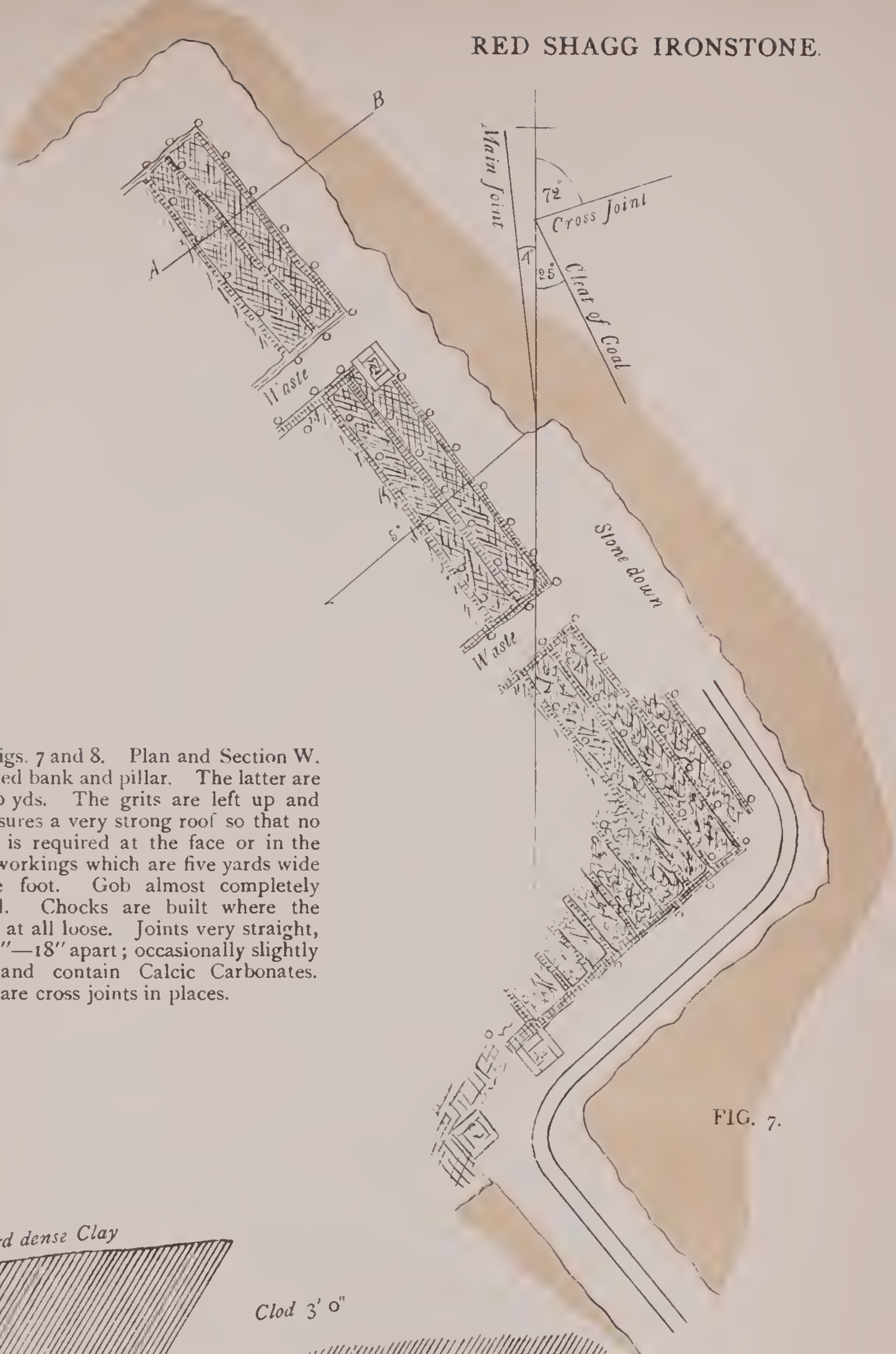


FIG. 6.

RED SHAGG IRONSTONE.



Figs. 7 and 8. Plan and Section W. Modified bank and pillar. The latter are 20 × 30 yds. The grits are left up and this insures a very strong roof so that no timber is required at the face or in the strait workings which are five yards wide at the foot. Gob almost completely packed. Chocks are built where the roof is at all loose. Joints very straight, from 6"—18" apart; occasionally slightly open and contain Calcic Carbonates. There are cross joints in places.

FIG. 7.

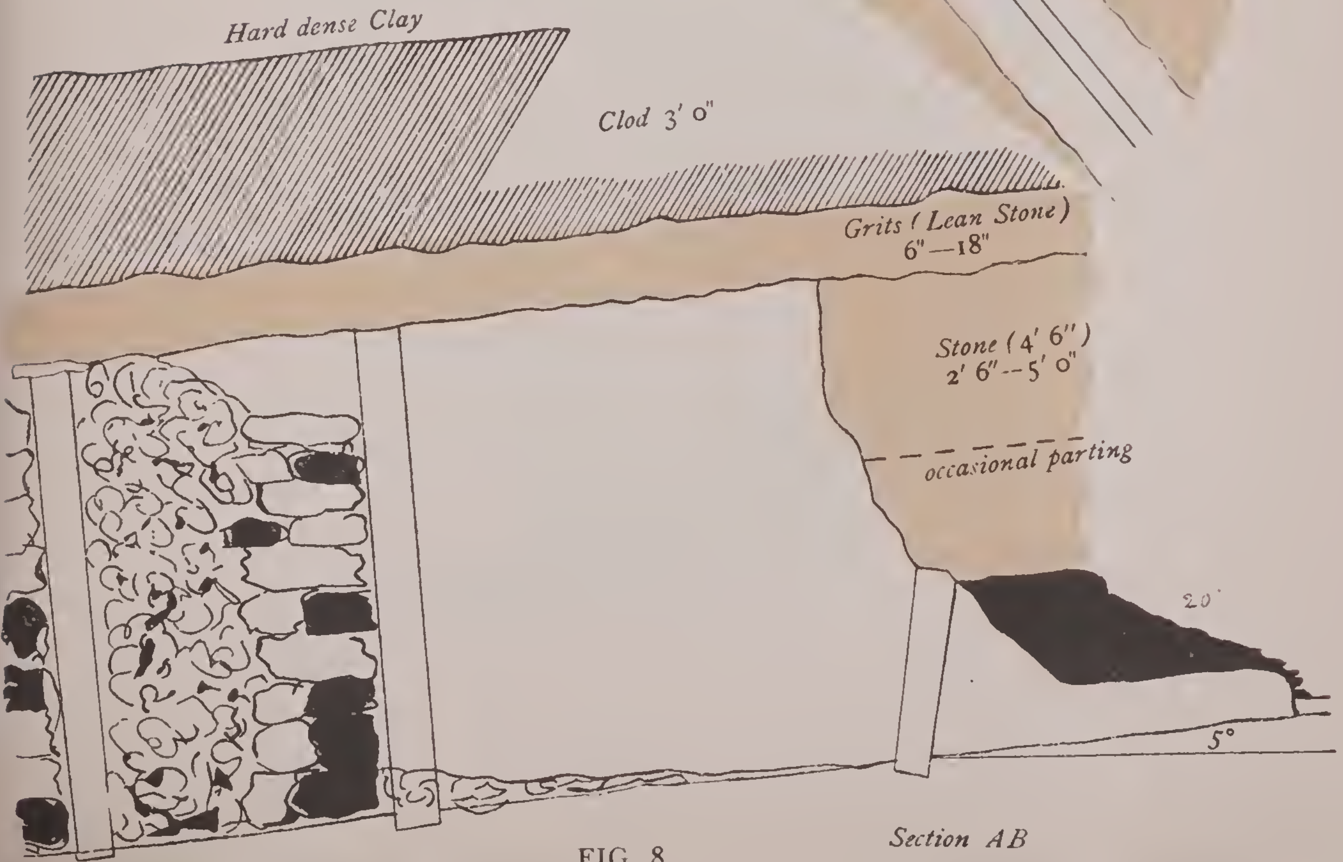


FIG. 8.

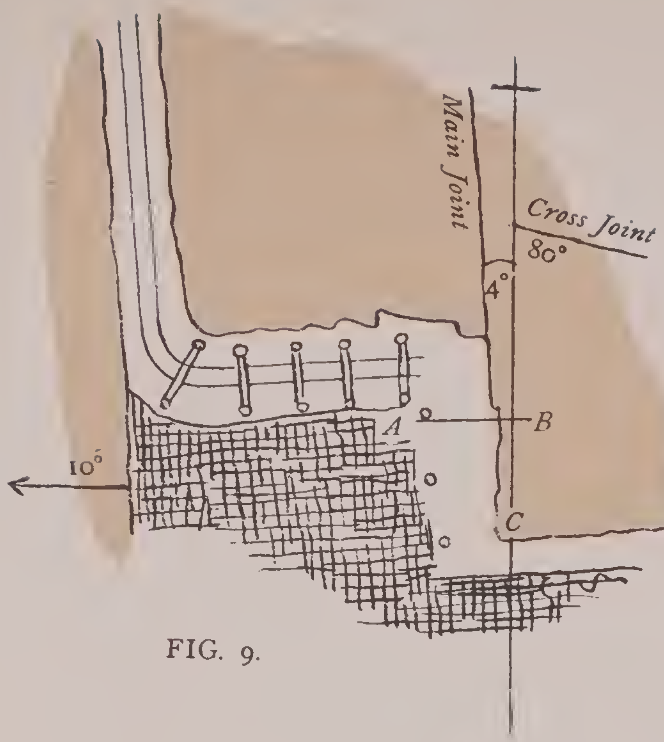


FIG. 9.

Figs. 9 and 10. Plan and Section N. of last Figs. Board and pillar. The latter are about 25 × 30 yds, and are worked off in slices. A small coal pillar 18″ square (spurn) is always left at the loose end (C) whilst holing. It is afterwards broken up from a distance by means of a pointed iron rod 9ft. long. These spurns are said to be 5—6 times more efficient than a sprag at a loose end. Main joints run 2′—4′ apart, and cross joints 18″ to 2′ ; they often set off or ride over when passing from one band to another. Where the pillars have stood a long while and been subjected to weight by proximity to the gob, the joints open greatly and secondary planes of division of very small extent appear between the joints and branching from them. They are called pincracks, and occur specially in the top stone. Old pillars are consequently easier to work off than new ones, but this method entails more timber and is more dangerous than the other methods. The grits are taken down and leave a clod roof which is full of slips and very treacherous.

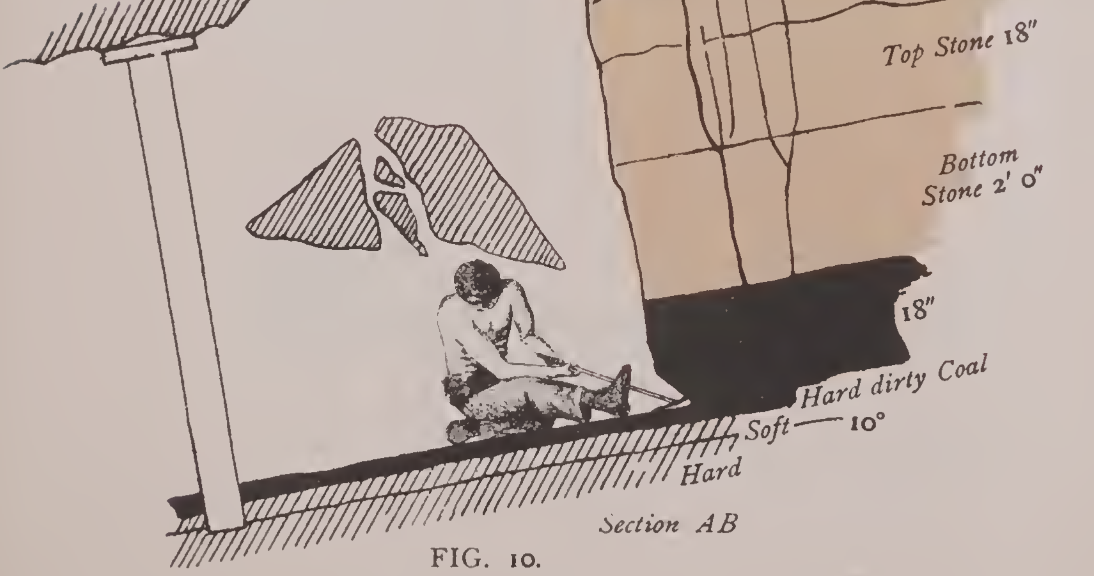


FIG. 10.

Fig. 10 illustrates a fatal accident which occurred through the fall of a large piece of this clod from between 2 slips. The collier started holing without first setting a post close behind him, the last post being about 6ft. from the face.

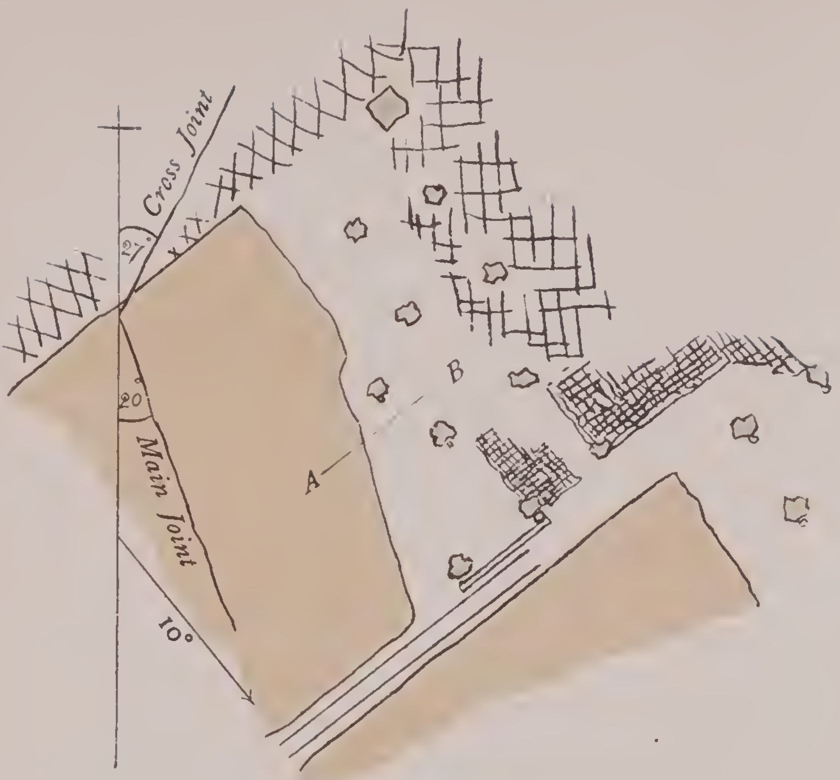


FIG. 11.

Figs. 11 and 12. Plan and Section N. of last Figs. Lancashire method. Roof supported by " Riflemen " made of pieces of Cinders and Stone which are sometimes recovered. Main joints very regular about 3ft. apart. The floor lifts much.

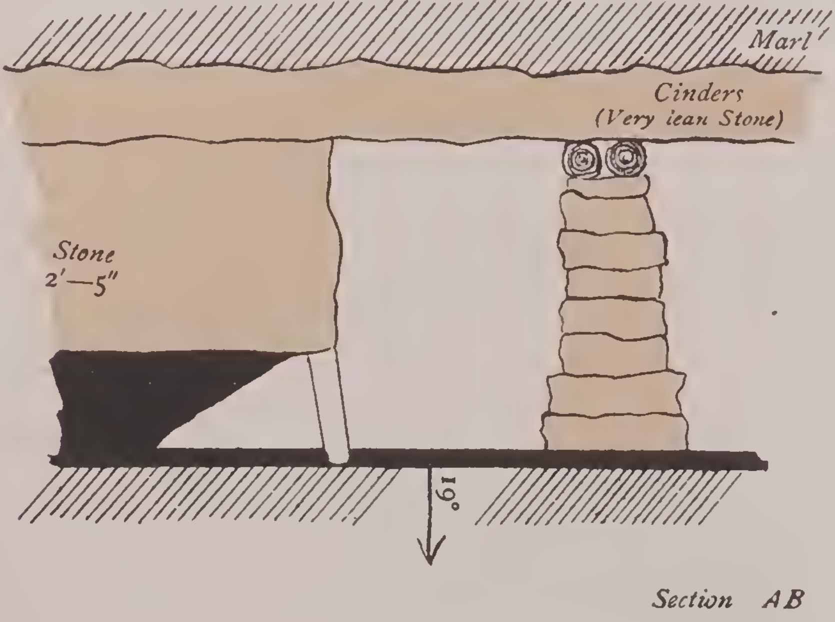


FIG. 12.

A carbonaceous band of woody fibre called "Flannels" lies on the top of the stone throughout the coalfield.

Figs. 13 and 14. Plan and Section S. E. (Near Figs. 5 and 6). Bank and pillar. A waste is formed in the centre of the gob which eases the "weight" in the roads.

FIG. 13.

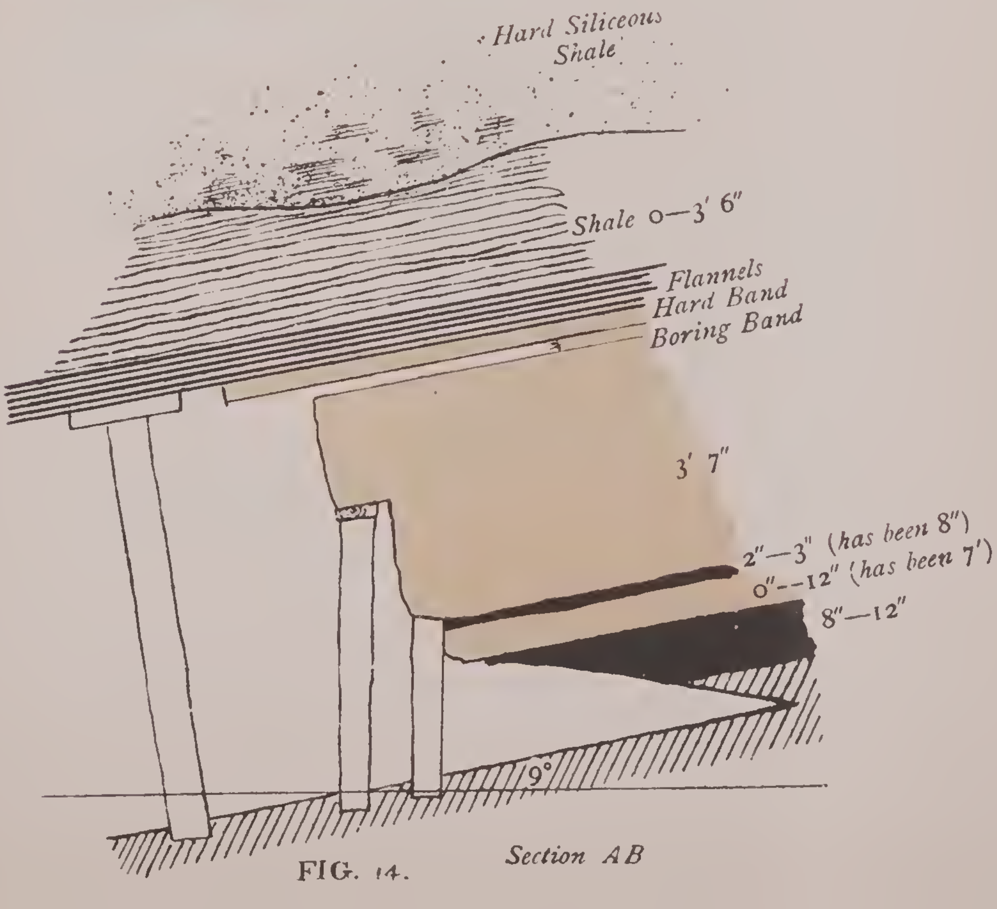


FIG. 14. *Section AB*

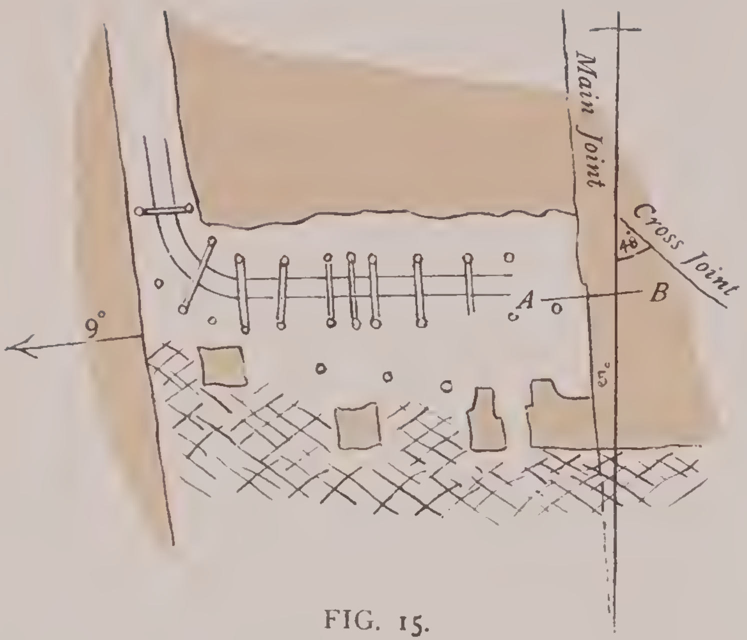
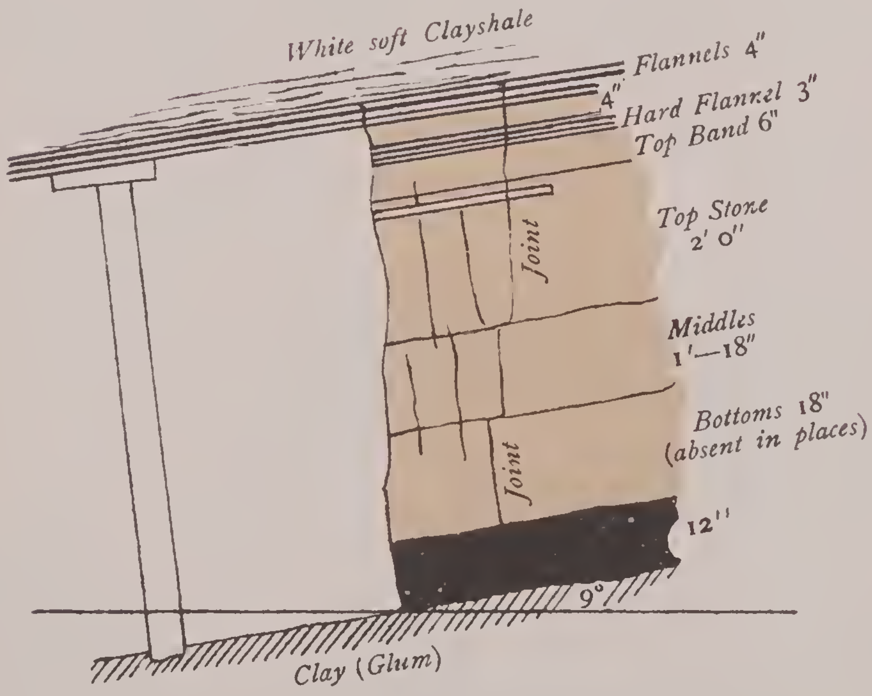


FIG. 15.

Figs. 15 and 16. Plan and Section. N. of last Figs. Worked as in Figs. 9 and 10.



Section AB

FIG. 16.

RED MINE.

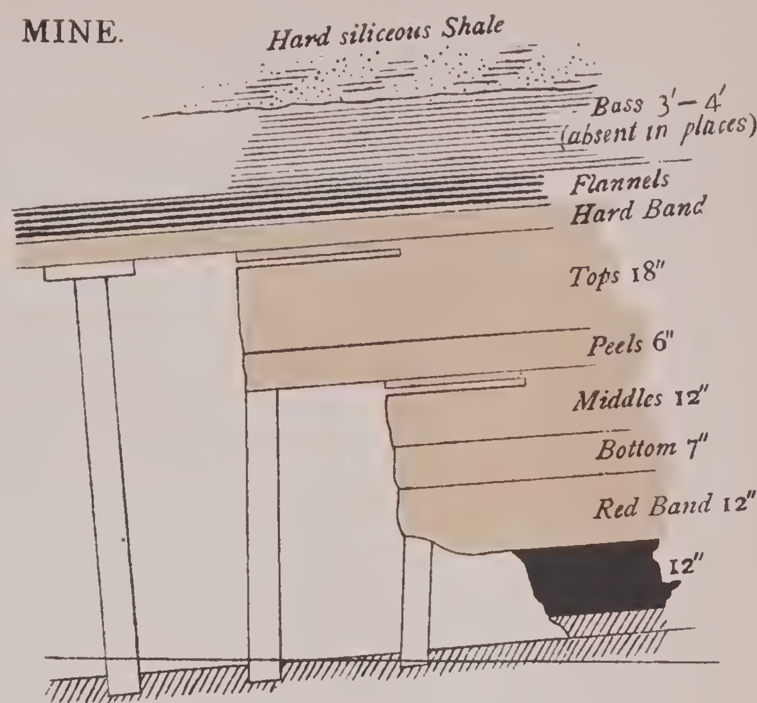


FIG. 17.

Fig. 17. Section N. of last Figs.

FIG. 18.

Figs. 18, 19 and 20. Plan, Section and Elevation N Worked as in Figs. 11 and 12.

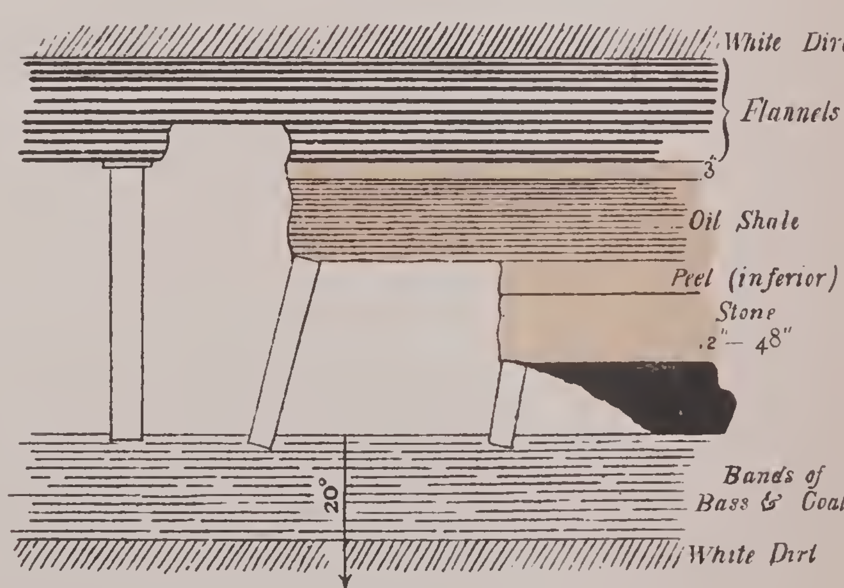


FIG. 19.

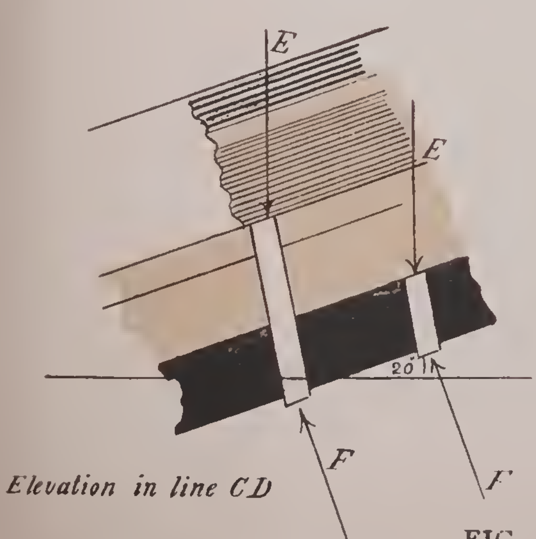


FIG. 20.

BLACK BASS IRONSTONE.

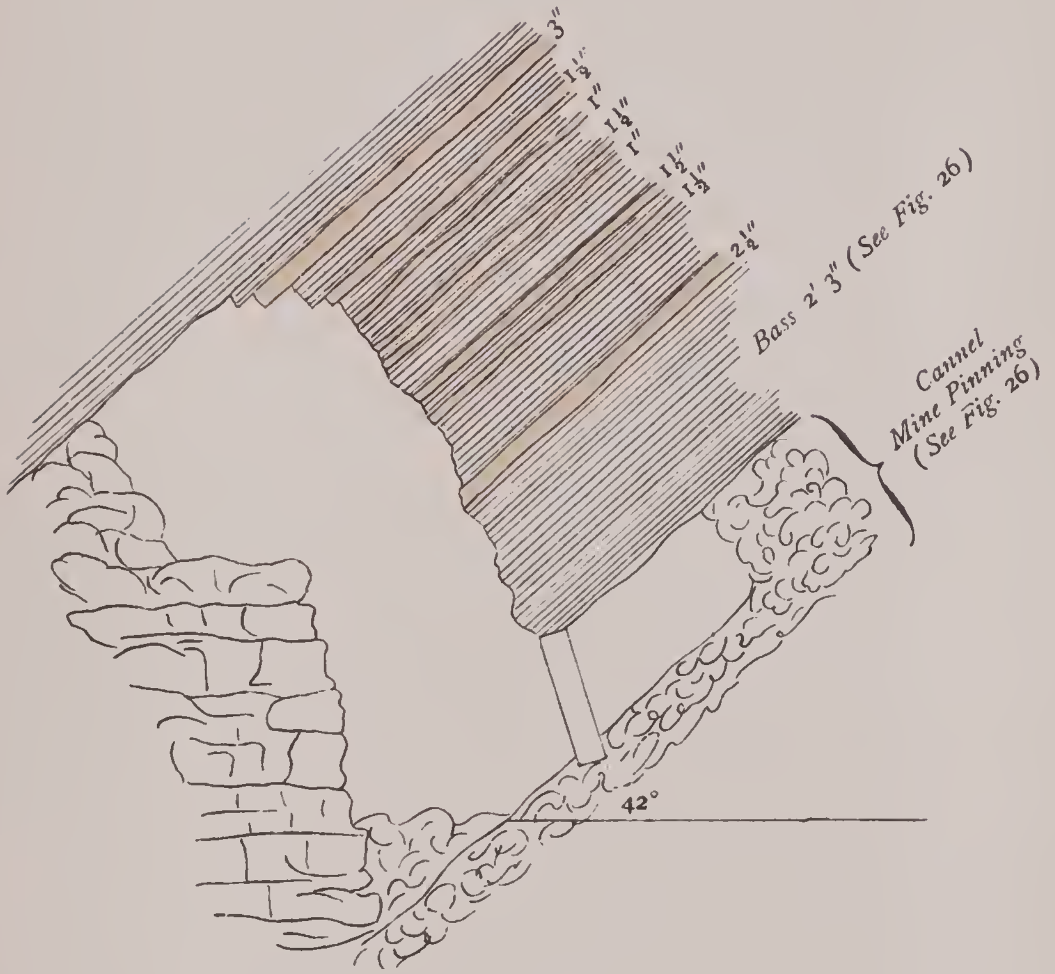


FIG. 21.

Fig. 21. Section C. Worked a considerable time after the Cannel Mine Ironstone which underlies it. (Fig. 26). Longwall, drifts 7 yds. on each side of sladder. Gob entirely packed, some bass being sent out. The roof is broken where the Cannel Mine gob has not been well packed. Little timber is otherwise set. A footlid is placed under sprags where the Cannel mine pinning is not solid.

CANNEL MINE IRONSTONE AND COAL,

(GREAT ROW COAL).

The former is frequently worked in conjunction with the latter.

Figs. 22, 23 and 24. Plan and Sections S. Lancashire method. A small rib of coal is left against the gob above; it is tightened by the lifting action of the floor; the inclination of the seam being small the gob dèbris has no tendency to push it in. Cleat distinct. Slips from 3′—6′, but further in places; from 13°—20° NW. Only a few run through into the Cannel, and some bend over on entering it, but not for any distance. (Fig. 24). A collier was killed whilst pulling down

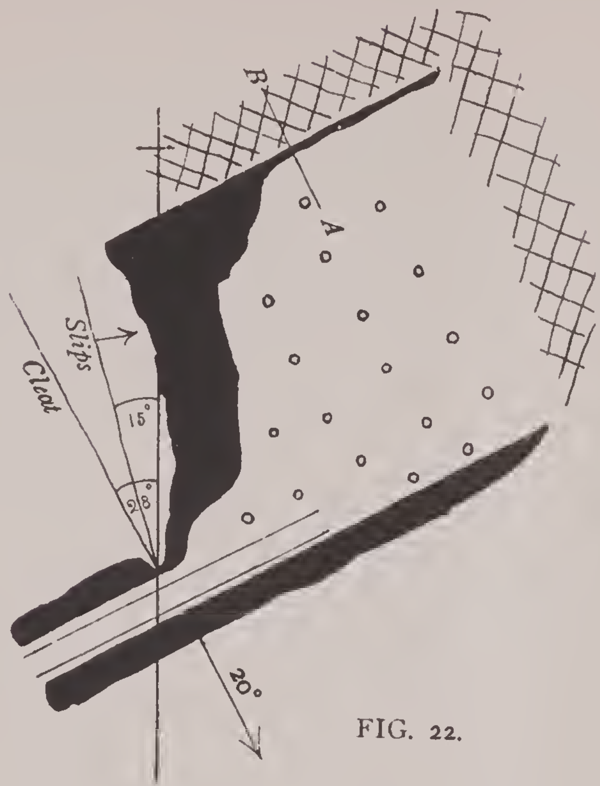


FIG. 22.

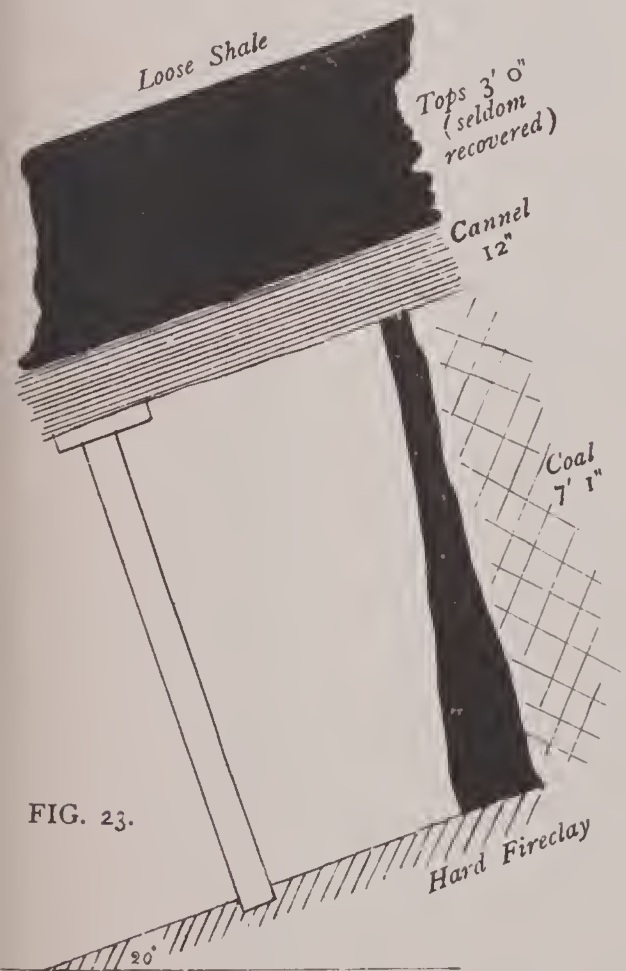


FIG. 23.

Section AB

SECTION SHEWING SLIPS.

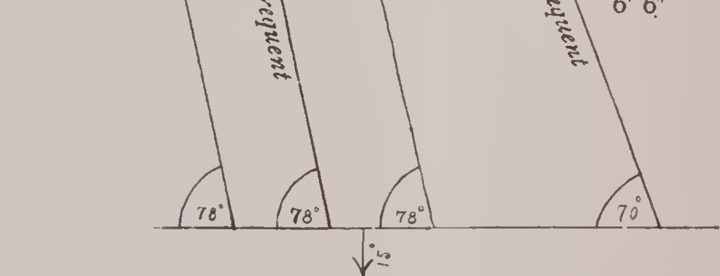


FIG. 24.

the Cannel in a dip 8 ft. in width. The Cannel had begun to work and was unsafe. It came off a slip on either side of the dip. The slips were known to be in the coal, but not supposed to run into the Cannel. The Cannel Mine Stone Bands lie 18′ above the top coal. They are worked a long time after the coal has been got. Though the intervening strata contain numerous small bands, those lying between the Grits and the Blue Band, which are about 7′ apart, are alone worked. Further South the Cannel dwindles down to 2″ and the bottom coal thickens. Southwestwards the top coal is 18″ thick and very hard and tough, and the bottom coal 5′ thick, and they are separated by a bed of Cannel coal 6″ thick.

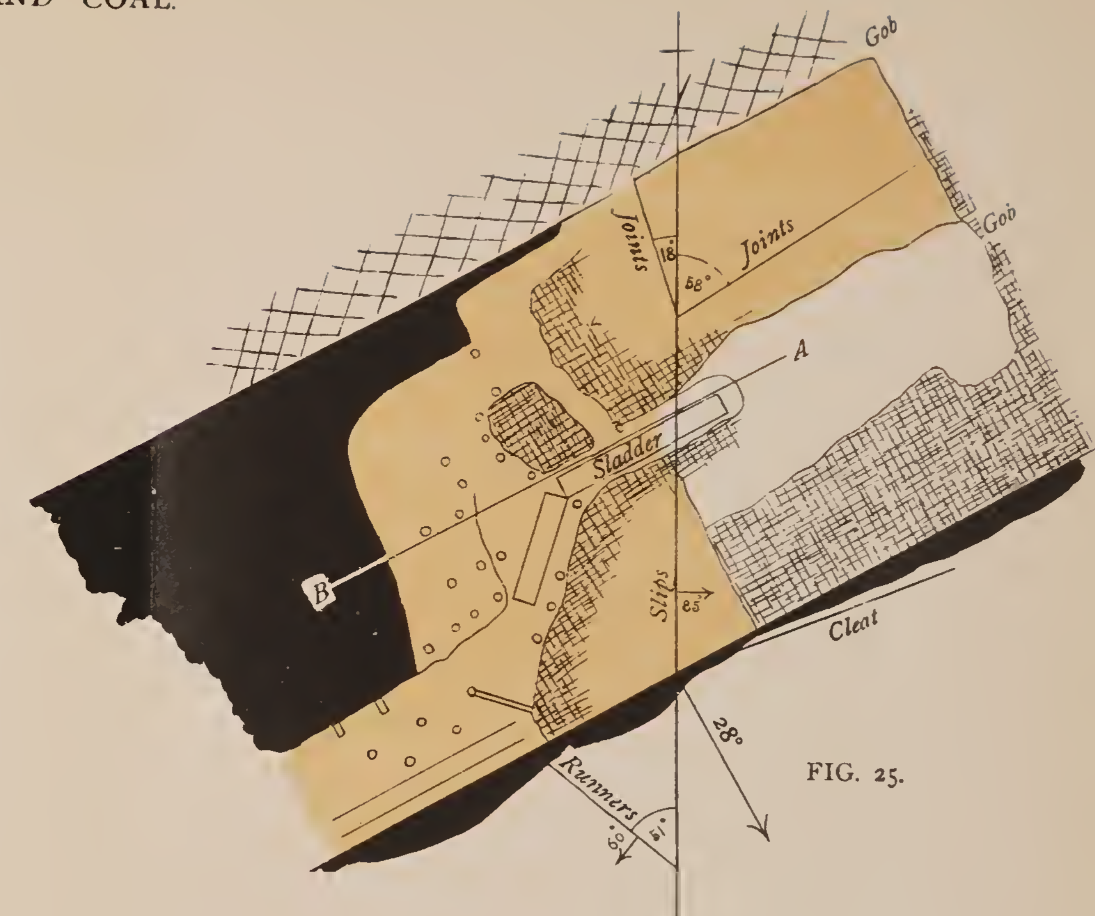


FIG. 25.

Figs. 25 and 26. Plan and Section N. of last Figs. Coal worked by Lancashire method. It is drifted back 18—20 yds. according to the fall of the measures. The old gob above is then slipped and packed under the top coal (unless a fall has taken place preventing it). The stone measures are then turned over; the bottom half in going in and the top half in coming back. A sladder is formed with iron plates, down which the stone is thrown. Hardly any timber is used in the stone work. Cleat distinct. Slips 2—4 yds. apart. Runners not frequent. Joints: in Cannel very distinct, in stone bands irregular, but in the same direction. The bands of stone are very regular.

Northwards the Cannels thin down to 2′ 6″

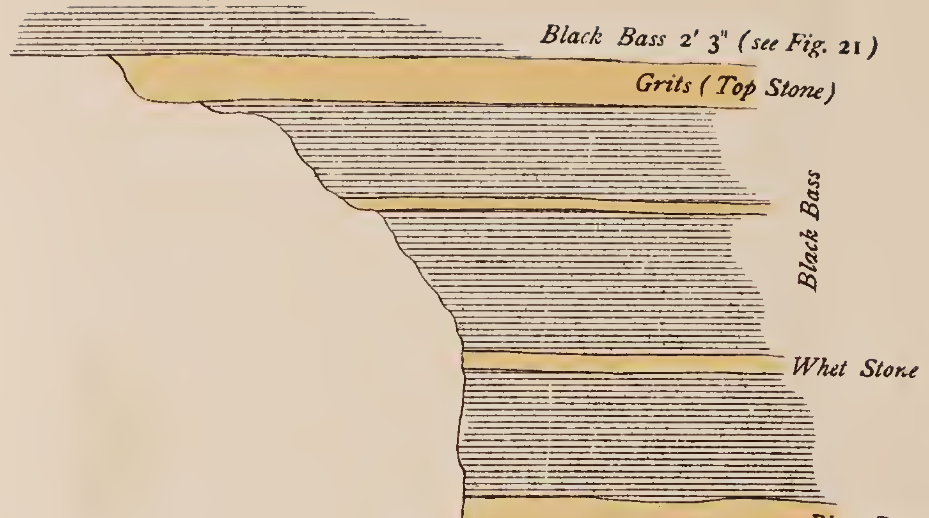
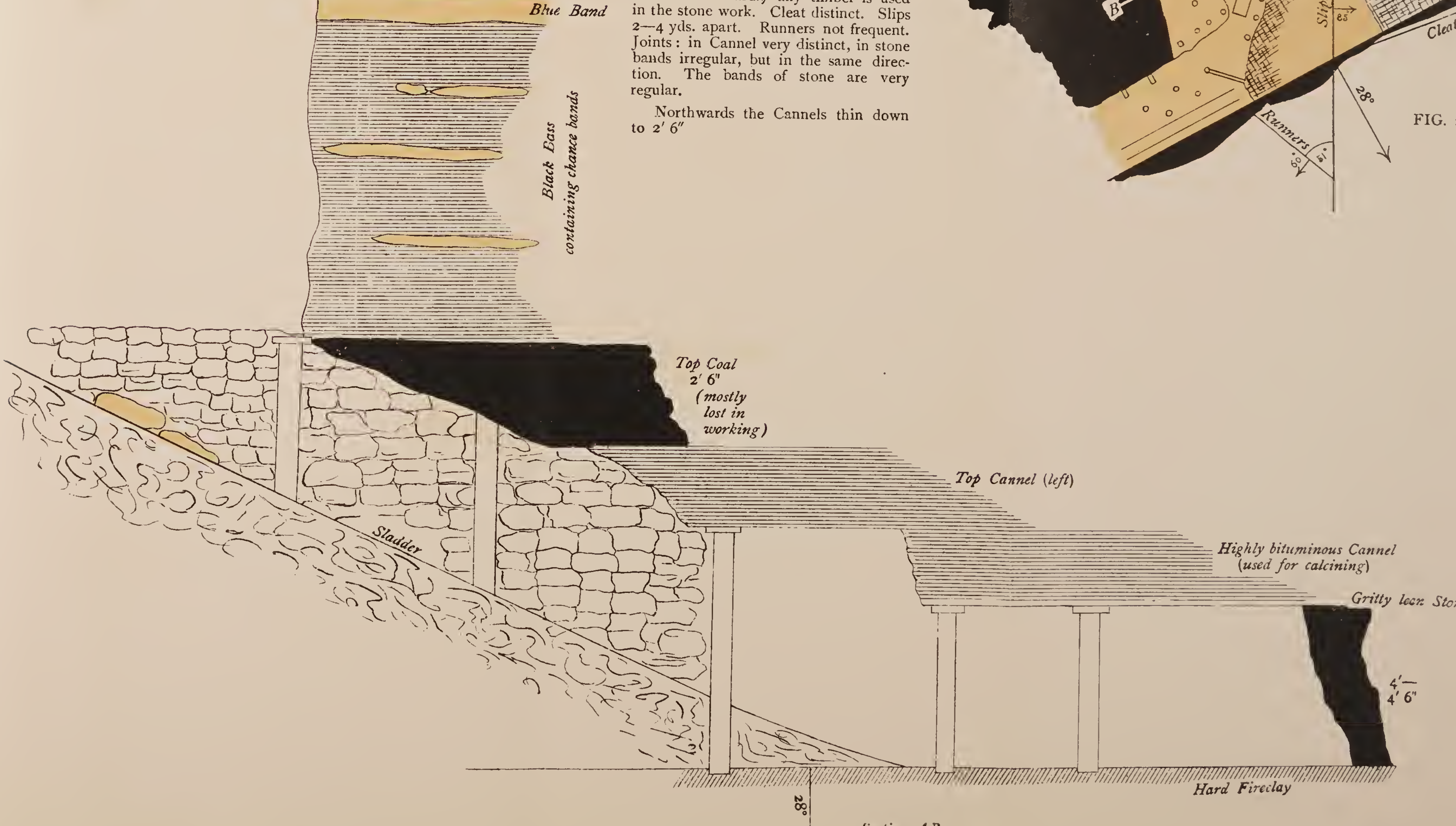



FIG. 26.

Fig. 27. Section of coal E. of last Figs. Worked alone; by the bank and pillar method. The roof is very strong, and little timber is used. Strait places are driven 5 yds. wide, without any timber. The Cannel comes down in large bodies, which posts cannot support. Chocks are built when a weight is expected. Cleat 28° NW. Slips numerous in places NW., but bearing irregular.

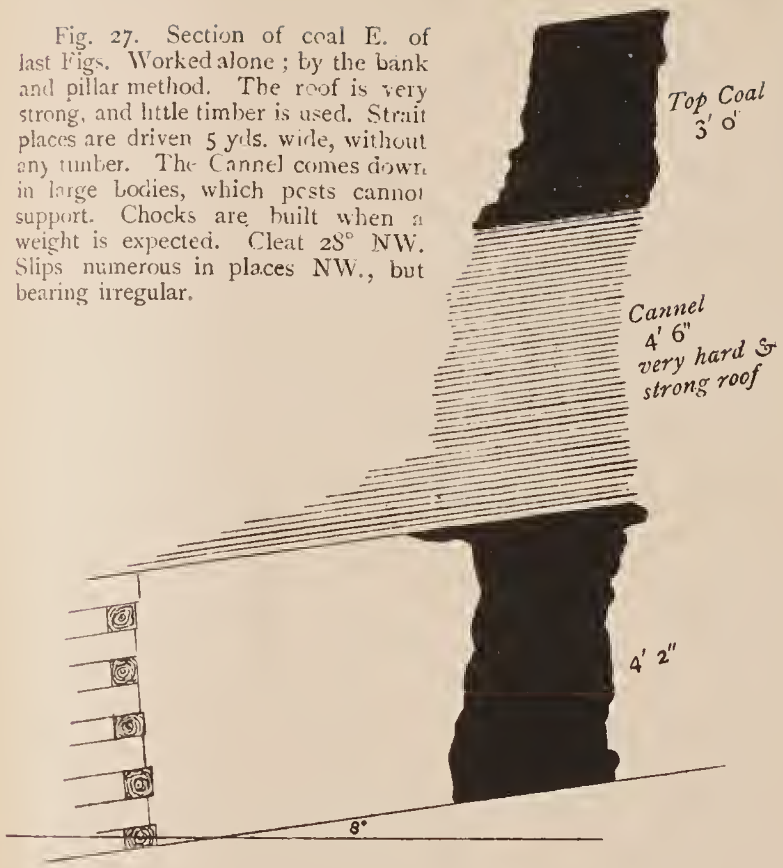


FIG. 27.

Figs. 28 and 29. Plan and Section N. of last Figs. The bottom coal is worked first by longwall, with regular packs at intervals; the Cannel, top coal and gubbin are then dropped in the wastes and picked out. The gubbin only is then worked over the packs. The Cannel roof is very strong, and hardly any props are set. Cleat not distinct. Slips regularly every 4 ft., through bottom coal, Cannel and bass, but not through top coal, which is very tough, and lies in layers.

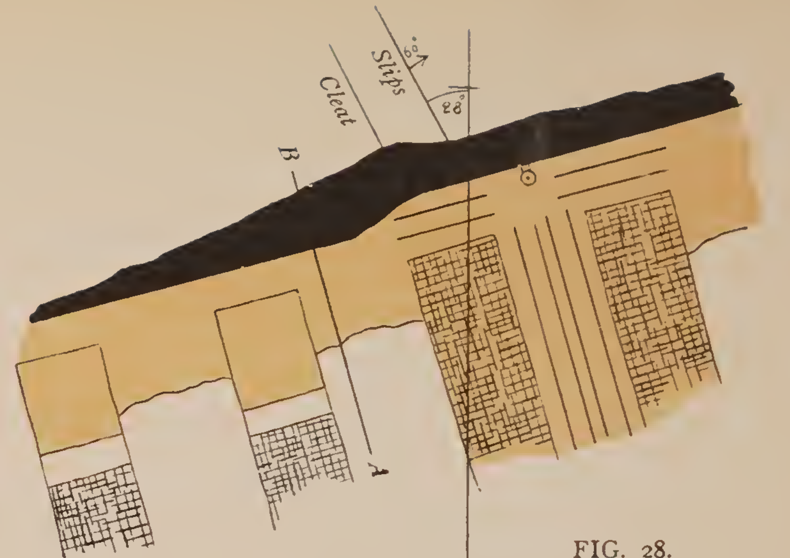


FIG. 28.

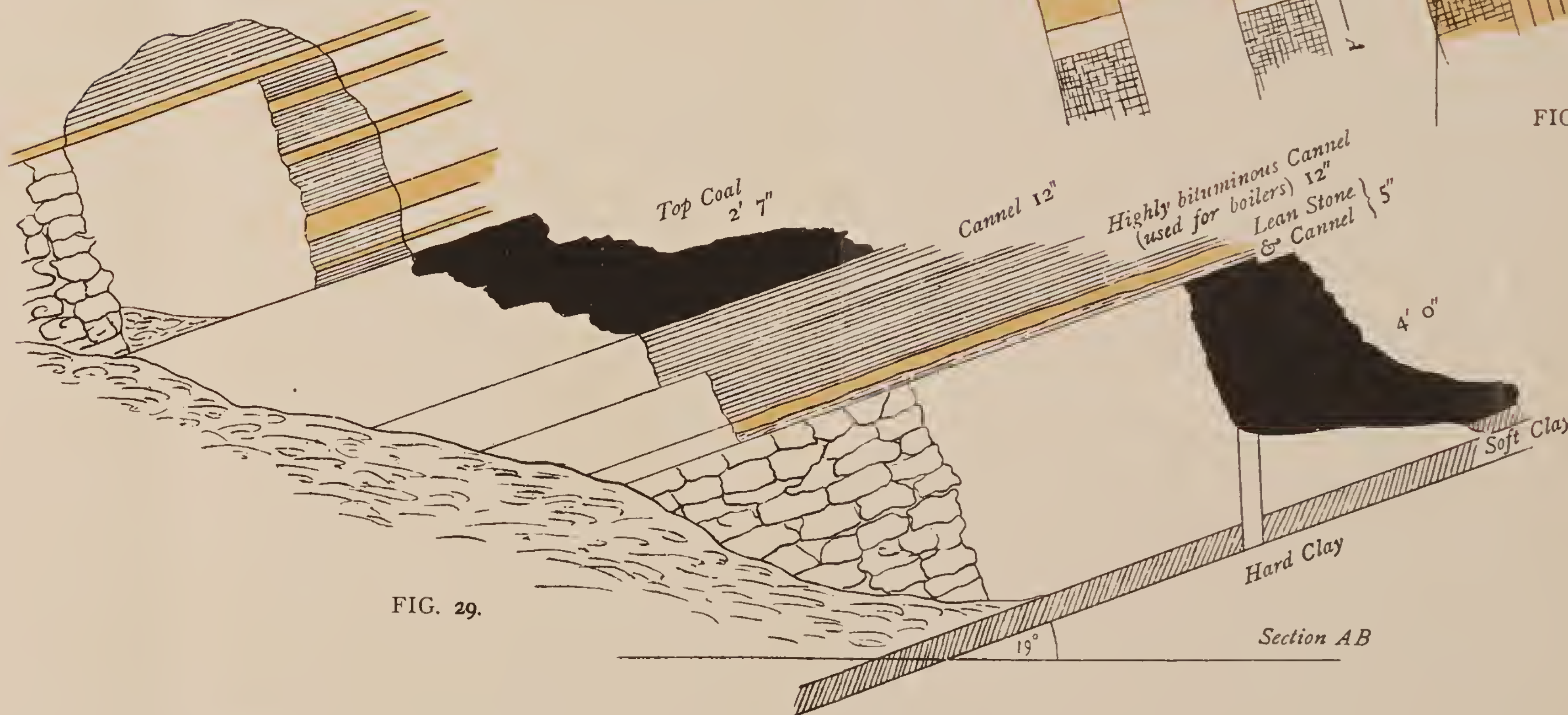


FIG. 29.

LITTLE MINE COAL (LITTLE ROW COAL).

Figs. 30 and 31. Plan and Section C. Lancashire method. The roof is very heavy; it hangs together in a body and comes down suddenly in large pieces. Cleat very distinct. Slips 13 NW. from 3'—4' apart and further in places, through the whole seam. Runners not frequent; do not always run through tops and middles.

A pillar is occasionally left to support the roof; it is, however, sometimes partly recovered after securing the side by a stretcher, as shewn.

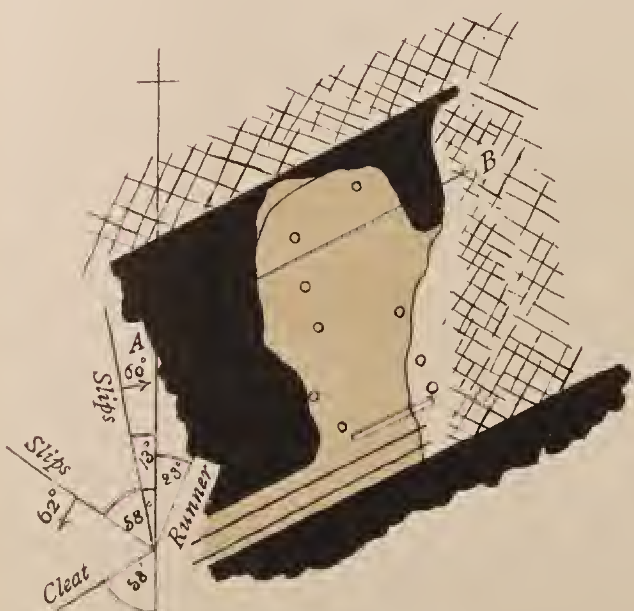


FIG. 30.

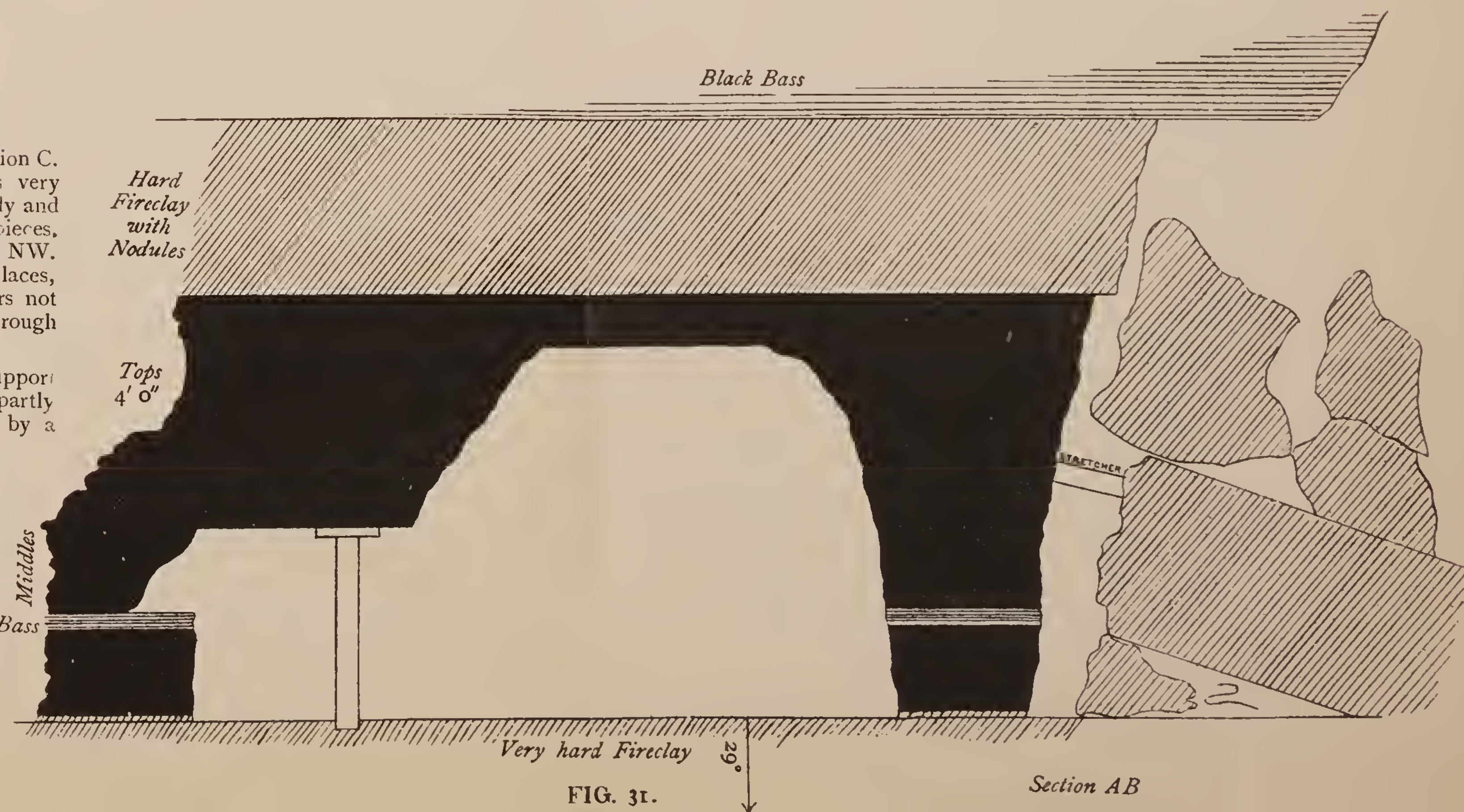


FIG. 31.

Fig. 31A. Section C, illustrating the occurrence of a fatal accident. The Top Coal, which is taken down behind the Middle and Bottom Coals, was supported up the drift by three rows of posts. There were from five to six posts in each row. Two colliers were engaged taking up dirt and replacing the rails, preparatory to cutting down the Top Coals. They had cut the Top Coals down to 10″ at the lower side of the heading, to enable them to load the tub, when they heard a "goth," and about 20 tons of coal fell, reeling out about 12 posts, and killing one of the colliers.

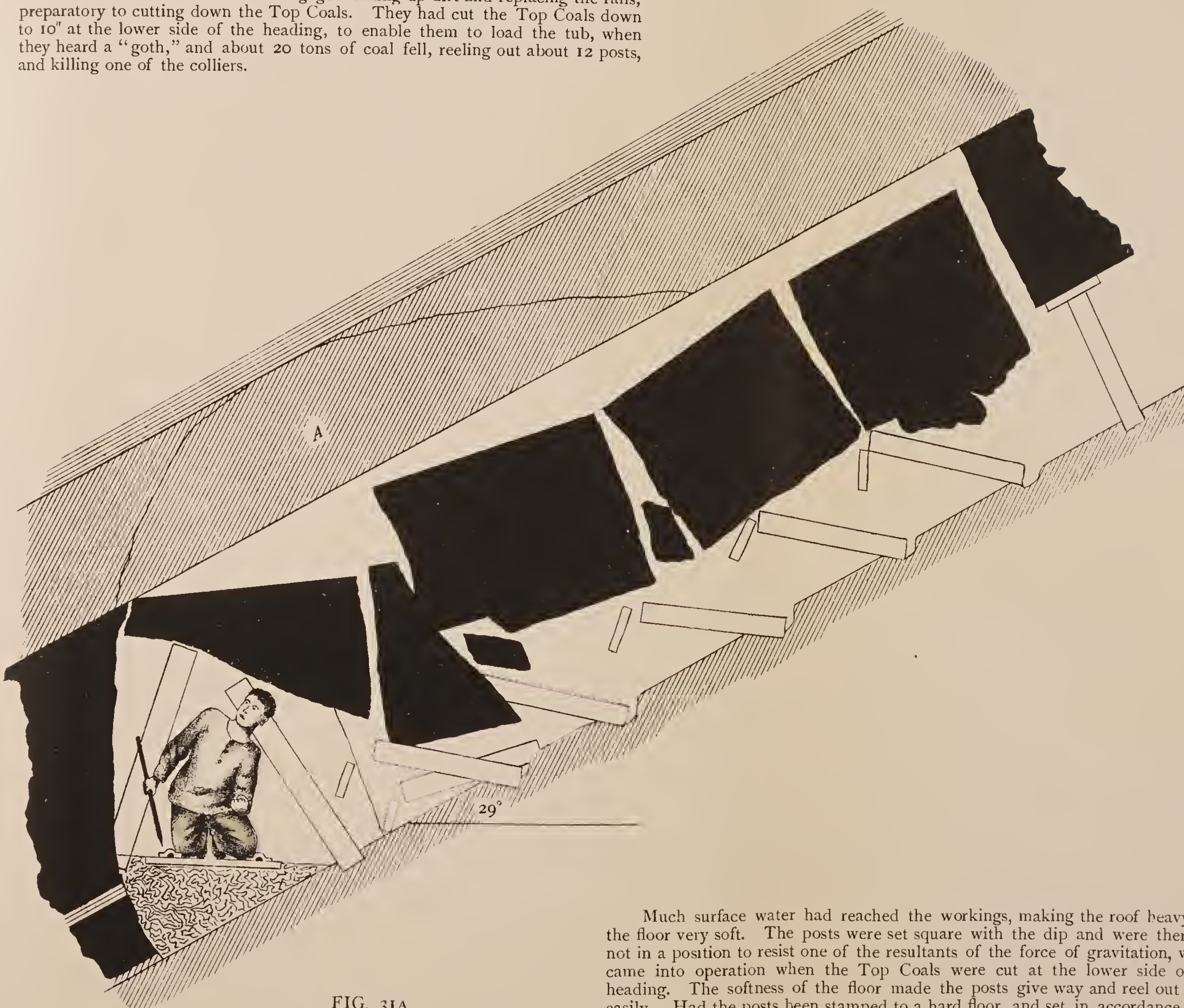


FIG. 31A.

Much surface water had reached the workings, making the roof heavy and the floor very soft. The posts were set square with the dip and were therefore not in a position to resist one of the resultants of the force of gravitation, which came into operation when the Top Coals were cut at the lower side of the heading. The softness of the floor made the posts give way and reel out more easily. Had the posts been stamped to a hard floor, and set in accordance with the table on page 50, the accident could not have occurred. A large piece of roof, *A*, fell soon afterwards.

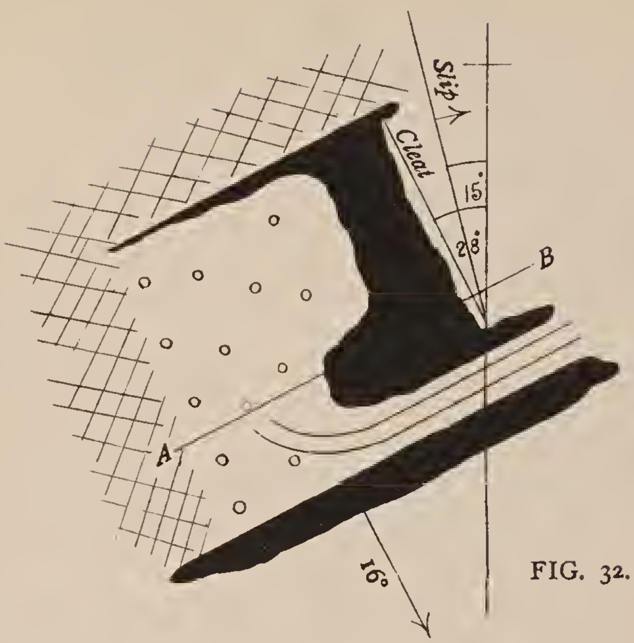


FIG. 32.

Figs. 32 and 33. Plan and Section further South. Worked as above. Cleat distinct and slips frequent.

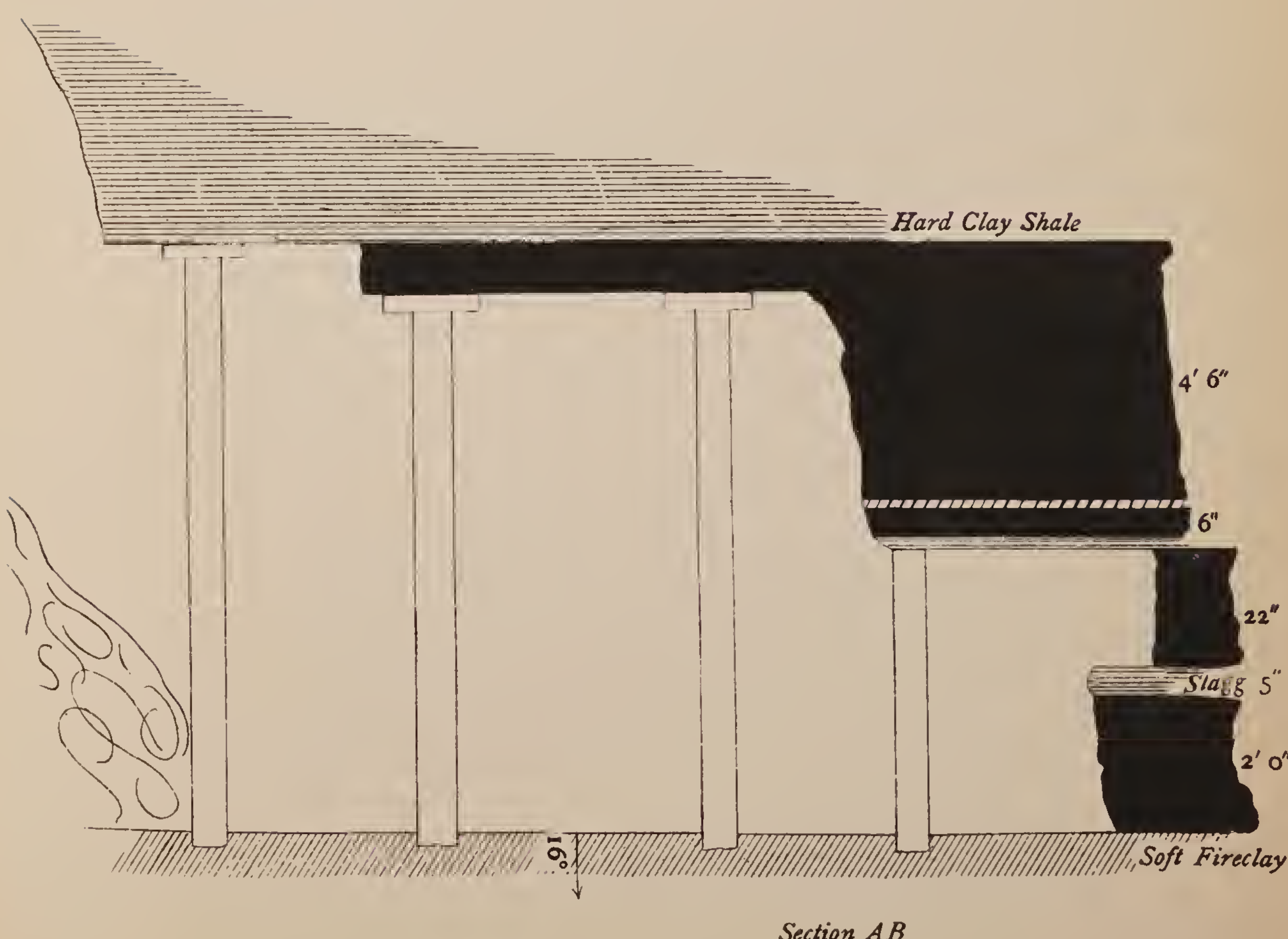


FIG. 33.

LITTLE ROW COAL.

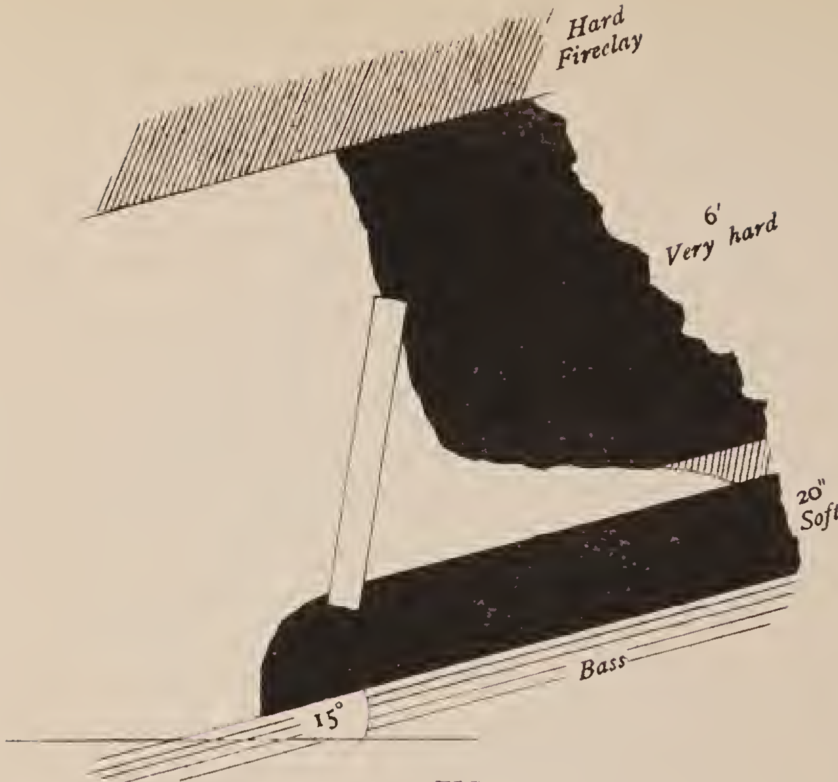


FIG. 34.

Fig. 34. Section SW. Ten tons of roof fell over an area of 20 square yards in an open place intended for a horse gin, near a dip. Seven posts, with stretchers and bars which were supporting it were knocked down; four men were injured, but none fatally.

GUBBIN MINE.

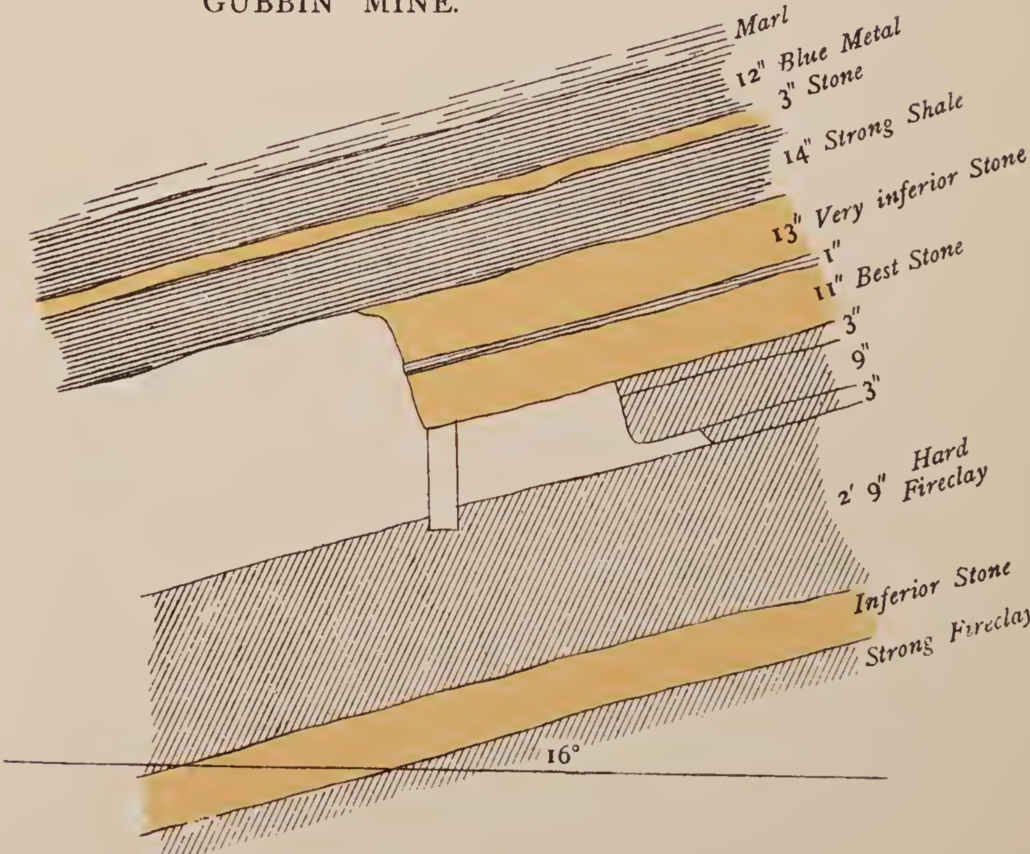


FIG. 34A.

FIG. 34A Section S. Worked by longwall, with sladders from 20—30 yds. apart.

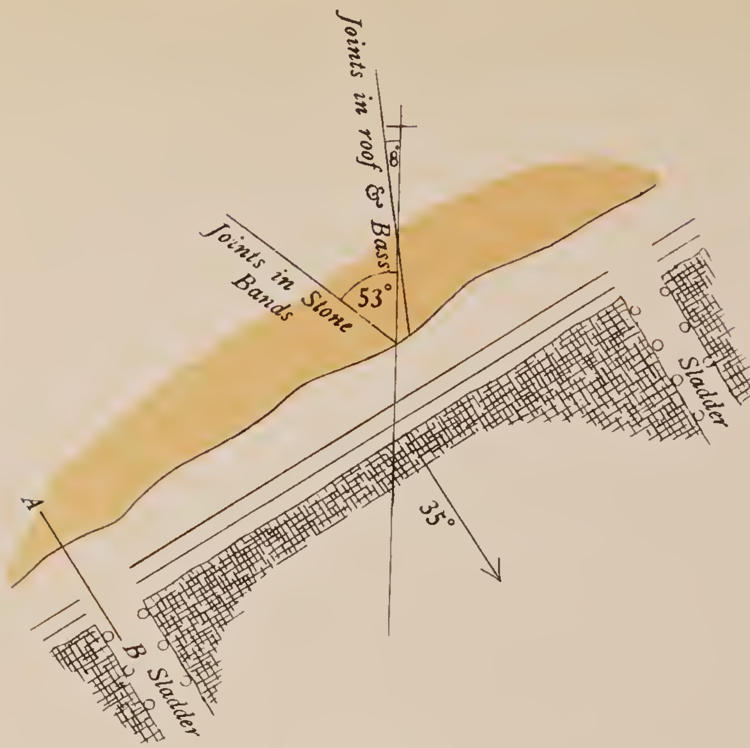


FIG. 35.

Figs. 35 and 36. Plan and Section S. Drifts are 120 yards long. The roof being very strong no timber is set unless the drifts are exceptionally wide. The stone works itself off without holing, and only has to be turned over and picked.

The joints in stone bands run 3″—6″ apart; those in the bass do not run any distance.

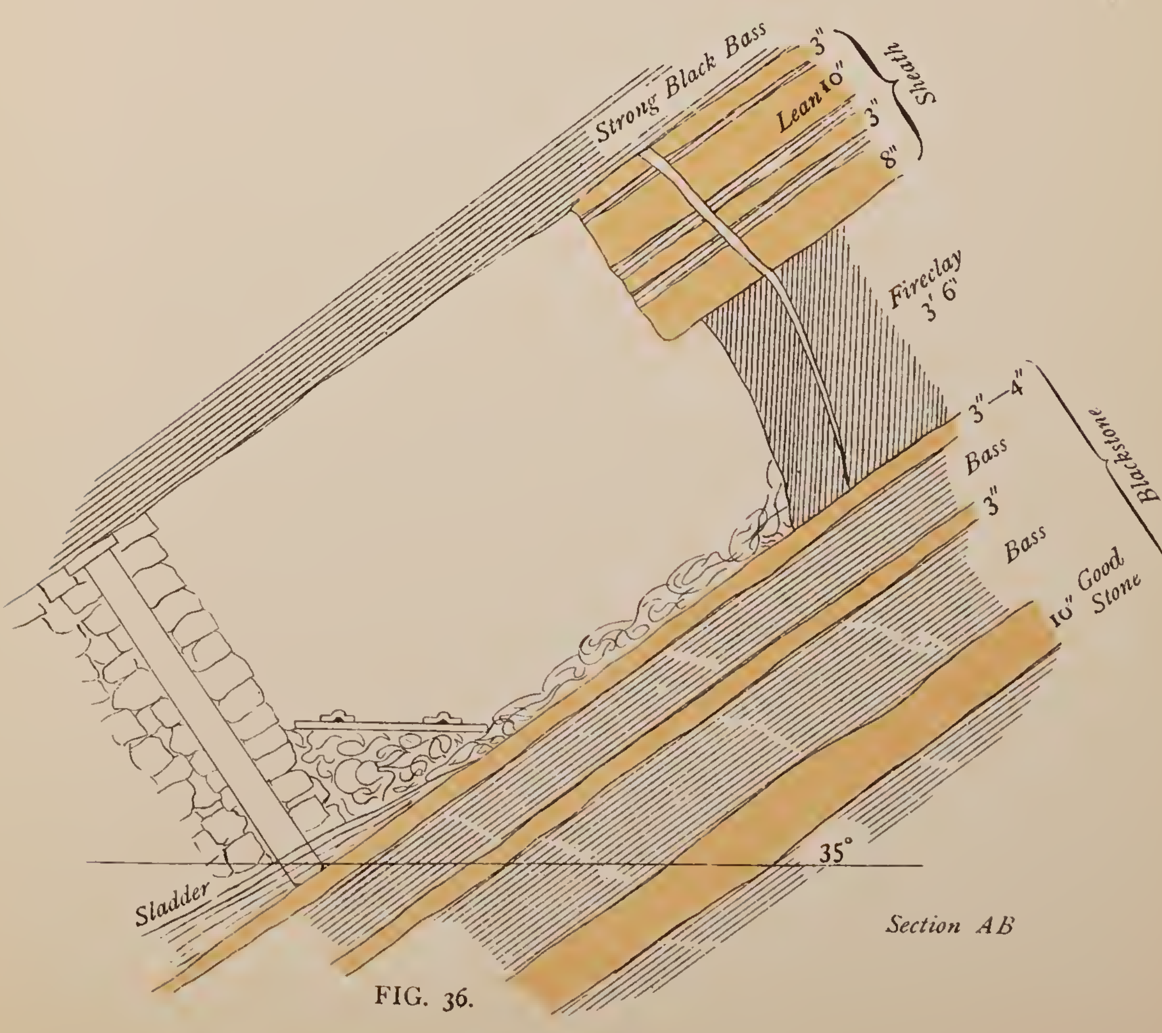


FIG. 36.

CHALKY MINE IRONSTONE.

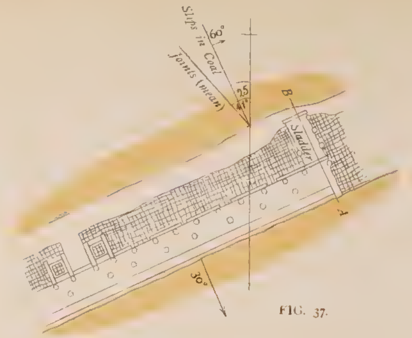


FIG. 37.

Figs. 37 and 38. Plan and Section C. Shewing beginning of a longwall drift from the level without a pillar being left. The lower side of the pack is supported by thick posts (D) 9″ thick, well stamped, 12″. Temporary posts (C) are set to throw the weight on to the pack, but are eventually removed. The two upper bands are left up at starting to reduce the space to be packed. The full thickness is ripped down about 7 ft. or 8 ft. from the level. Joints in stone not very parallel. Slips in coal very distinct, about 6 ft. apart.

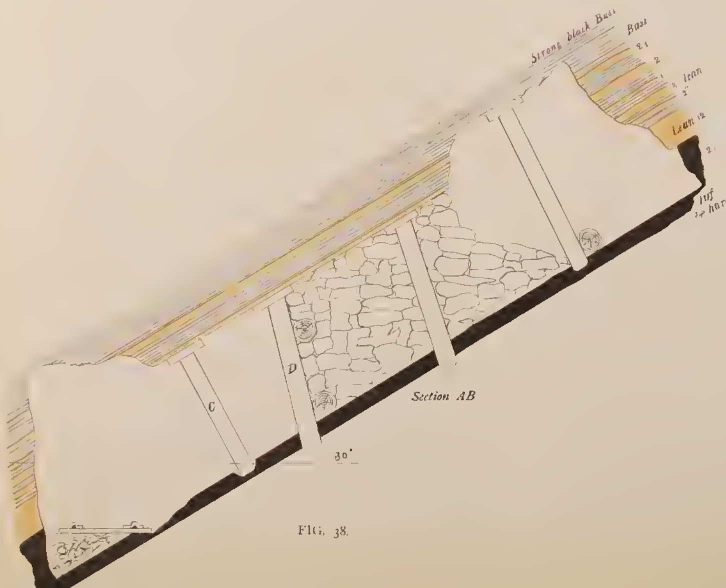


FIG. 38.

LITTLE MINE IRONSTONE.

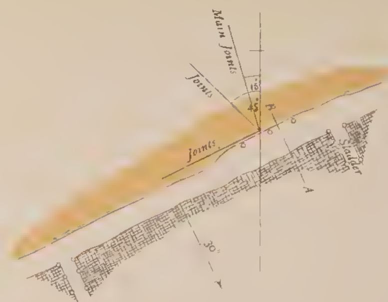


FIG. 39.

Figs. 39 and 40. Plan and Section C. Longwall. Main joints, 6″ and more apart, do not run through roof and bass.

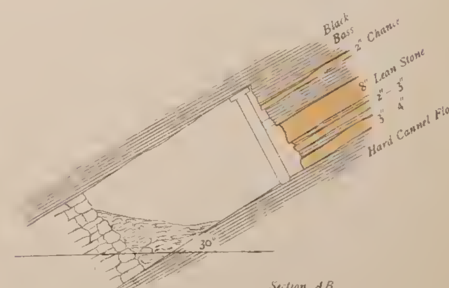


FIG. 40

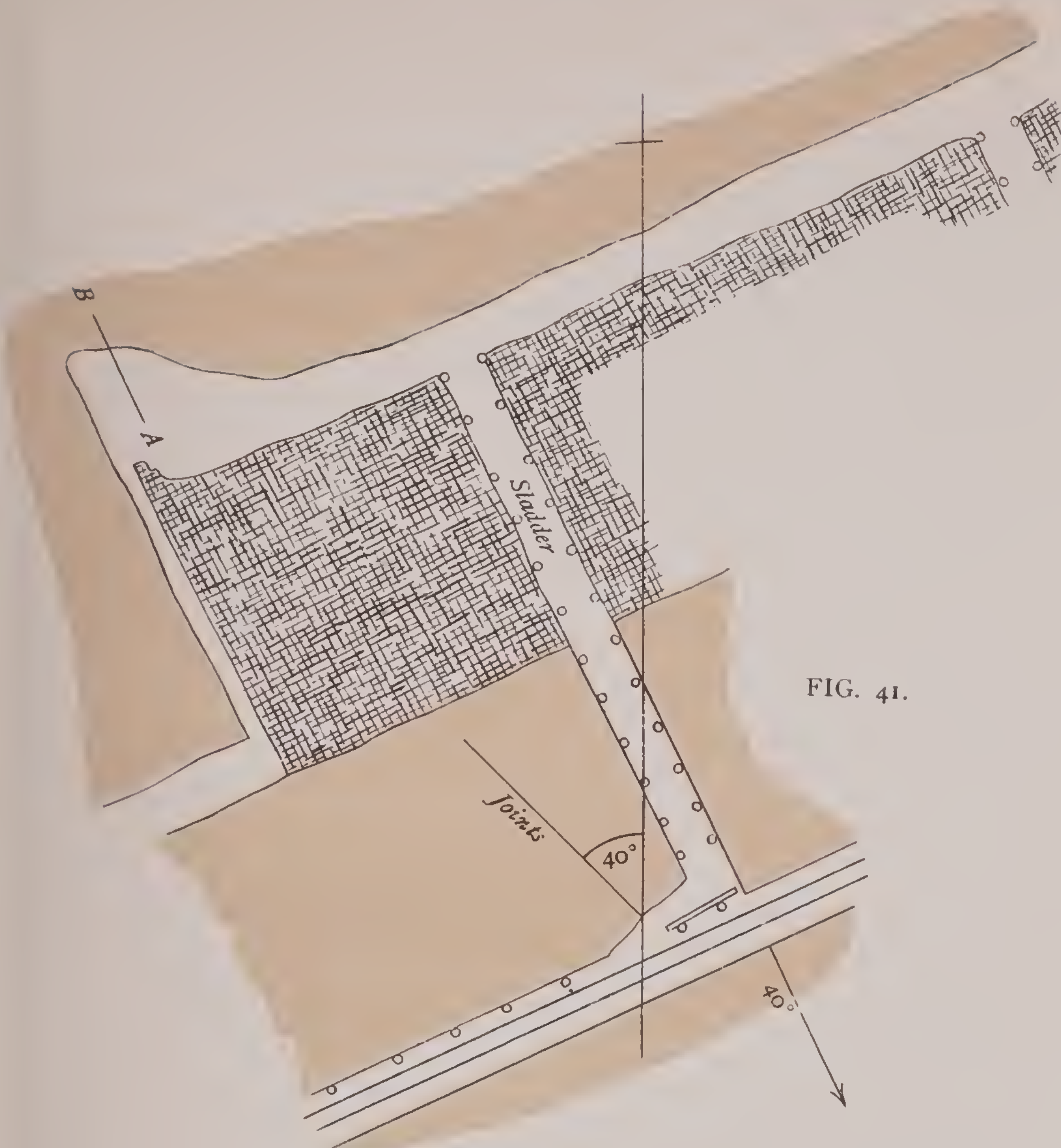
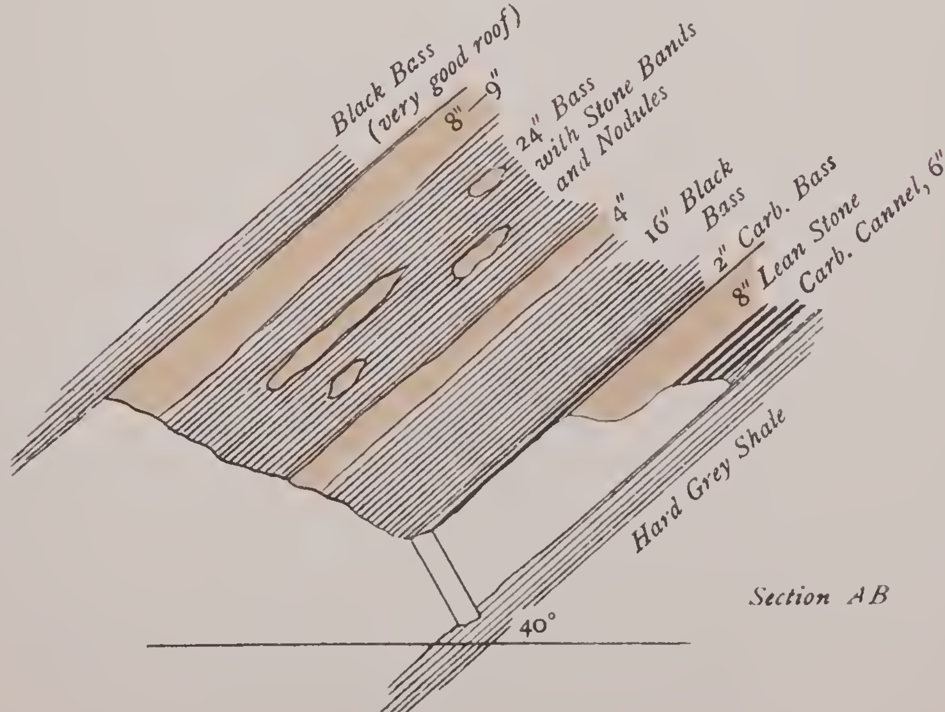


FIG. 41.

Figs. 41 and 42. Plan and Section C. No posts are set. Joints do not run very parallel. They run in the bass bands in the same direction as in the stones.



Section AB

FIG. 42.

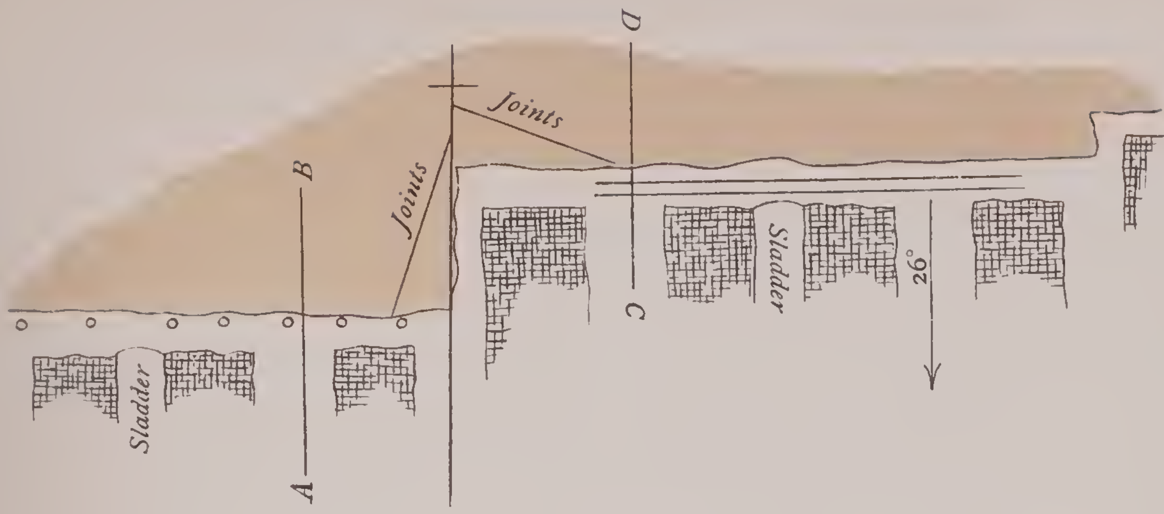


FIG. 43.

Figs. 43, 44 and 45. Plan and Sections C. The joints pass through all the stone and bass bands.

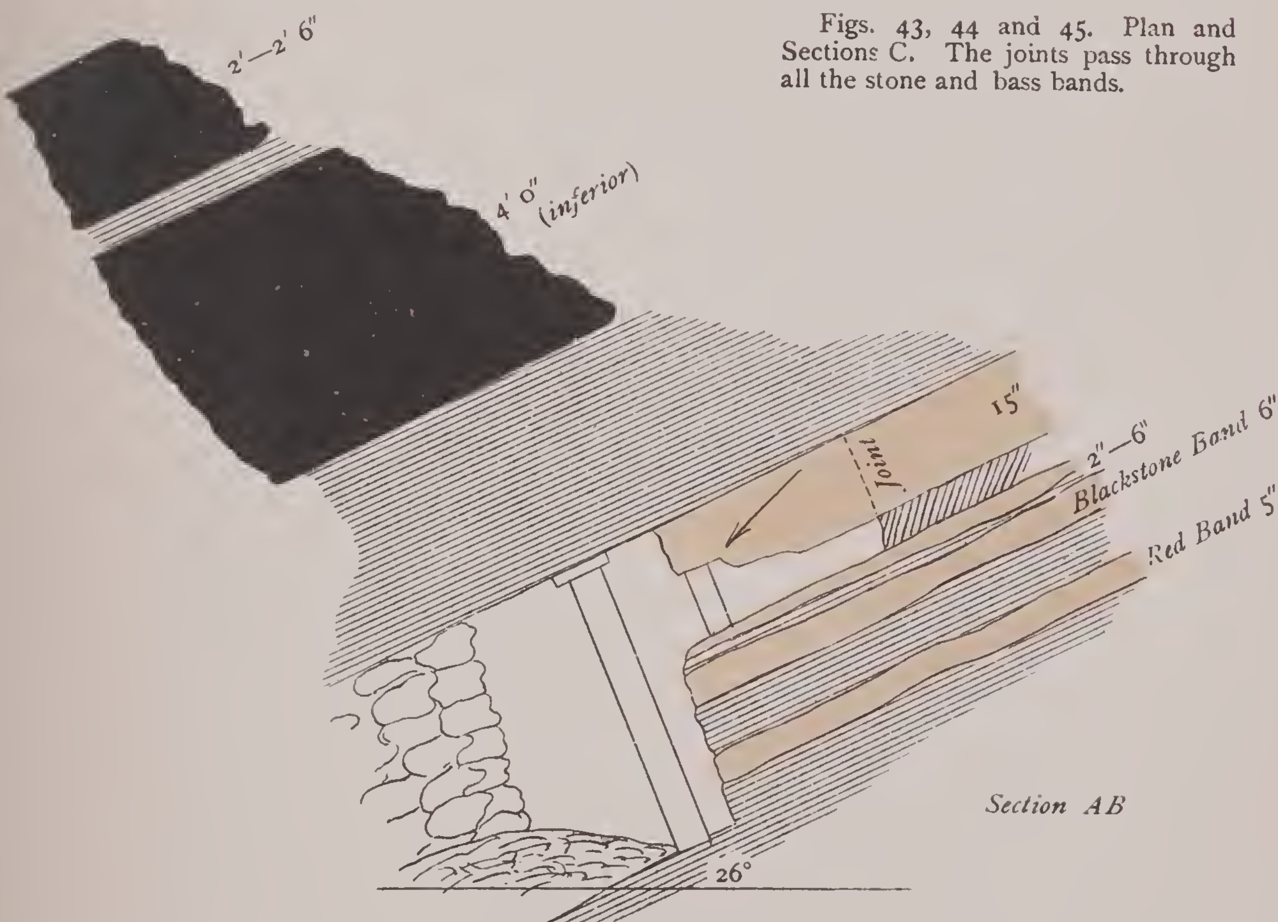


FIG. 44.

Fig. 44 represents the place in which a fatal accident occurred. (See page 45).

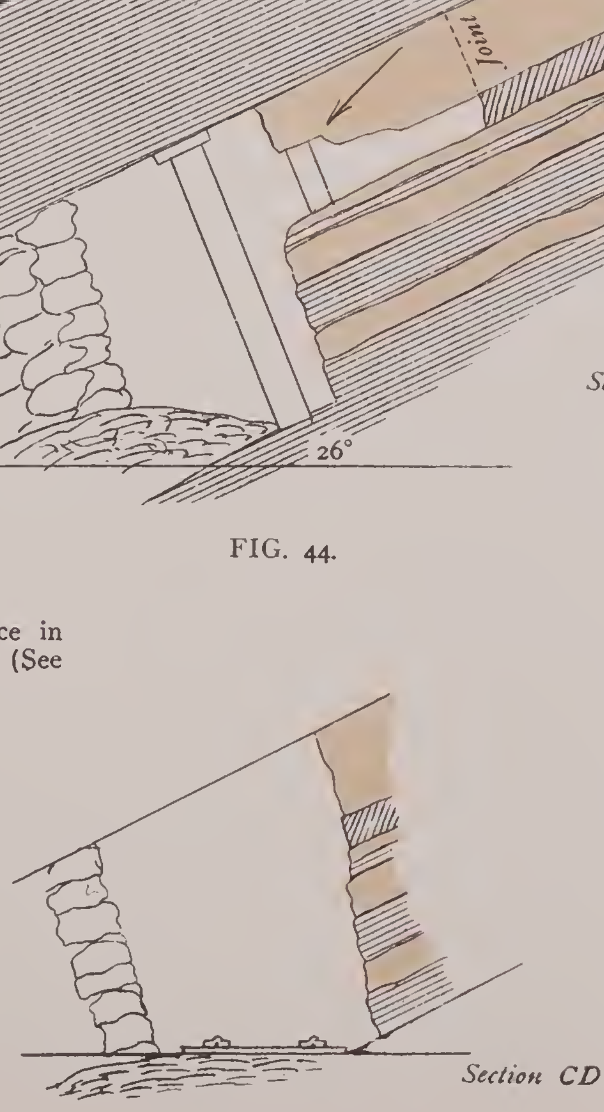


FIG. 45.

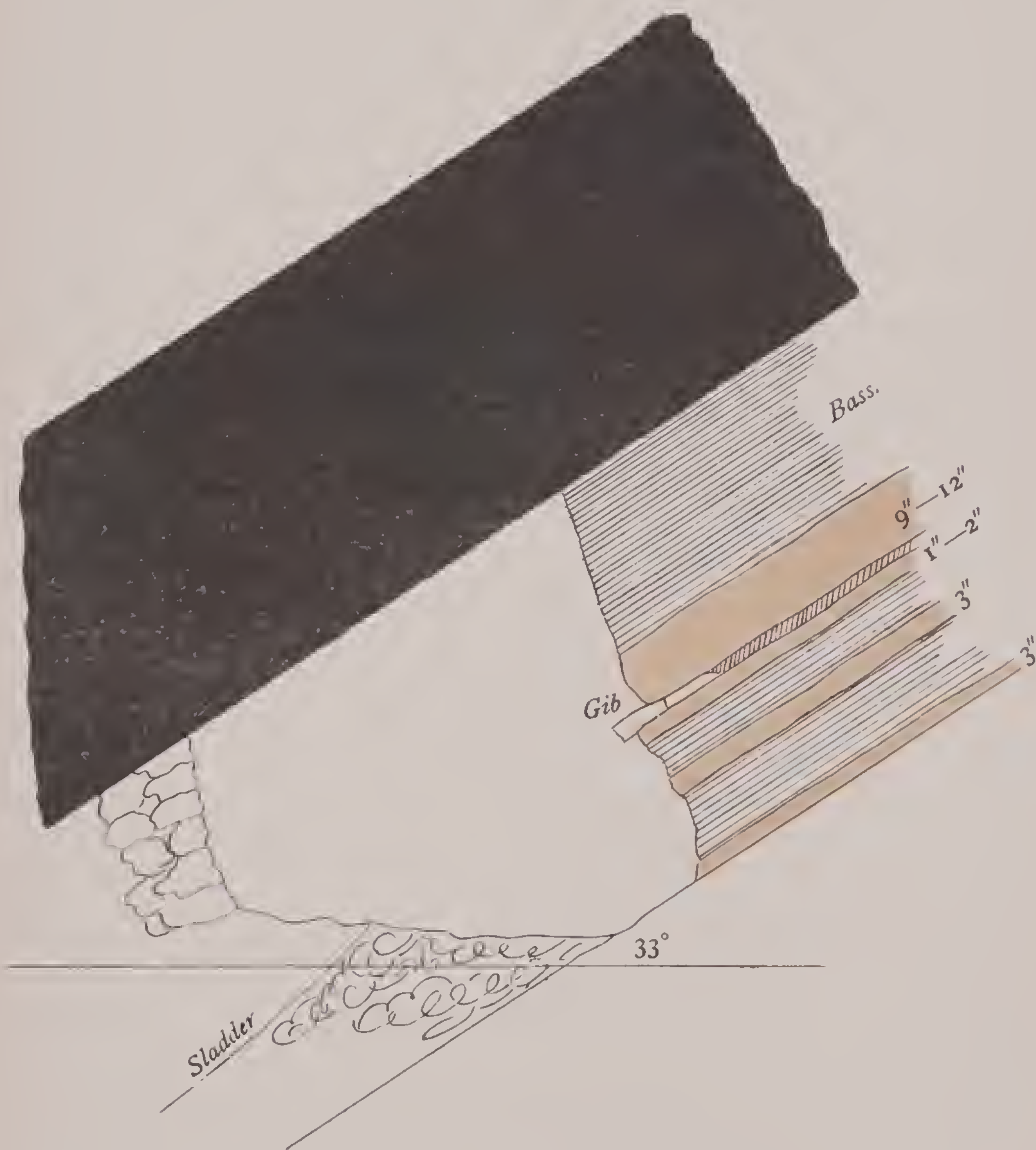


FIG. 46.

Fig. 46. Section SW. Tapering wooden wedges (gibs or block sprags), well hammered in, are used instead of sprags. The gob is entirely packed, so that the coal above is not injured. It forms a very good roof, and requires no timber. The stone is brought to the sladders in wheelbarrows.

FIG. 47.

Figs. 47 and 48. Plan and Section SW. Longwall, from pillars, which ensures better ventilation. Joints in stone bands very near to one another, mostly 80° NW and 47° NE, but in places 41° NW and 52° NE.

The bass contains numerous highly-polished slips, of small extent. The gob is closely packed, some bass having to be sent out. The roof is consequently well supported, and requires no timber.

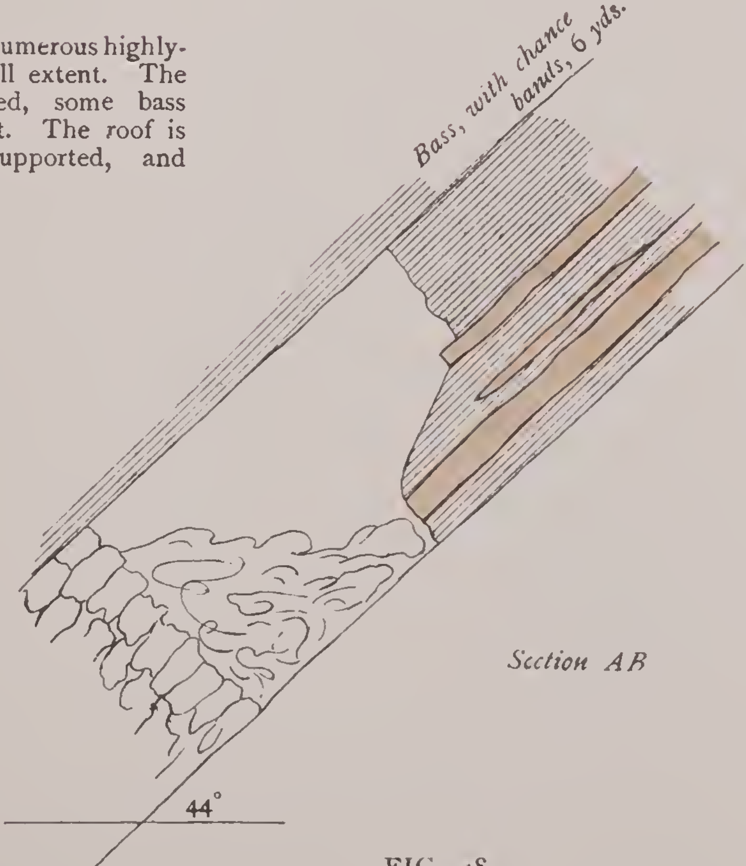


FIG. 48.

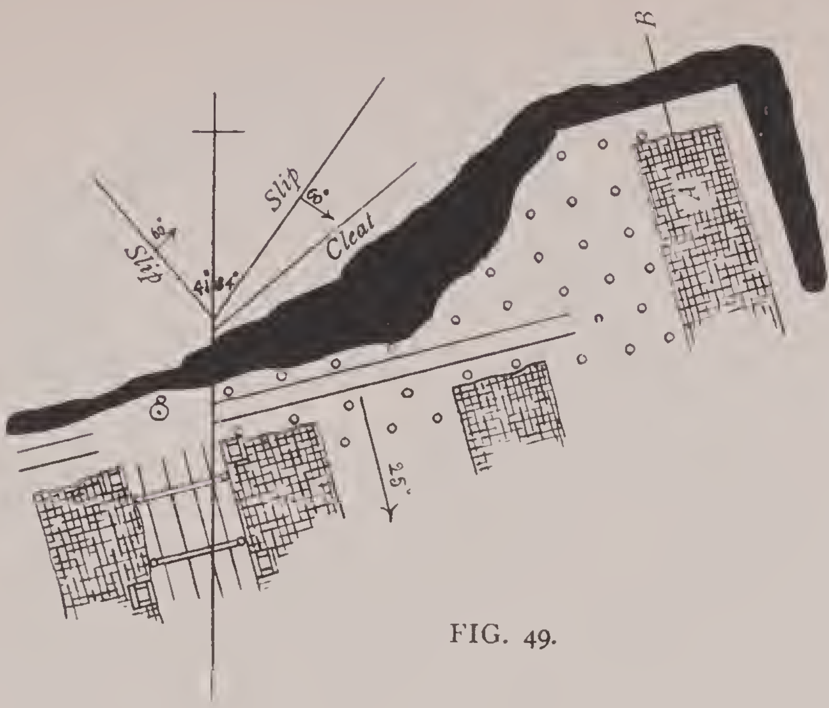


FIG. 49.

Figs. 49 and 50. Plan and Section E. The roof is so bad that as little of it is laid bare at a time as is possible, and the packs are kept close to the face, and built as soon as there is room for them. The drifts are 20 yards on each side the jig, and the face is advanced towards it from either side. It is sometimes worked as in Fig. 60. Cleat distinct. Slips: NE–34°, very frequent; from 6″—3′ apart; do not run into roof. NW-41°, occasional and run into roof.

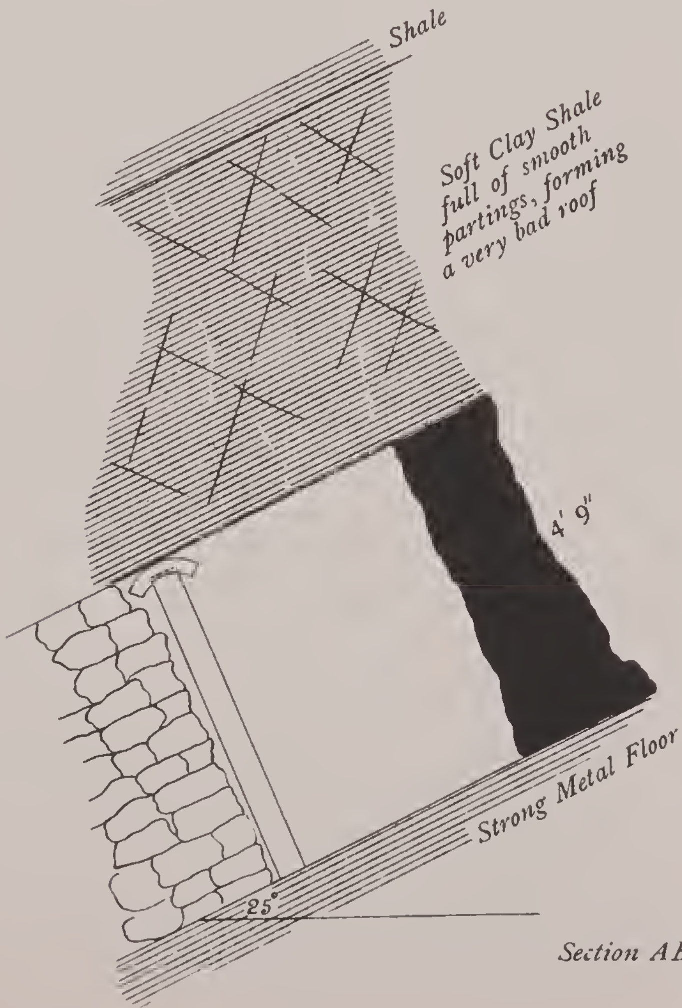


FIG. 50.

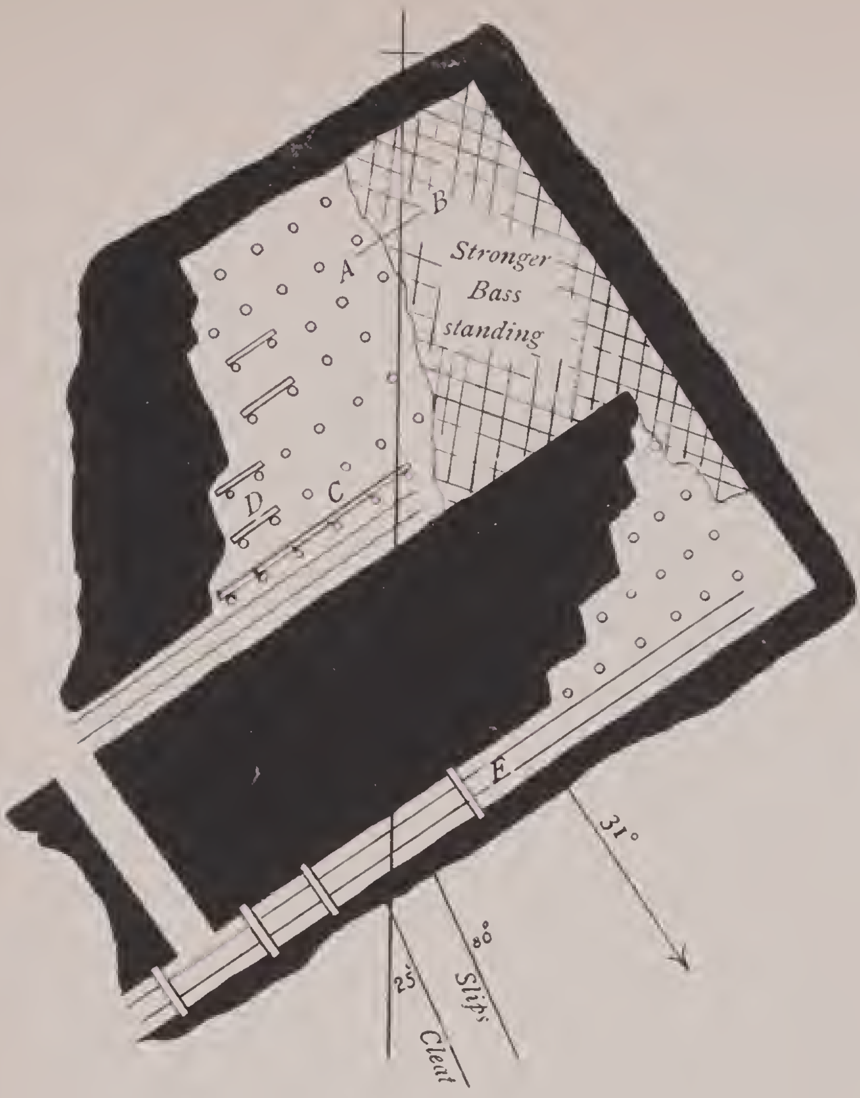


FIG. 51.

Figs. 51 and 52 Plan and Section C. The roof necessitates close timbering. C represents posts laid across to form a jetty, and D posts to stand on whilst working Cleat very distinct; cleat planes from ½ to 1 inch apart in the Cannel coal, and much oftener in the coal. There are numerous floors in the coal.

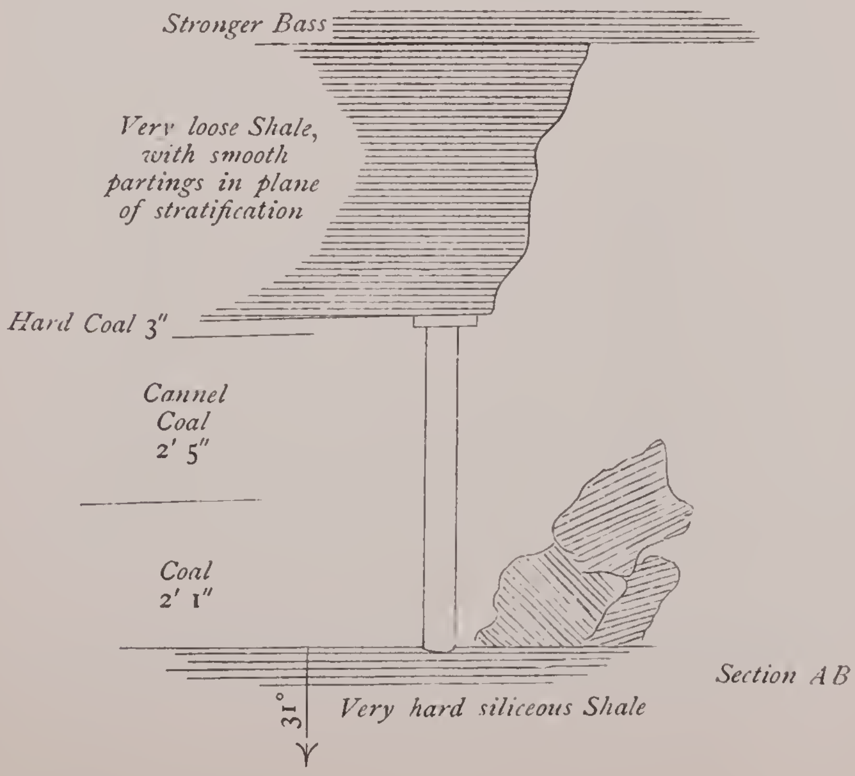


FIG. 52.

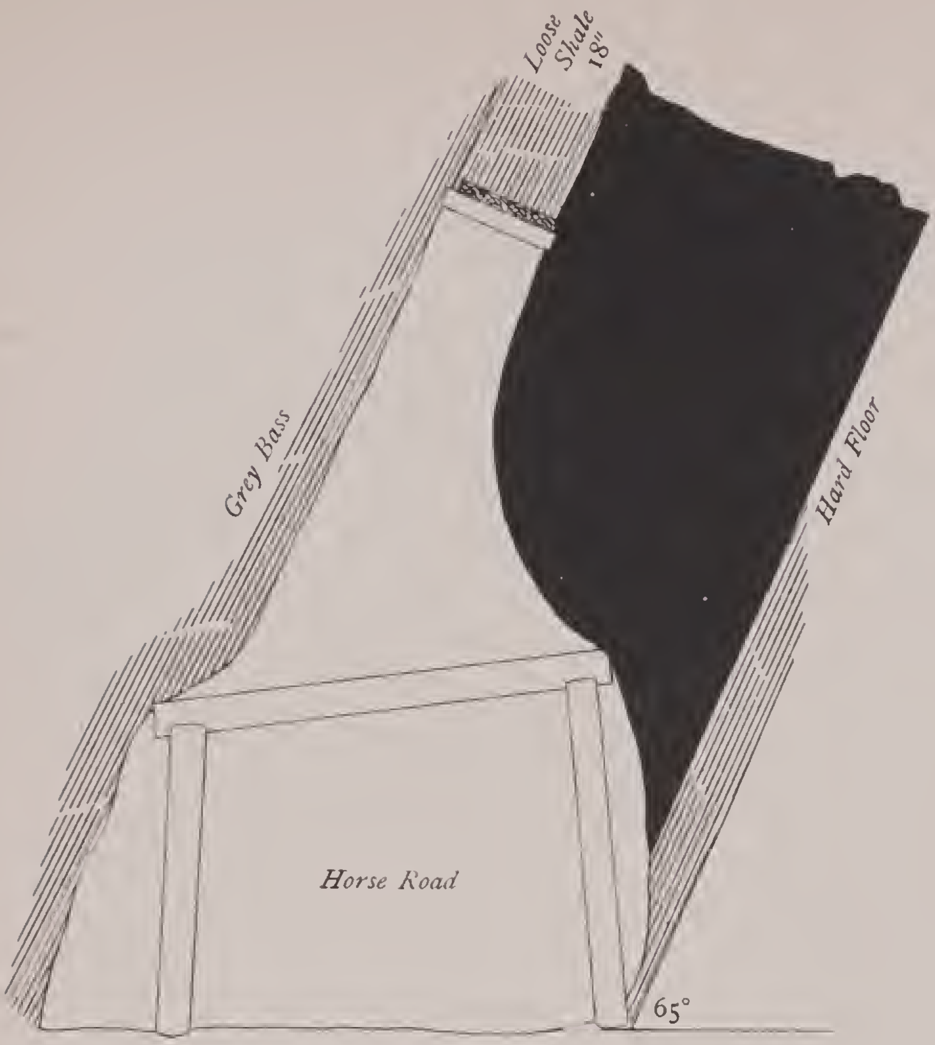


FIG. 53.

Fig. 53. Section W. Shews the result of atmospheric action, on the loose shale, and how it is guarded against. The loose shale is thinner, and the coal thickens to 6 ft. in places.

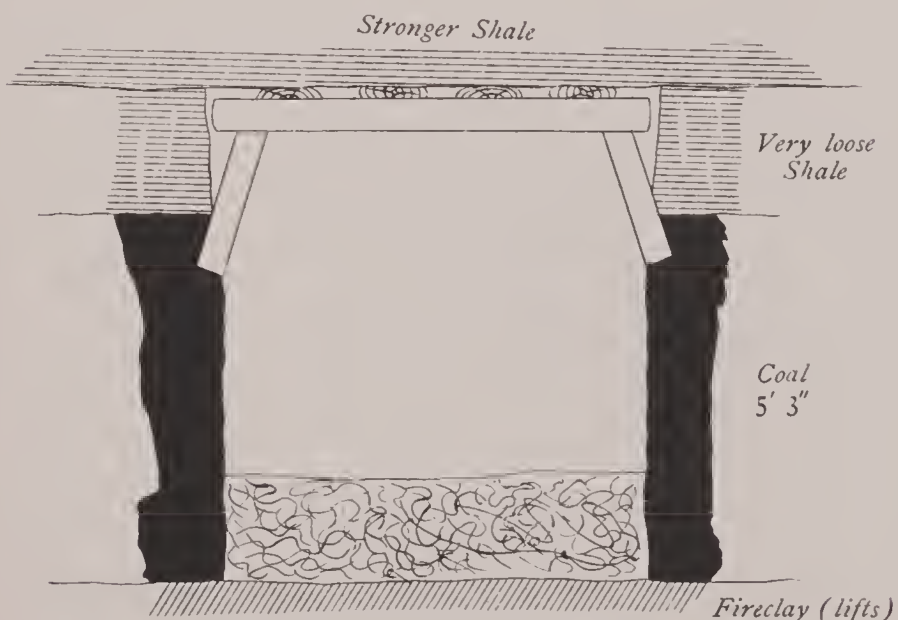


FIG. 54.

Fig. 54. Section of a main road SW. The inclination is slight. The seam is worked by longwall with regularly formed packs; but the wastes are mostly filled. The holing is done in the loose shale lying above the coal.

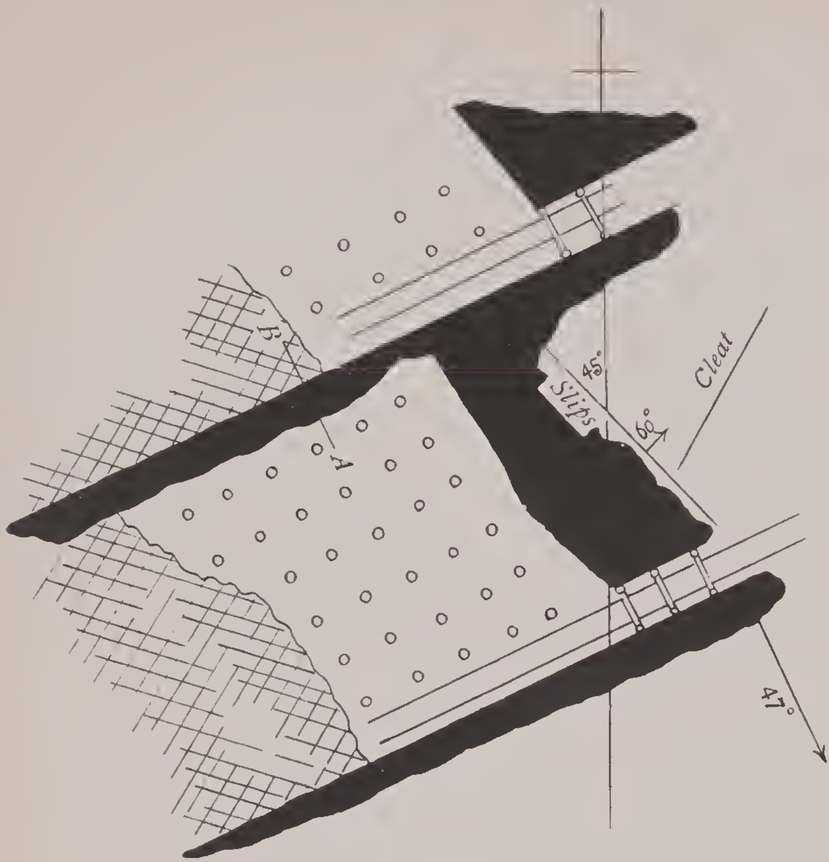


FIG. 55.

Figs. 55 and 56. Plan and Section S. The roof is good and smooth when first exposed, but soon peels off irregularly. Cleat distinct. Slips frequent, almost every yard; they invariably run into the roof.

Fig. 55 represents a back way drift, worked face-way, owing to the pillars being rather crushed, and so easier to work.

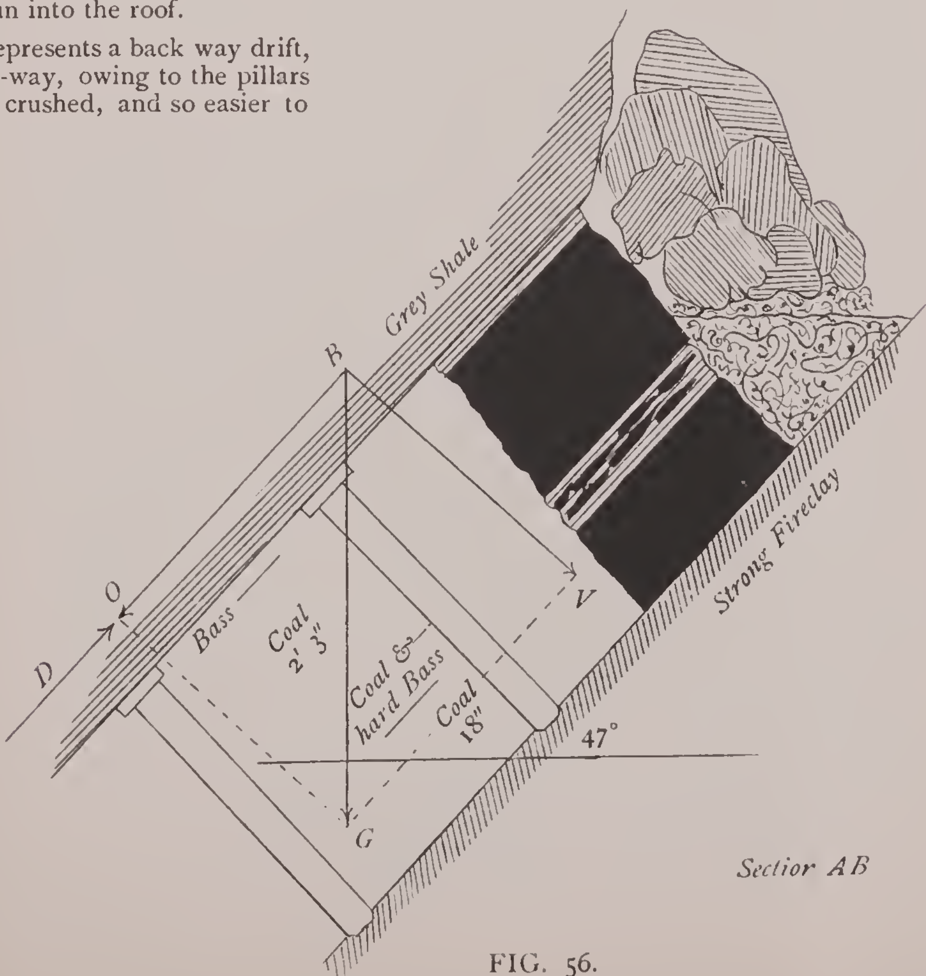


FIG. 56.

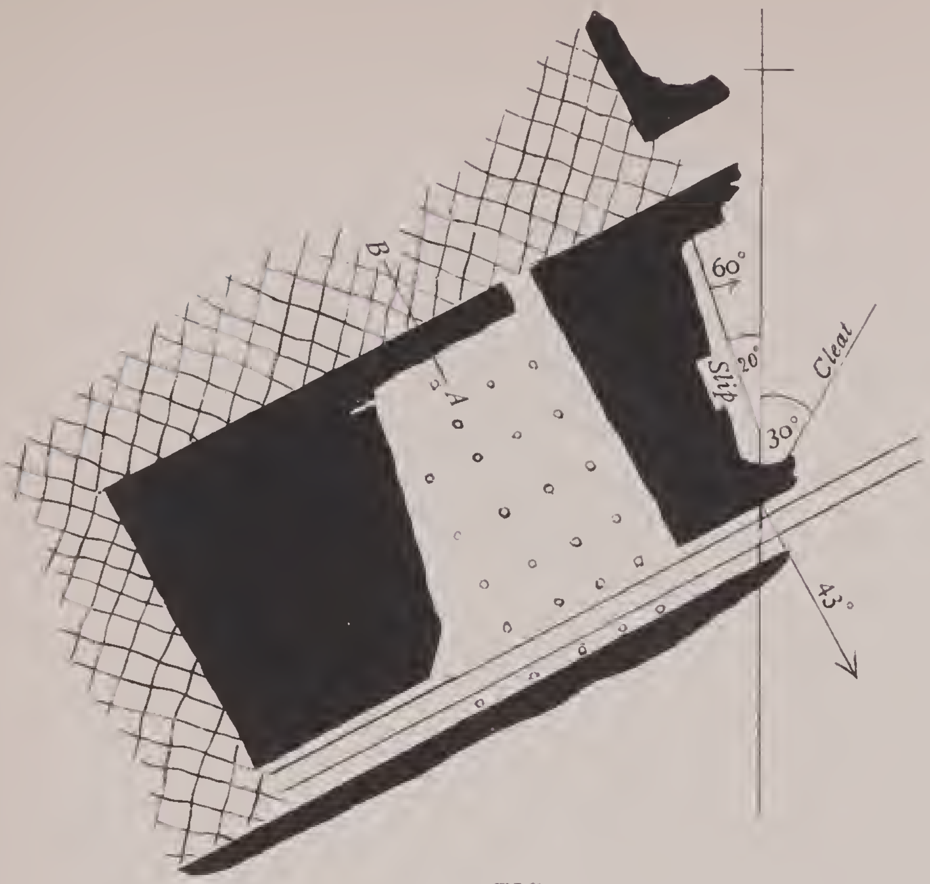


FIG. 57.

Figs. 57 and 58. Plan and Section S. The roof is good, but full of small polished slips. Cleat distinct. Slips frequent ; they run through the loose shale, but not into the roof.

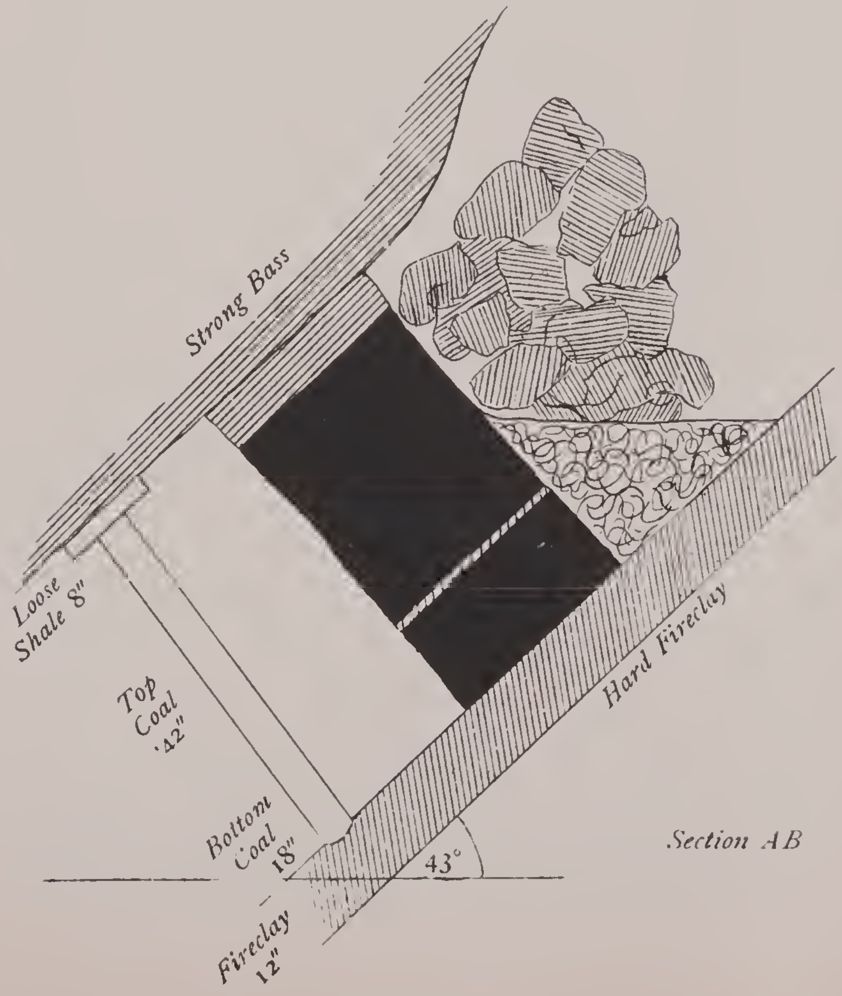


FIG. 58.

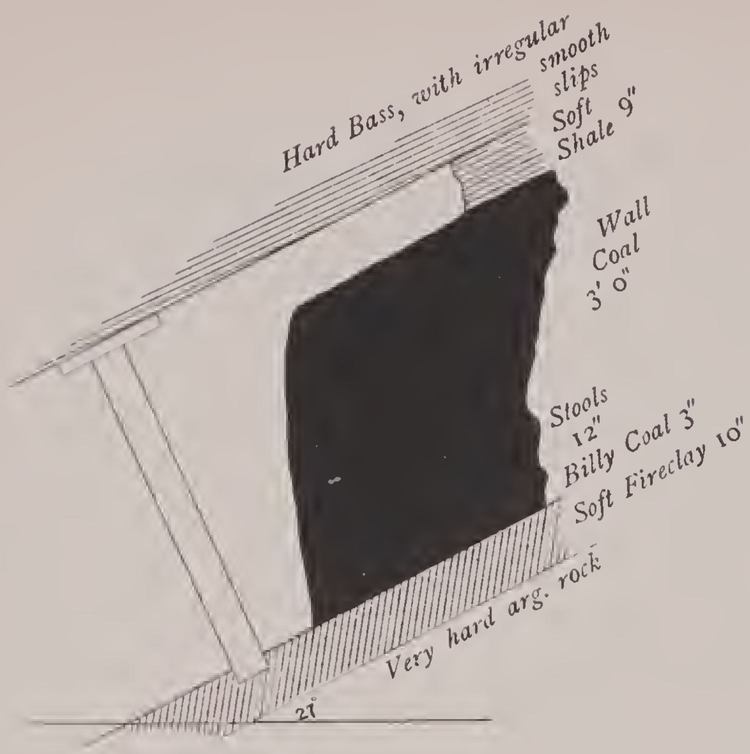


FIG. 59.

Fig. 59. Section Northward. Longwall. Slips 20° NW, from 1′—3′ apart, do not run into roof. Cleat in same direction as slips, and pretty distinct.

FIG. 60.

Fig. 60. Plan C. The coal is slightly thinner, and the inclination less than in Fig. 59. Longwall, with 20 yds. drifts on each side the jig. Cleat distinct. Slips, NW-45°, run into the roof; they are from 18″—2′ apart. Slips, NE-47°, which run parallel to the cleat, are pretty frequent; but do not run into the roof.

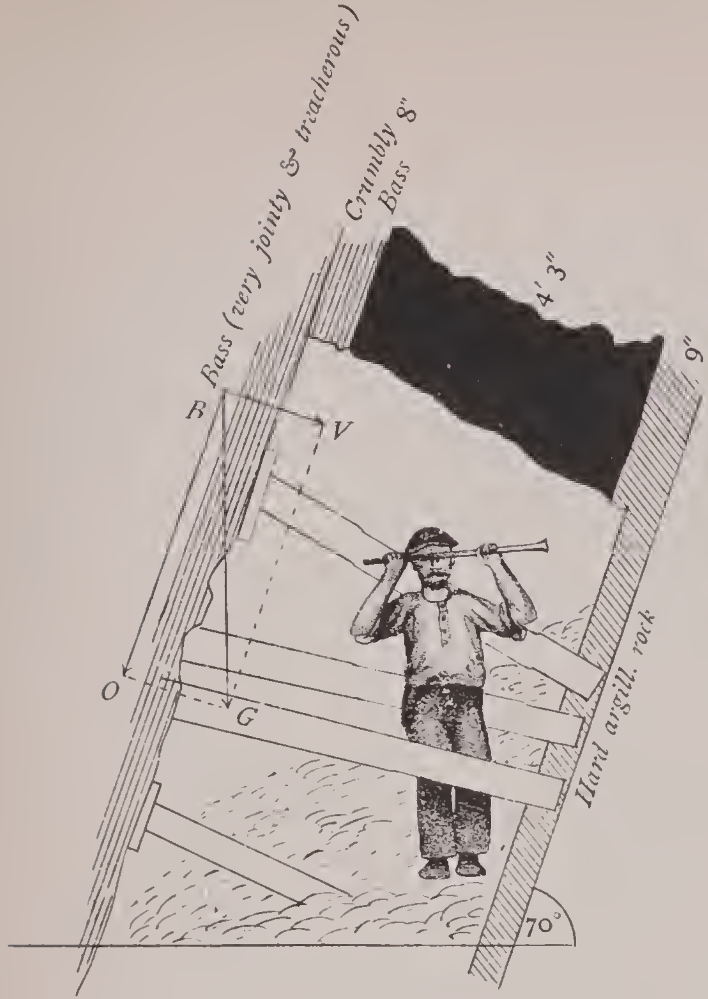


Fig. 61. Section W. Lancashire method as "Rearer." Roof very bad, necessitates timbering.

FIG. 61.

Fig. 62. Section SW. Same method of working. Roof very good; no timber set in drifts. Further SW the inclination is less; the loose bass is 12" thick, the coal 4' 9". The roof is good and the floor very hard. It is worked by the Lancashire method.

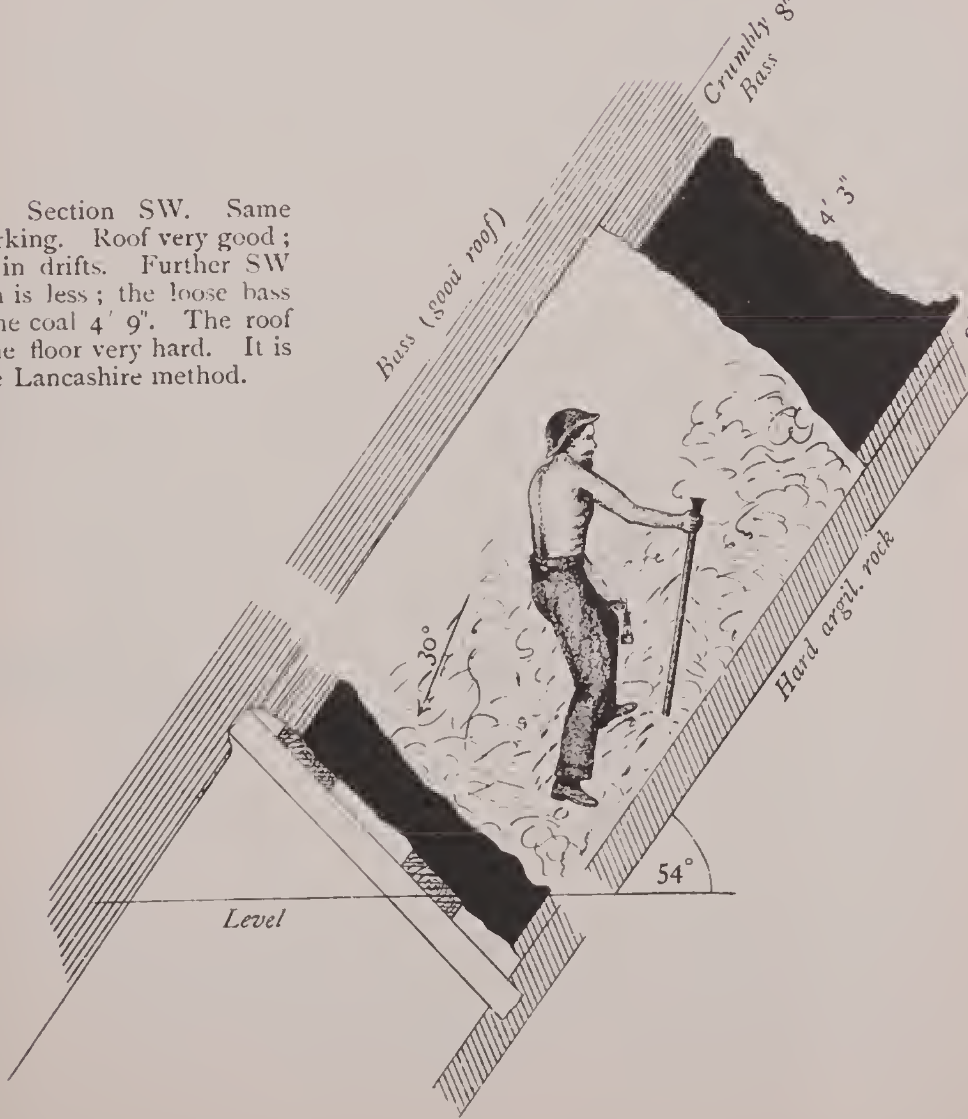


FIG. 62

RAGMAN, ROUGH SEVEN FEET AND HAMS COAL.

FIG. 63.

Fig. 63. Section W. The three seams are worked together. Heads are driven in the Seven Feet and in the Ragman coal, with occasional small holes through the Pous for ventilation. They are driven to the boundary (300 yds.) at different levels, leaving pillars 10 yds. thick. A 2 yds. rib is left; the rest of the pillars are drifted back, beginning at the higher levels. As many as four levels are drifted back together; but generally two. The Hams and Seven Feet are drifted back together; no timber whatever is set: the gob occasionally shoots down, after which a new breadth is started. The Ragman is got down partly from its own level, and partly, when the Pous falls, before the gob shoots down, from the Seven Feet level. About one-third of the Ragman is left behind; very little of the other seams, except the ribs which give way when the gob shoots down.

To the South-West the inclination is about 8°; the Hams is 5′ thick, otherwise the section does not change materially. The three seams are worked together, by the Lancashire method. The headings are driven 9′ wide in the Hams and Yardley; from 10—12 yards apart. Drifting is begun in the Hams, the Bottom Seven Feet is then either shot down or it falls on drawing the posts. The Top Seven Feet is propped up to retard its breakage and the consequent slipping of the gob until the Hams face is sufficiently forward. On the Top Seven Feet Posts being drawn the Pous comes down, the men step on to it and get what Ragman they can (about one-third). The Ragman roof is very strong, and stands well.

To the South the inclination is from 34° to 42°; the Ragman is from 4′ 6″ to 5′ thick; the Pous is 10′ thick and very loose; the Yardley is 4′ 0″ thick and the Hams 4′ 6″. The three seams are worked conjointly. Headings are driven in the Seven Feet Coal, as in the Lancashire method of working, on either side the jig. Cruts are driven from each of these headings to the Hams Coal every 12 yds., beginning 12 yds. from the boundary, and driving them as required. A heading is driven in the Hams Coal from the first crut to the boundary, a distance of 12 yds., and the coal drifted out that distance with a 12 yds. face; the timber is then drawn and the Yardley falls. The crut is then abandoned, and the Bottom Seven Feet Coal, which meanwhile subsides, is got at and removed from the Seven Feet heading, beginning at the far end and posting to the Top Seven Feet Coal. The latter is afterwards dropped in short pieces, posts being set to the Pous. The consequent subsidence or "swag" of the overlying Ragman Coal, which is immediately perceived in the upper level, greatly assists its extraction. A separate heading is driven in the Ragman Coal from a crut leading into the Seven Feet heading close to the jig. As soon as the first drifts are completed in the Hams and Seven Feet Coals, new drifts are started 12 yds. back in the same way.

This method of working these three seams is frequently slightly modified, especially where the Yardley is 6′ and the Pous 15′ thick, as it is in places. Some of the Top Seven Feet and Ragman Coals are often left in.

To the North the Seven Feet Coal divides into two seams separated by 6′ of shale. The top part is worked in conjunction with the Ragman. The Hams lies 17 yards below, and is worked separately :

RAGMAN AND TOP SEVEN FEET COAL.

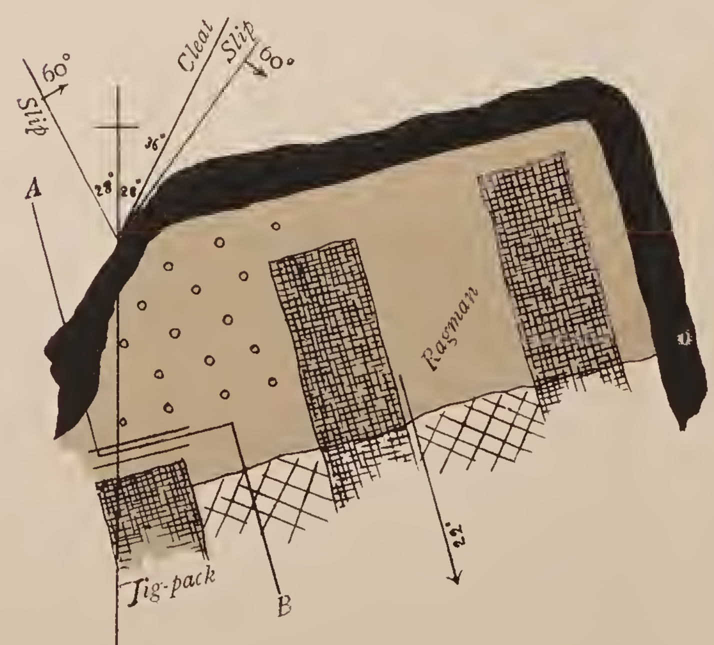


FIG. 64.

Figs. 64 and 65. Plan and Section North. The drifts extend 20 yards on each side the jig. The Seven Feet Coal is first drifted back in 7 or 8 yds. breadths from each side to the jig, the Pous forming the roof. The packs are built as soon as possible. In going in again about 6′ of coal is removed to form the new road. The Ragman is got from the new level in going in. That which falls with the Pous only requires picking (Fig. 65), the remainder is worked by turning the rails into the wastes about 7 yds. The coal is also worked off all but the jig packs.

Another way in which these two seams have been worked is by first taking the Ragman Coal out 4 yds. in advance to the rise, and removing the Pous overnight, when the Seven Feet Coal is afterwards found broken up into large coal, and only requires to be loaded. This is advantageous, as it prevents small coal being formed, which would heat the gob.

The Seven Feet Coal is good and hard. It contains a few hard grey bands in the middle of the seam; these are impregnated with lumps and grains of pyrites. The cleat is distinct and slips frequent.

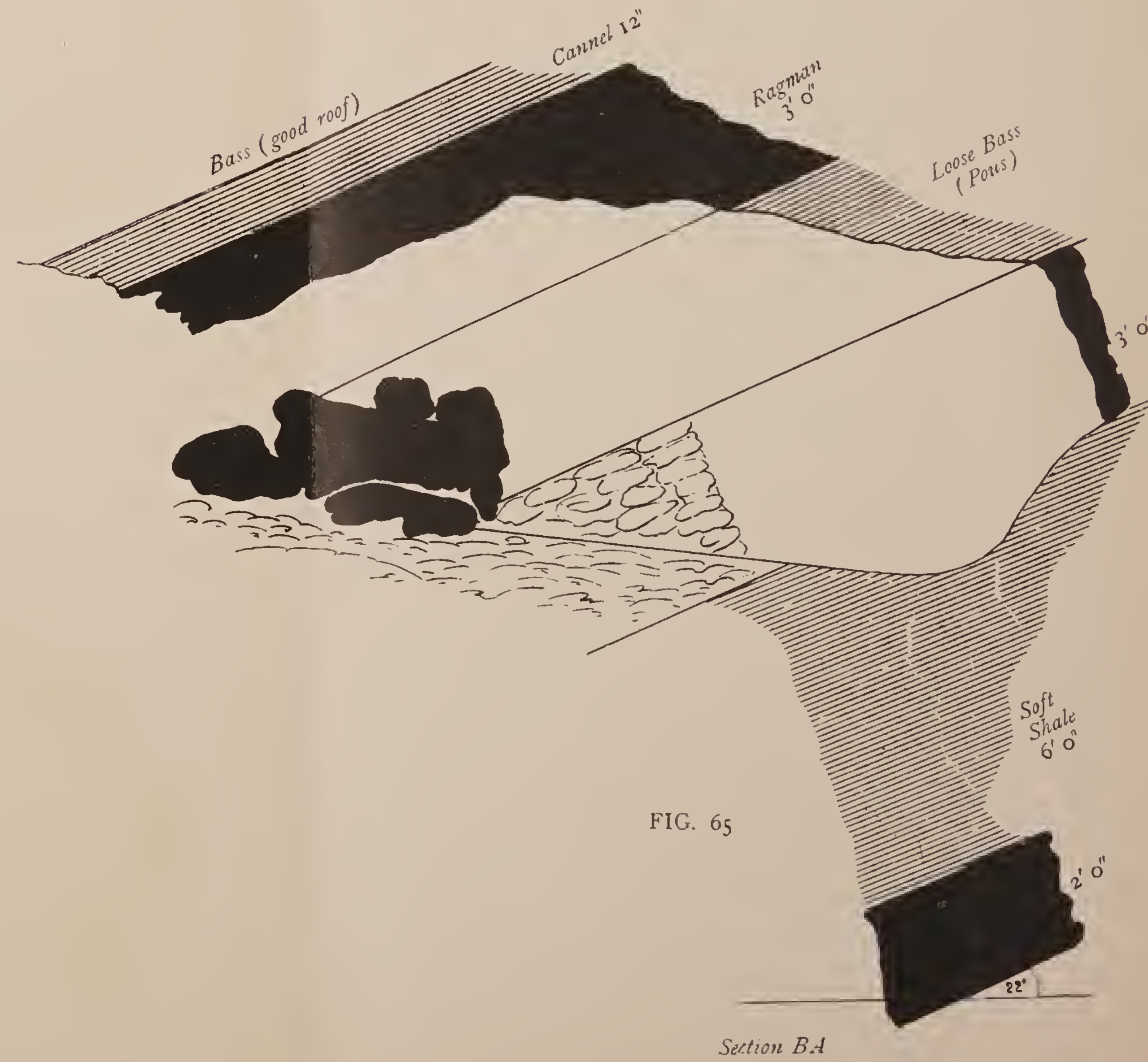


FIG. 65

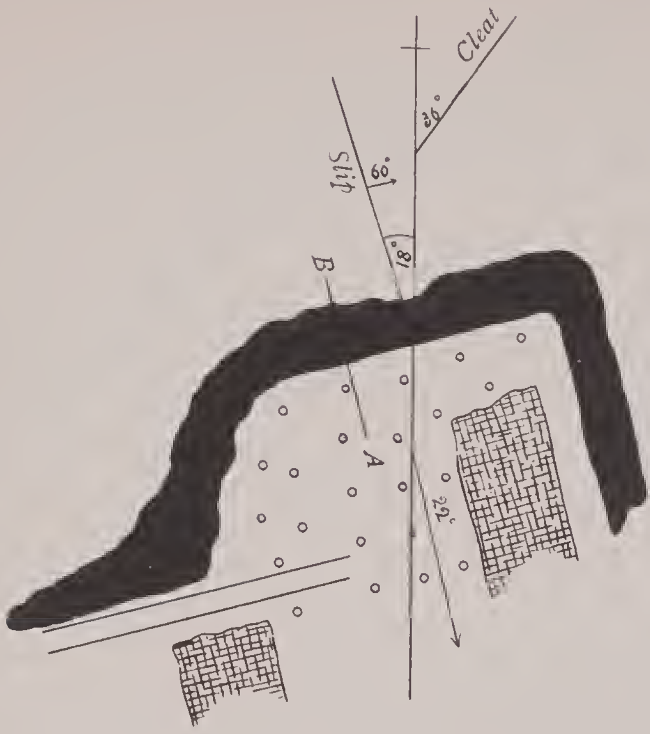


FIG. 66.

Fig. 66 and 67. Plan and Section North. Worked in 20 yds. drifts on each side the jig. Cleat very distinct. Slips frequent.

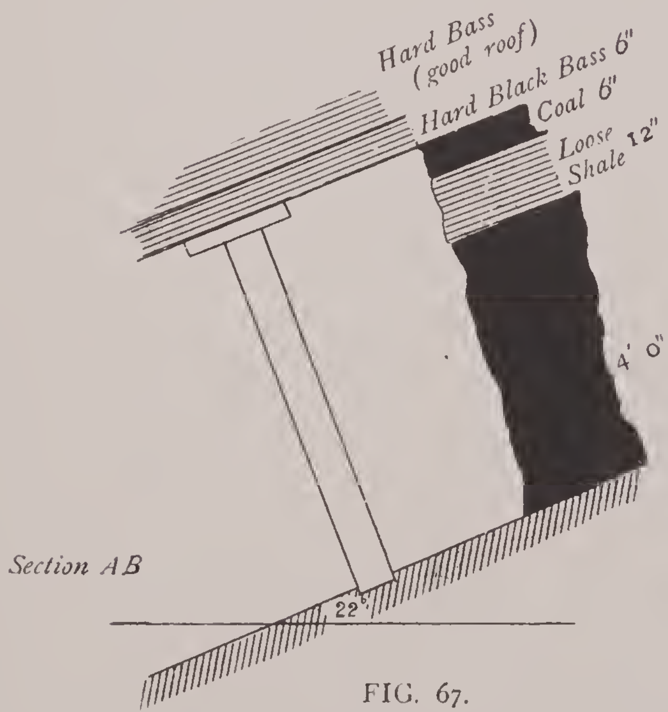


FIG. 67.

Towards the centre the Ragman and Hams Coal only are worked, and this independently of each other :

RAGMAN COAL.

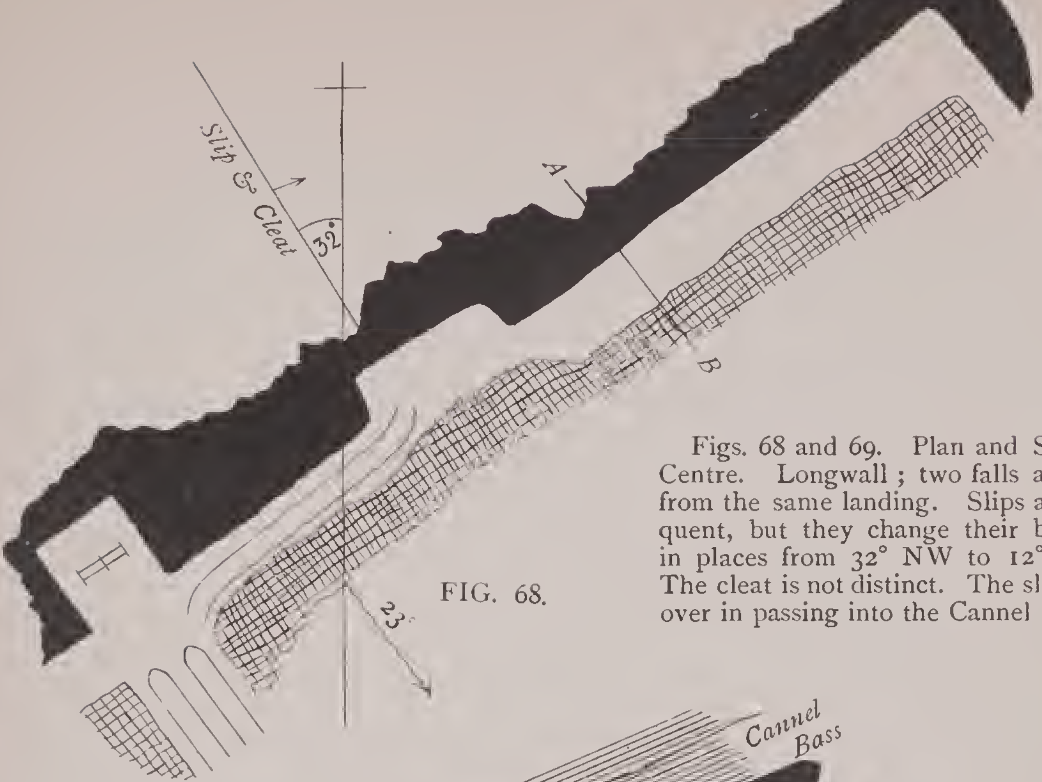


FIG. 68.

Figs. 68 and 69. Plan and Section Centre. Longwall; two falls are got from the same landing. Slips are frequent, but they change their bearing in places from 32° NW to 12° NW. The cleat is not distinct. The slips lap over in passing into the Cannel Bass.

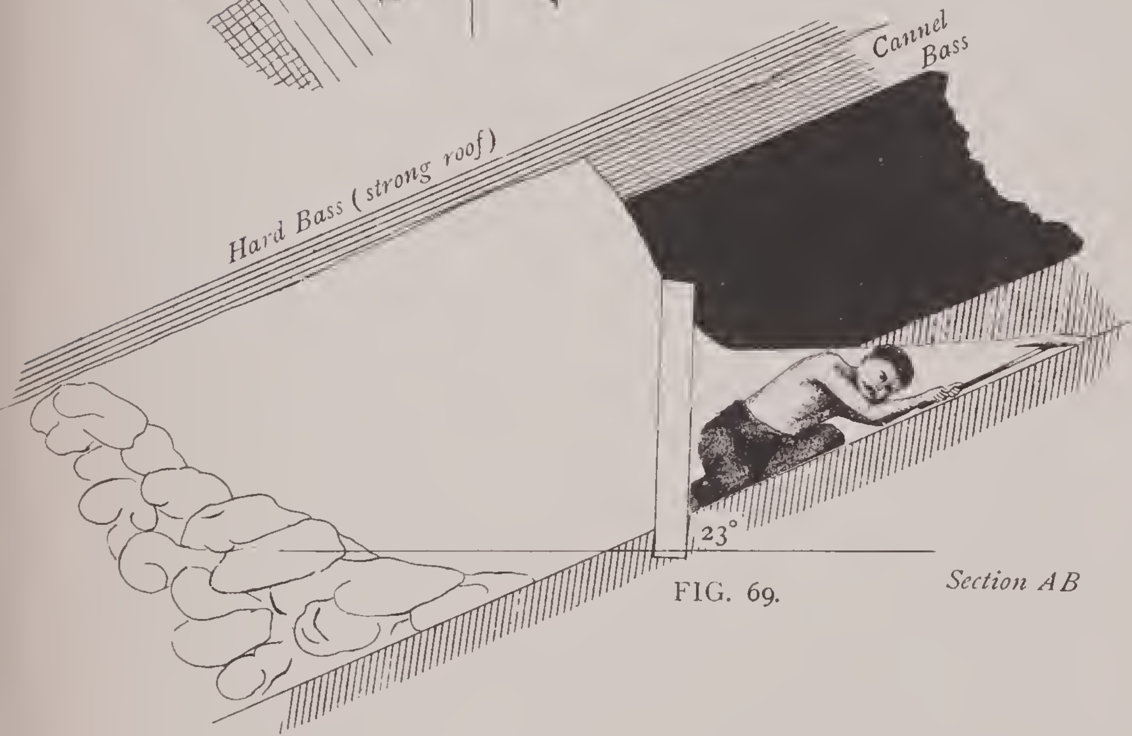


FIG. 69. *Section AB*

HAMS COAL.

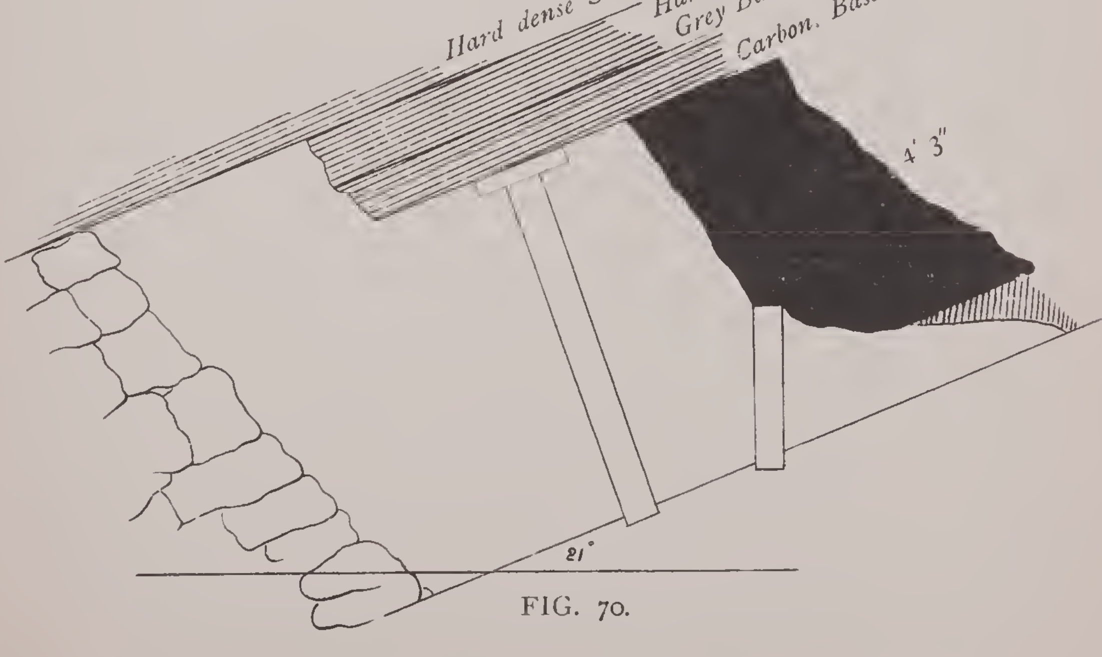


FIG. 70.

Fig. 70. Section Centre. Worked like Ragman. Slips occur 11° NW and 24° NW in different places, and dip NE.

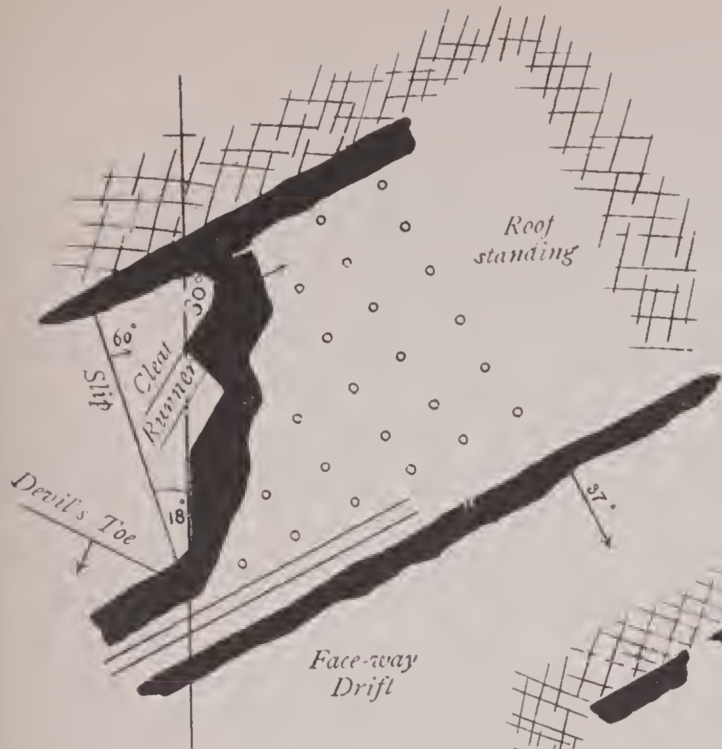


FIG. 71.

Figs. 71, 72, 73. Plans and Section S. Lancashire method. Fig. 71 is a "face-way drift" and Fig. 72 a "back-way drift," worked from a fast end at intervals. Cleat distinct. Slips: very frequent, and all run into the roof. Runners: small faults in the direction of the cleat, throwing both coal and roof slightly up on the gob side above. They run like the cleat at right angles to the plane of stratification. It is supposed that they are due to the pulling action of the roof over the gob above, and are only breaks, which, owing to the grinding action to which they have been exposed, present rather smooth surfaces. The roof is very strong.

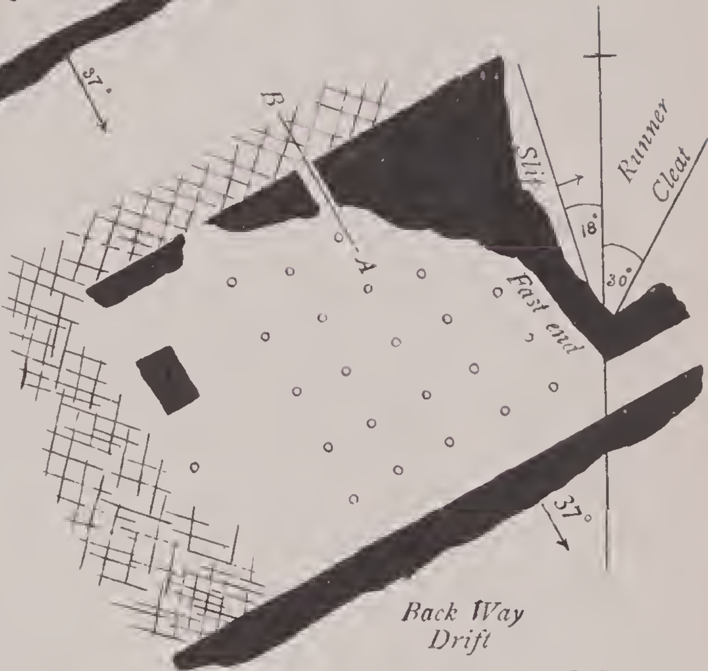


FIG. 72.

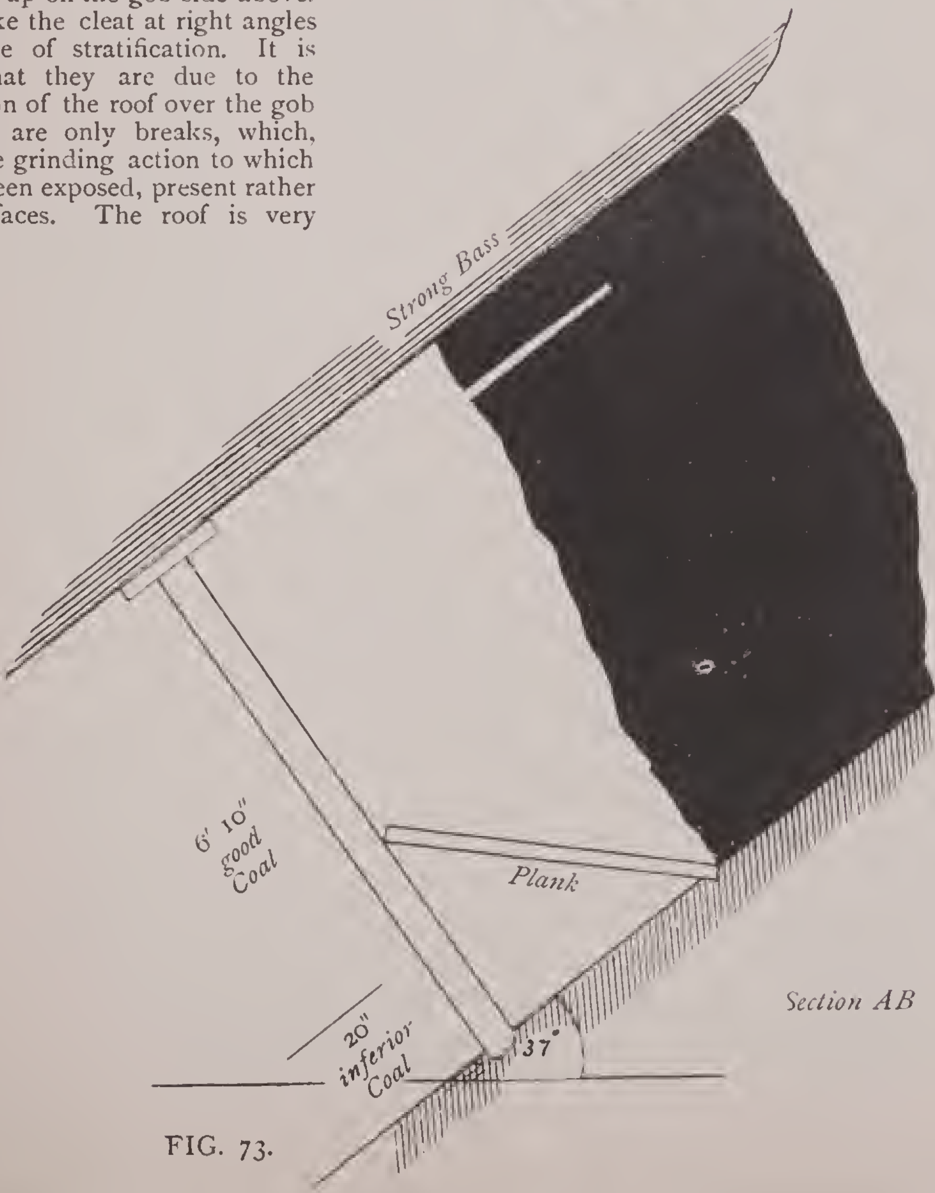


FIG. 73.

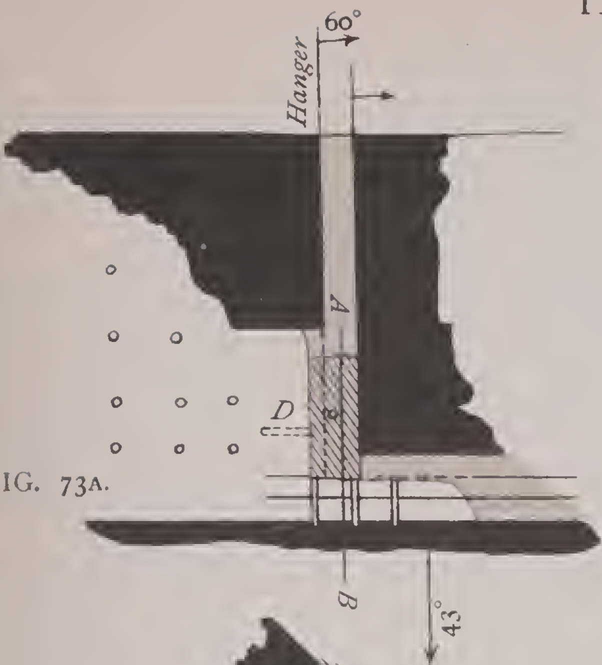


FIG. 73A.

Figs. 73A and 73B. Plan and Section of a drift near Fig. 73, illustrating a fatal accident which occurred to the fireman during his examination, after he had fired a shot higher up the drift. The drift had reached an old thurling, in which the Top Coal was supported by a post *P*, and two stretchers or sprags, such as *S*. The fireman was standing near the tub, and the collier was stamping a hole, preparatory to drilling it, for the purpose of blowing the Top Coal down, when five tons of it fell off a slip towards the drift, reeling out the post and the two stretchers. Had another post been set under the Top Coal in the thurling, or a sprag *D* set against the Top Coal the accident would have been prevented.

Section AB

FIG. 73B.

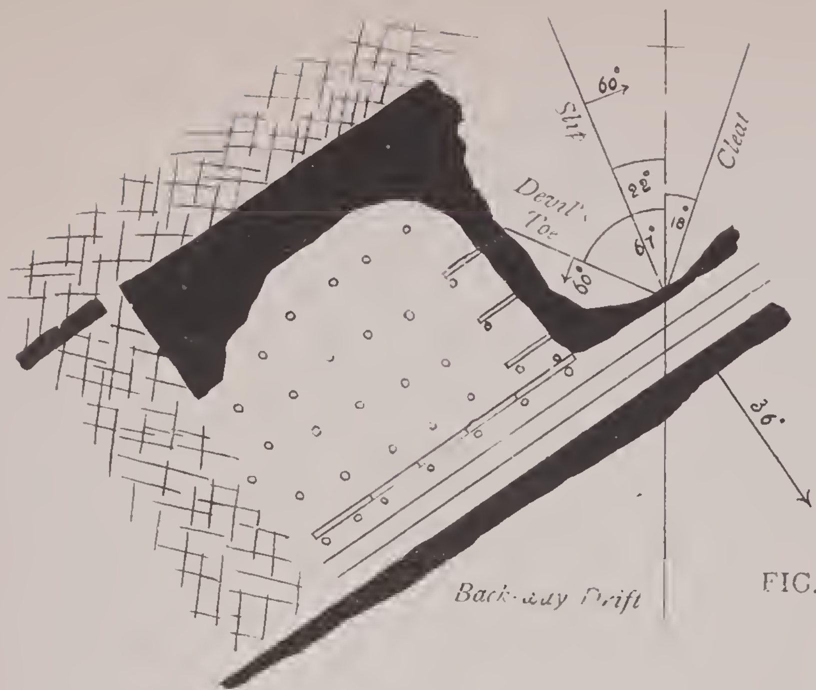


FIG. 74.

Fig. 74. Plan of "Back way Drift" C. Section nearly the same as in Fig. 73. Roof fairly good. Cleat pretty distinct, 18° NE and occasionally nearly at right angles to this direction. Slips occur frequently, and only run through a 4′ layer of strong black bass which forms the roof. Slips called "Devil's toes" occur in places; sometimes as small 1 inch faults, which at times stand a little off when entering the roof. They make the get of the coal more difficult in "strait places" when working backway to them.

SW. The cleat is very distinct, and runs 38° NW. Slips frequent: run 18° NW

W. The coal contains a half inch dirt band, 20 inches from the top; the inferior coal at the bottom, called "stools" are left in all "strait" work, as the floor is very soft.

TOP TWO ROW IRONSTONE.

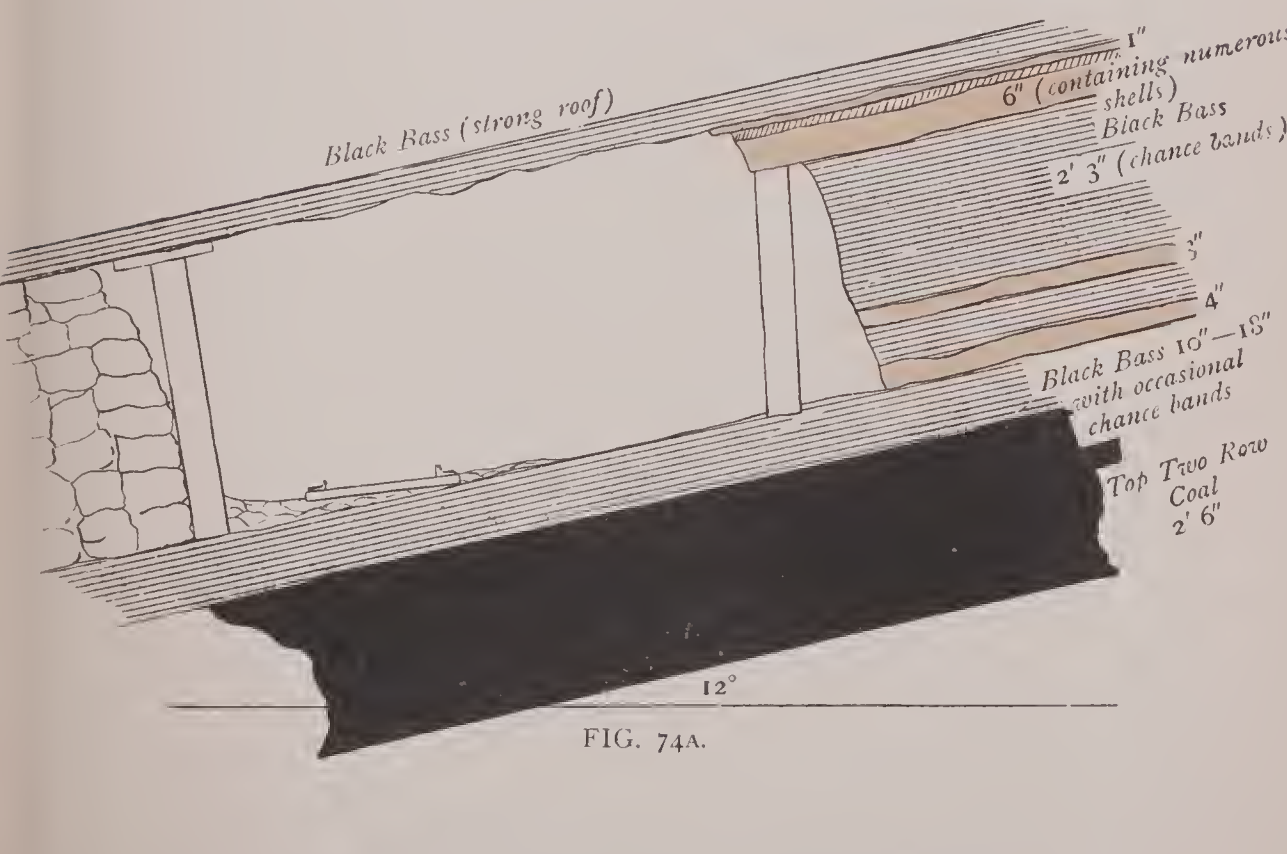


FIG. 74A.

Fig. 74A. Section S. The stone is worked in longwall drifts, with jigs 80 yards apart. The gob is entirely packed. One of dirt is sent out to two of stone. Water is thrown on to the face, and loosens it considerably.

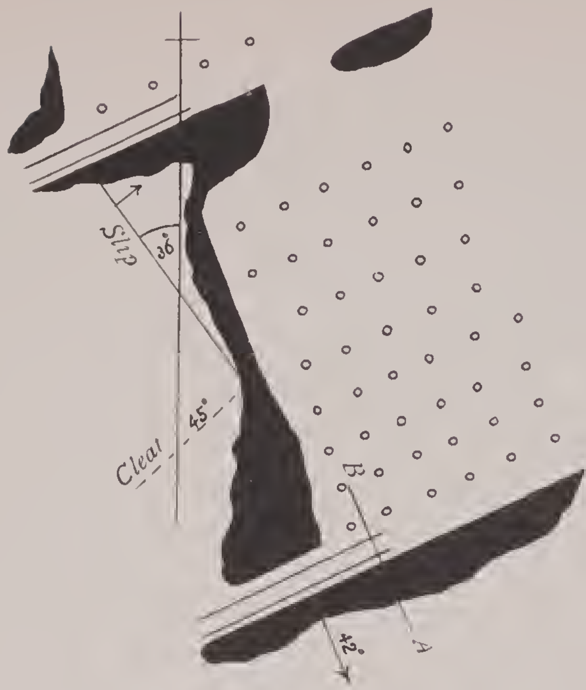


FIG. 75.

Figs. 75 and 76. Plan and Section SE of last Figs. The ironstone bands in the roof are sometimes worked simultaneously with the coal, a few yards behind it. The coal is hard and extremely dusty. It sticks to the roof, and would require to be blasted if underholed. This is dangerous, owing to the quantity of dust present. Consequently holing is done at the top, which enables powder to be dispensed with, but increases the dust. Cleat not distinct. Slips: from $\frac{3}{4}$ to 1 yard apart.

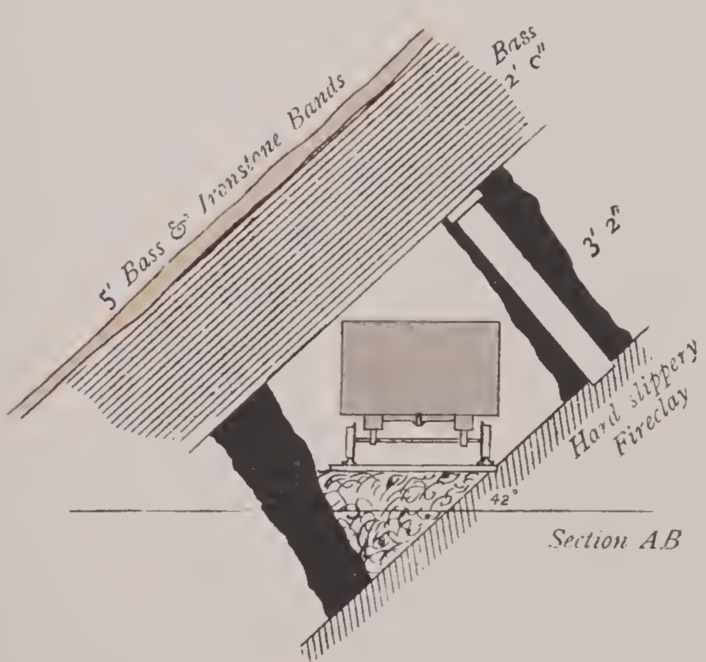


FIG. 76.

SW. The thickness of the seam is the same, but there are 8" of Cannel Coal at the bottom. The roof is not good.

N. The coal lies on 10" of carbonaceous shale, in which the holing is done. There is a band of stone, which varies in thickness 10" above the coal. The bass above it contains numerous fossils.

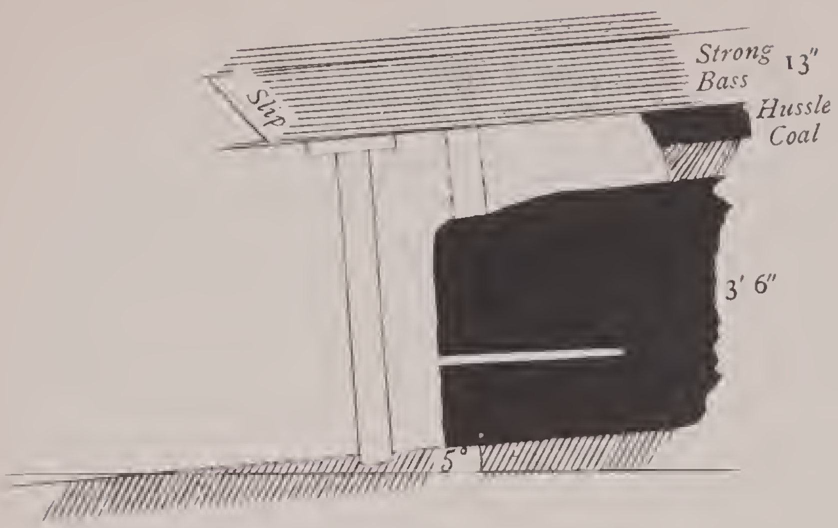


FIG. 77.

Fig. 77. Section N. Cleat irregular. The roof is strong, but contains slips, through disregard of one of which an accident occurred to a collier.

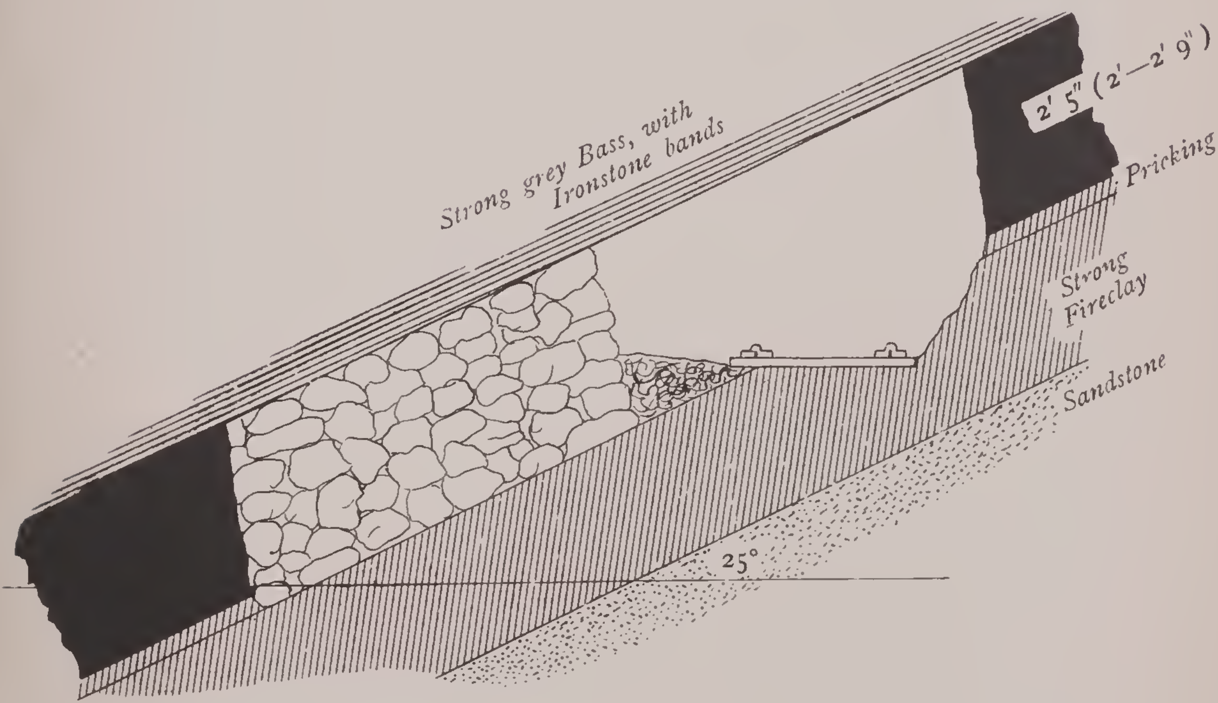


FIG. 78.

Fig. 78. Section of heading S. Lancashire method, as in Fig. 75, except that headings are driven four yds. wide, and the floor taken up at the high side for room, the dirt so taken up being packed at the lower side. Slips frequent, pretty much as in Fig. 75. Holing is done in the pricking, generally to a slip, but no great distance, as the coal comes off well, and the men keep getting it off. The pricking is very hard in places, so that the coal has to be holed at the top, and it is then levered up with a pick. Powder is seldom used in drifts; it is used in "strait" work and for blowing up the floor. The seam is dusty.

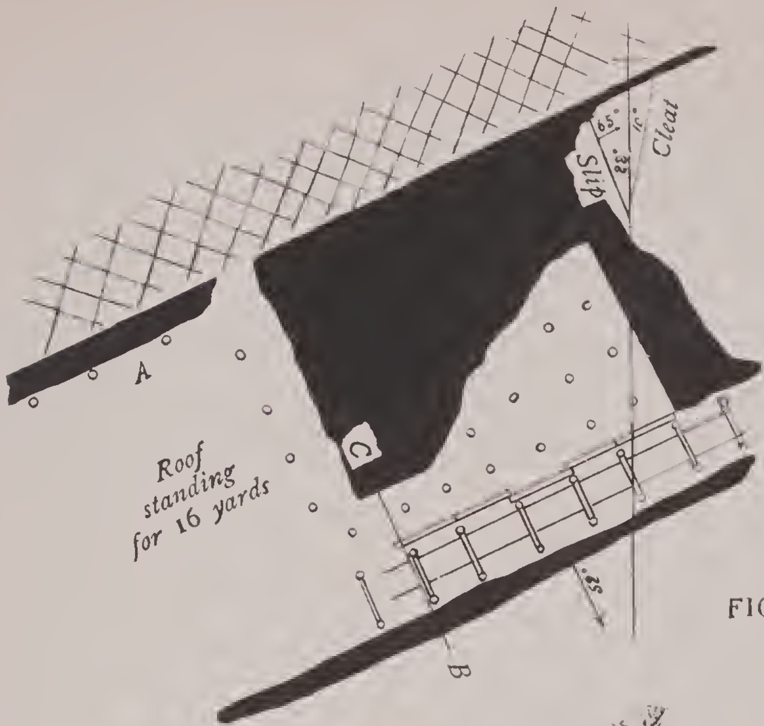
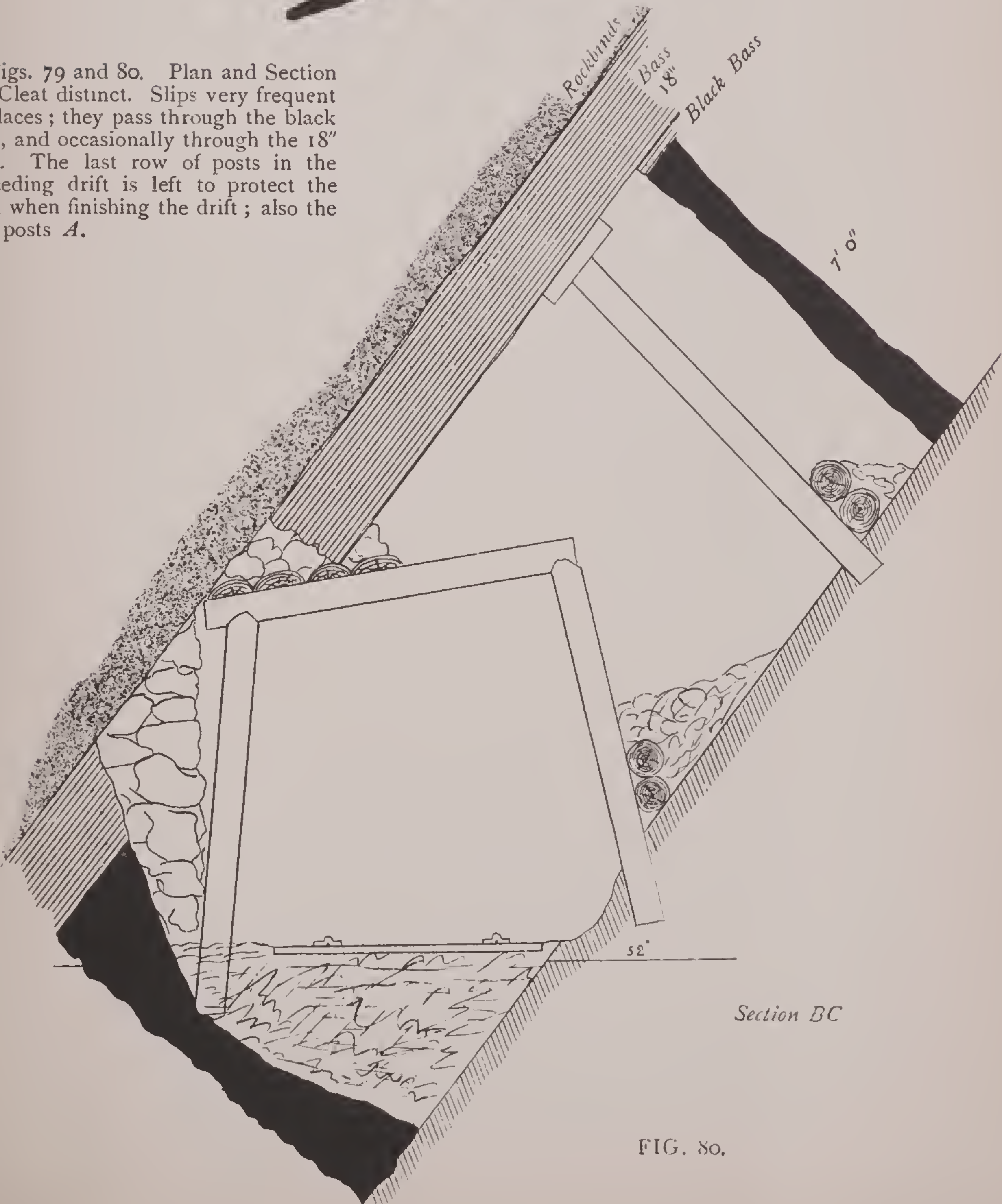


FIG. 79.

Figs. 79 and 80. Plan and Section S. Cleat distinct. Slips very frequent in places; they pass through the black bass, and occasionally through the 18″ bass. The last row of posts in the preceding drift is left to protect the men when finishing the drift; also the gob posts *A*.



Section BC

FIG. 80.

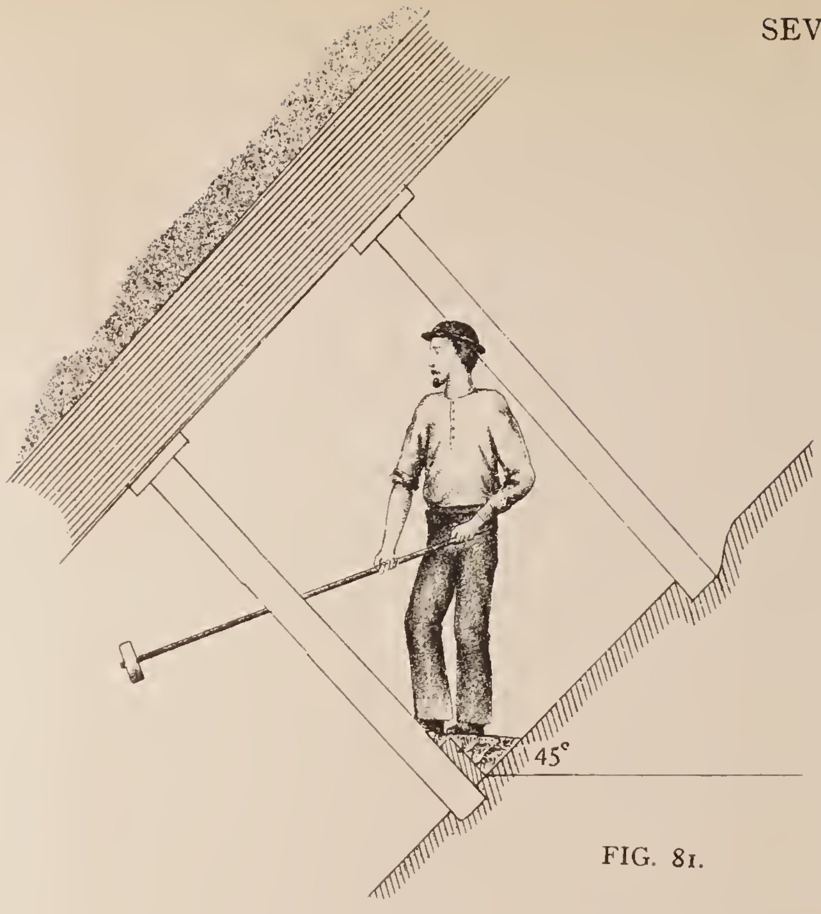


FIG. 81.

Fig. 81. Section S. Shewing how the timber is drawn.

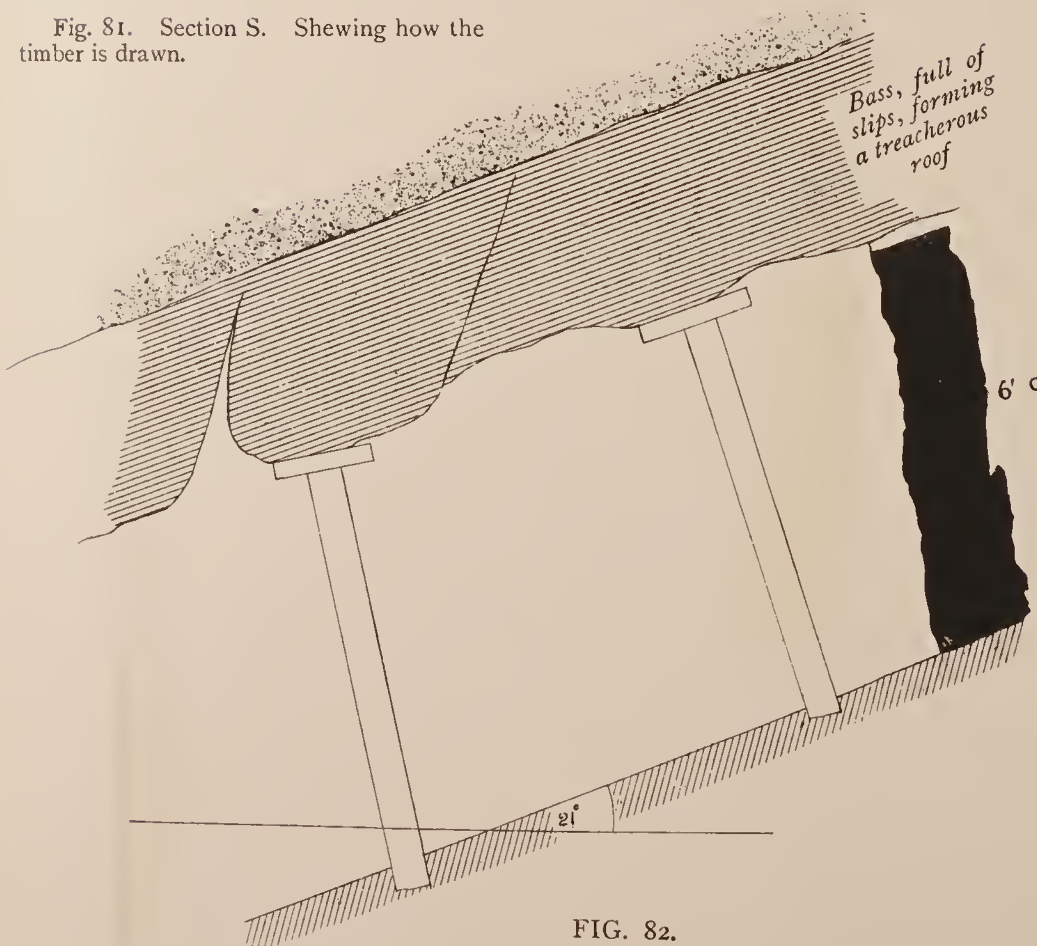


FIG. 82.

Fig. 82. Section further North. The bass is thicker and full of slips in places, forming a treacherous roof. The cleat is pretty distinct. Slips, 9° NE, dipping East 60°, very frequent. Dips and levels are often driven wide (15′), and the bass packed to one side as it falls. The sandstone roof is very strong.

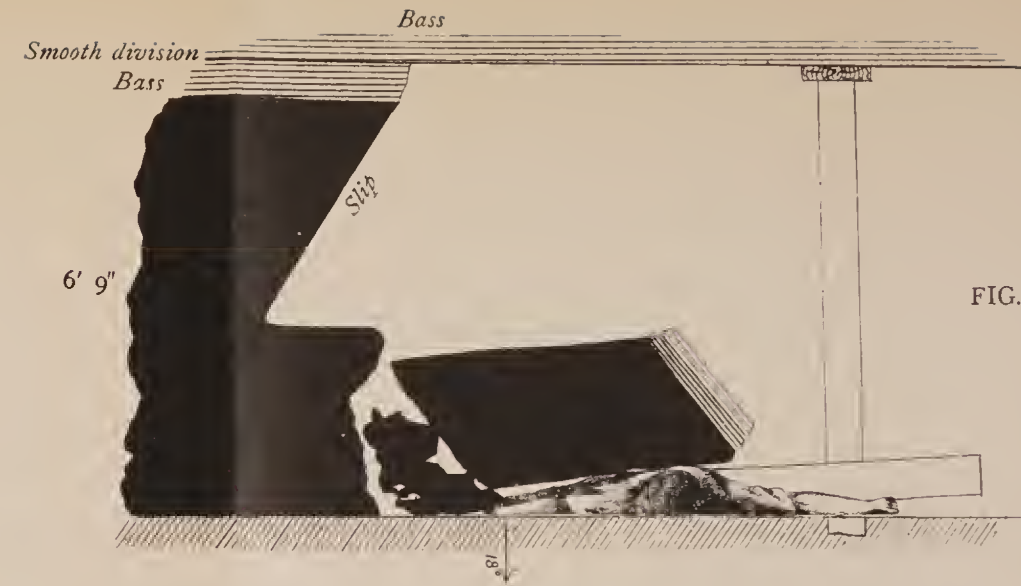


FIG. 83.

Fig. 83. Section of face of "back-way" heading, near last Fig., illustrating an accident.

The heading was 5 yds. wide; there was a row of posts on either side of the rails, and these were laid in the centre. The posts in each row were from 3′—4′ apart; the last post in the lower row was close to the face. The coal was cut a distance of 4′ at the high side. The place had stood two or three days. The collier, who was very deaf, was pulling off some coal in front when a piece 2′ thick came off a slip the whole width of the face. It fell on to the collier, but the post which was knocked down at the same time saved him, and enabled his mates to extricate him.

The collier should have pulled the coals down from the high side; a proper examination would have warned him of the danger. "Back-way" headings, especially when wide, require greater care than "face-way" headings, as the coal then hangs over.

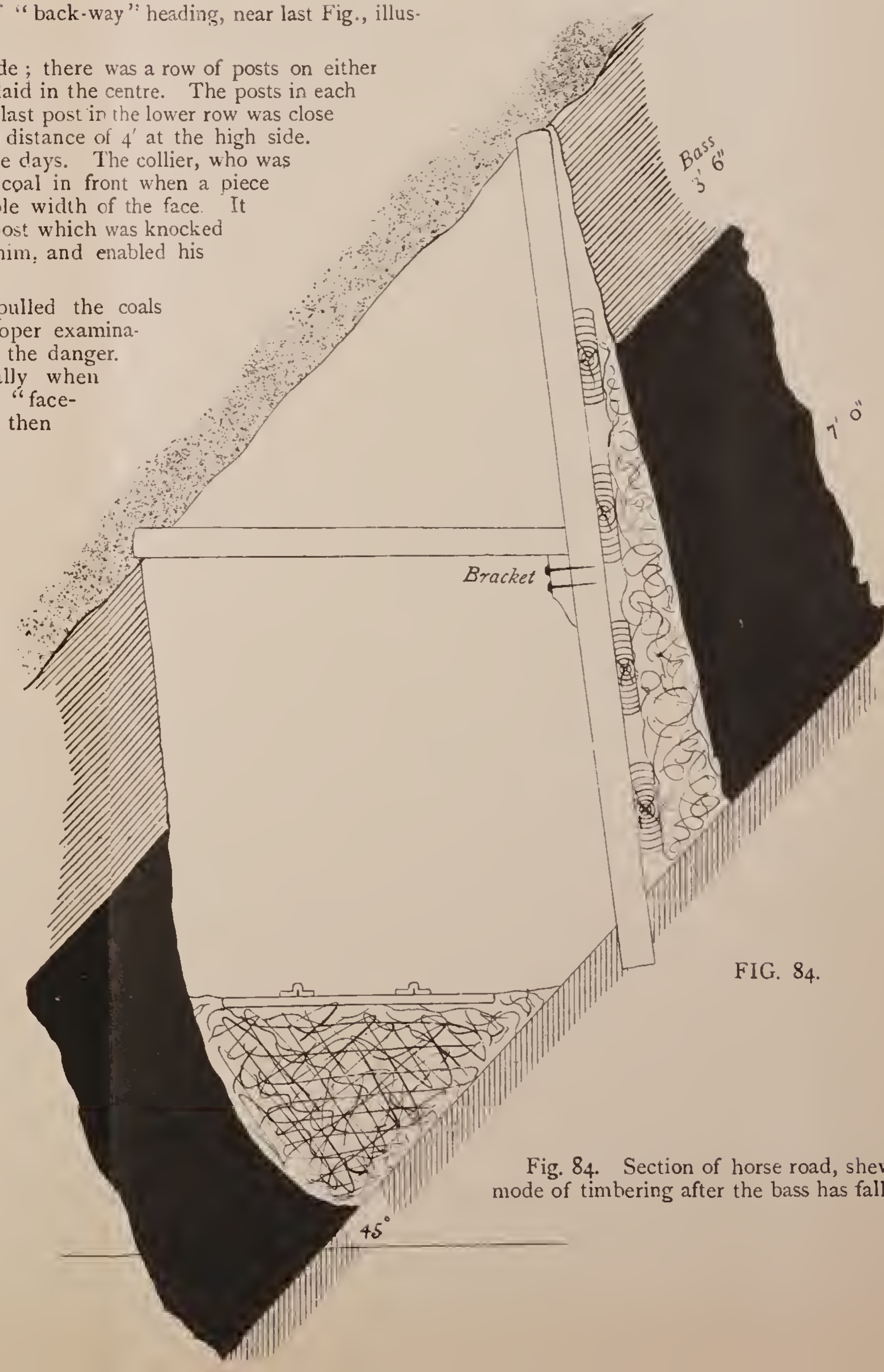


FIG. 84.

Fig. 84. Section of horse road, shewing mode of timbering after the bass has fallen.

FIG. 85.

Fig. 85. Section SW, illustrating a fatal accident from a "leaning slip." (See page 17.)

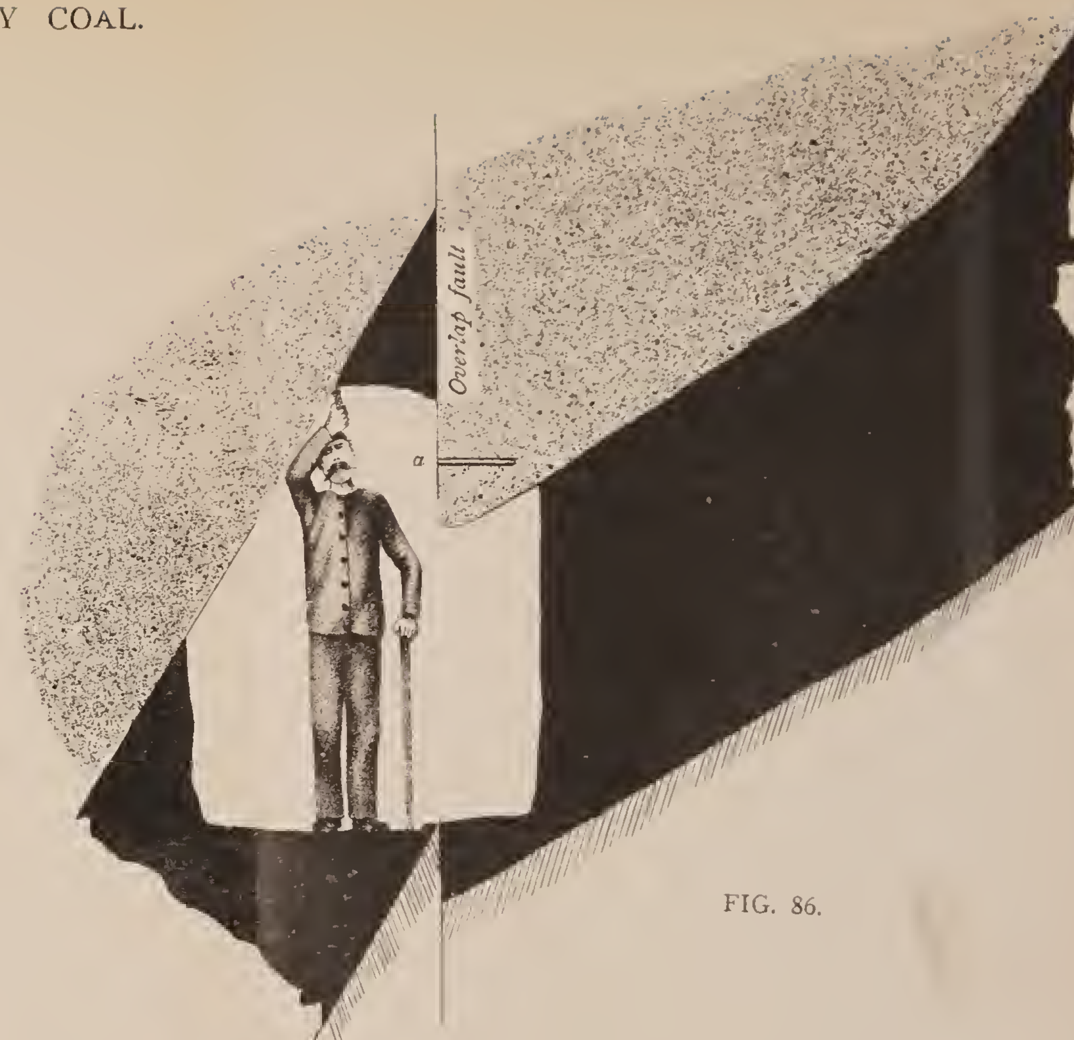


FIG. 86.

Fig. 86. Section also SW, shewing an overlap fault, throwing the sandstone roof, which lies immediately above the coal, into the heading. It was whilst attempting to blow down this projecting piece of rock that an explosion occurred, whereby 62 lives were lost. The coal is close-grained, curly and hard. Cleat just visible in places. Slips frequent. The floor lifts, and in most cases closes the gob up to the roof. (See pages 18 and 27.)

Westwards the coal is as thin as 4' 6" in places, with 2" of bass below the rock; the usual thickness is 5' 6".

FIG. 87.

Fig. 87. Section N. Illustrates an accident from a "leaning slip" and fault, whereby two men were killed. The headings are driven 4—5 yds. wide. (See page 17.)

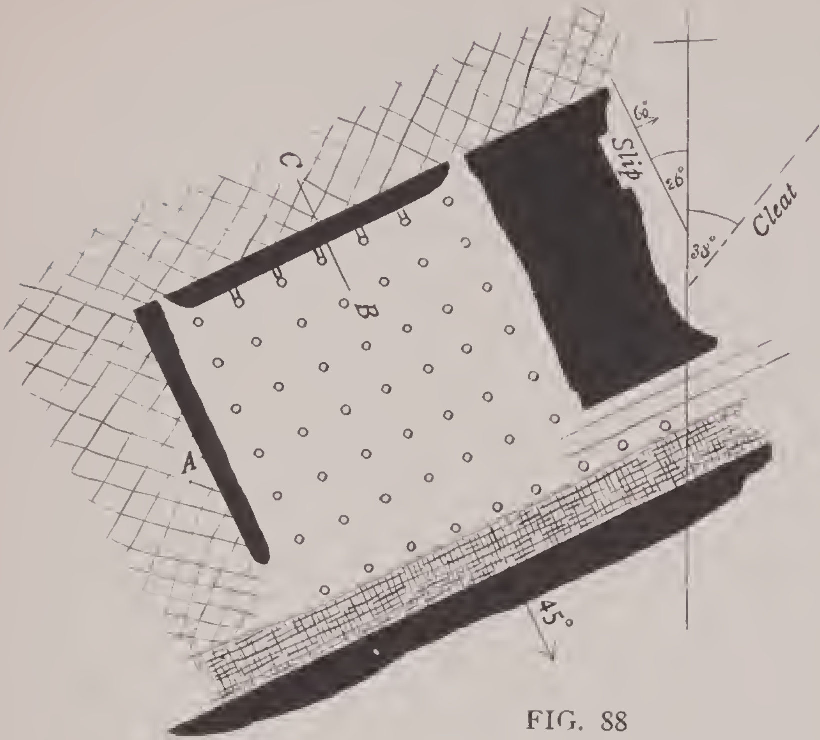


FIG. 88

Figs. 88 and 89. Plan and Section S. Cleat indistinct. Slips frequent. Rib *A* is left, owing to an uneasy roof and to make the timber drawing safe. This is not usual.

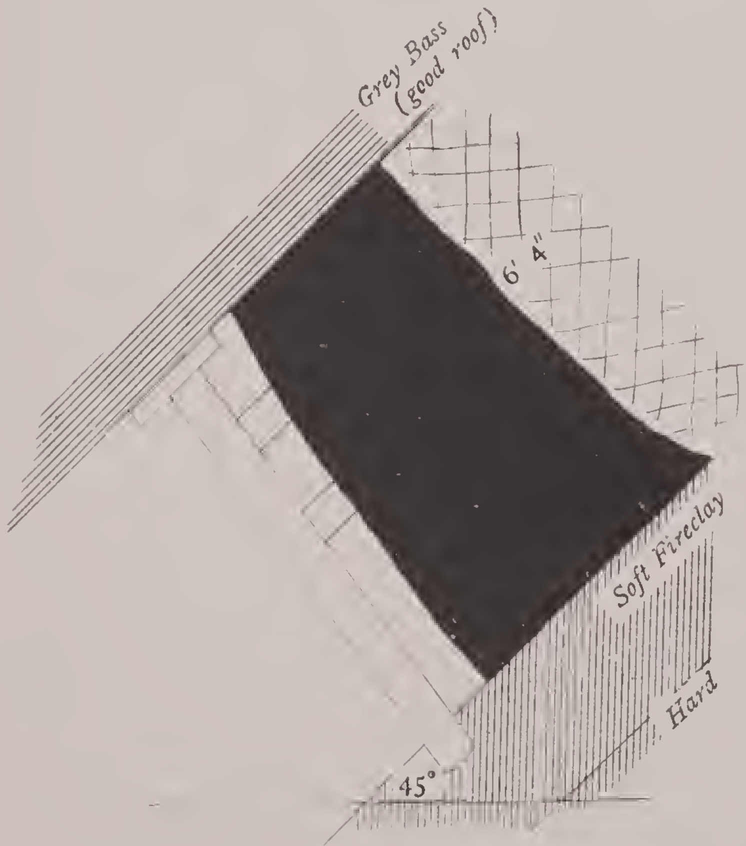


FIG. 89.

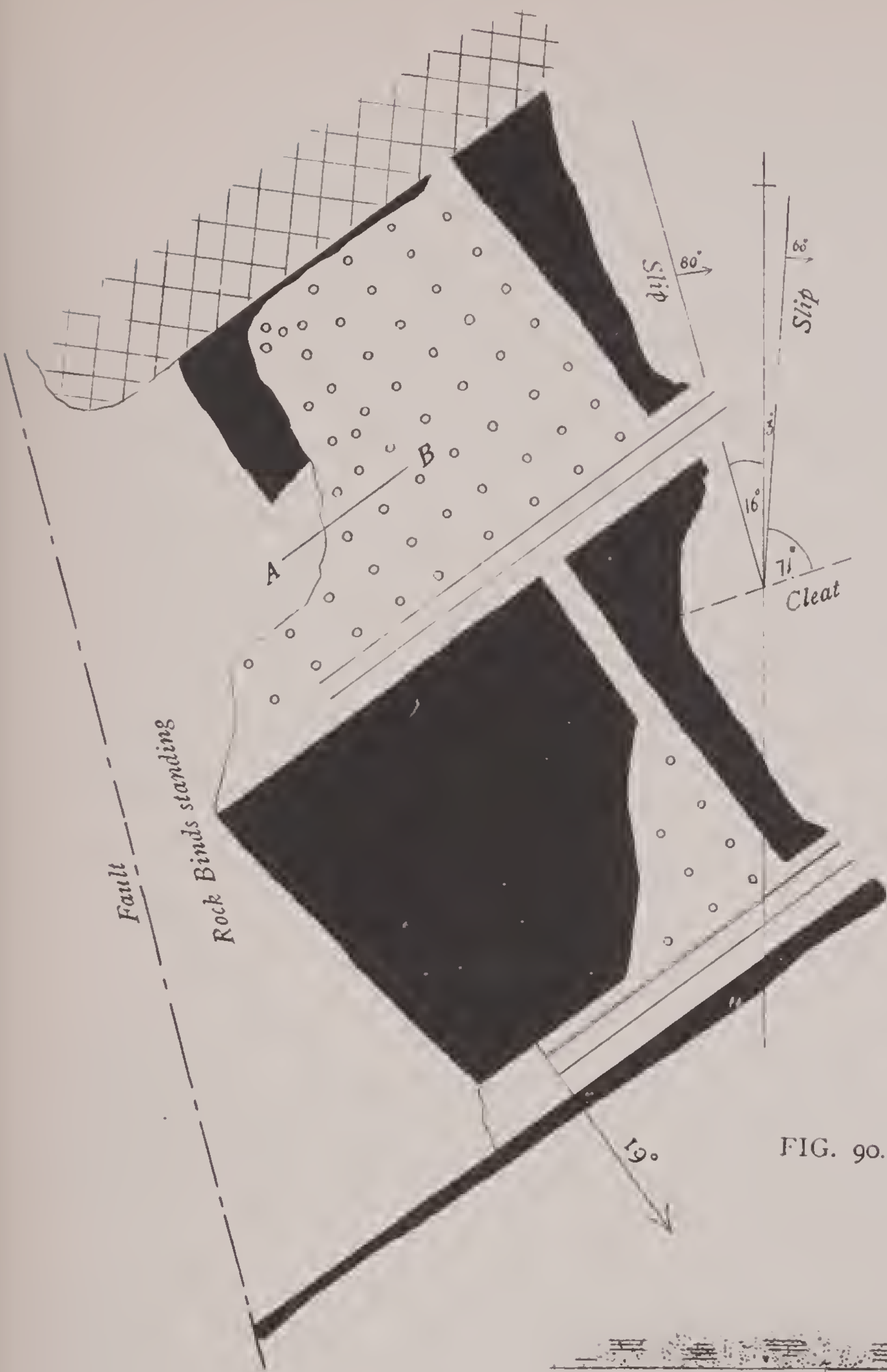


FIG. 90.

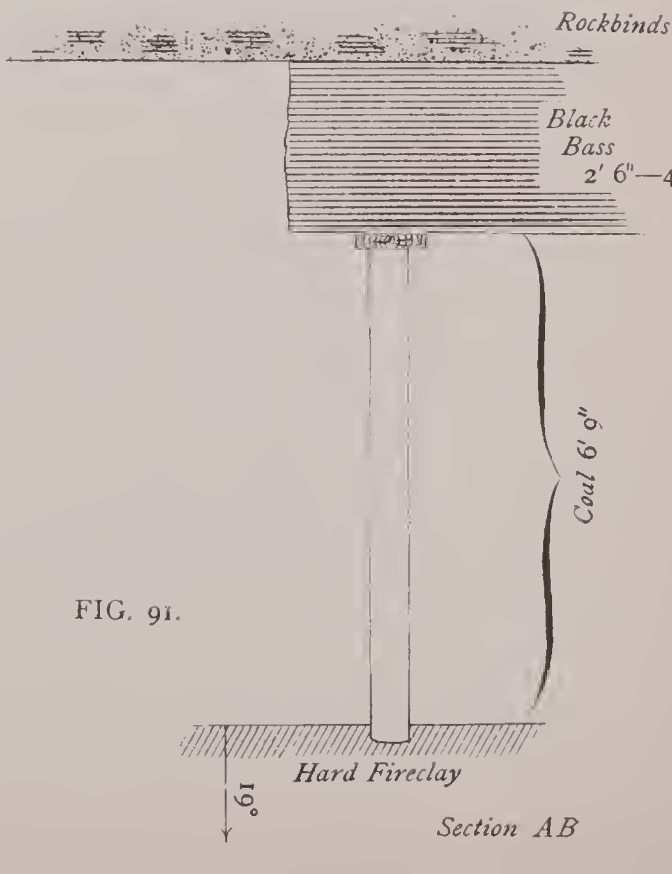


FIG. 91.

Figs. 90 and 91. Plan and Section further North. Slips: 3° NE, are very frequent, and pass through the black bass; 16° NW, called "straight things," are less frequent.

FIG. 92.

Fig. 92. Centre. Plan of drift in which a fatal accident occurred. The coal in this drift was unusually thick, owing to disturbances and irregular inclination, and required 12′ posts. The seam is worked by a modified board and pillar method. The pillars, which vary in size and shapè, owing to the irregularities of the dip of the seam, are worked off in dressings about 3 yds. wide, as soon as they are formed. One of these pillars was being sliced, the drift being just through to the old gob, when the roof, which had a loose end on one side, fell over the whole area, reeling out all the posts (10 or 12) and killing the collier. The roof fell over an area of 35 square yards, and was 5 yards thick at the face side. It was loosened by a slip, which was not perceptible in the roof, owing to the roof coal being left at that point. This accident shews the importance of erecting chocks where the roof is broken on two sides of the drift, and when working slowly, and of always keeping two or three rows of posts on the gob side of the rails.

The roof is generally good, and stands sometimes unsupported over large areas; slips are rare, except near faults. The coal is dense, and contains no distinct cleat; slips abound, which do not all run through the whole seam, and seldom run into the roof.

The coal is usually 7′ 6″ thick, with a 3″ band, 12″ from the floor.

Southwestwards and westwards in part the Eight Feet seam runs out to an unworkable thinness.

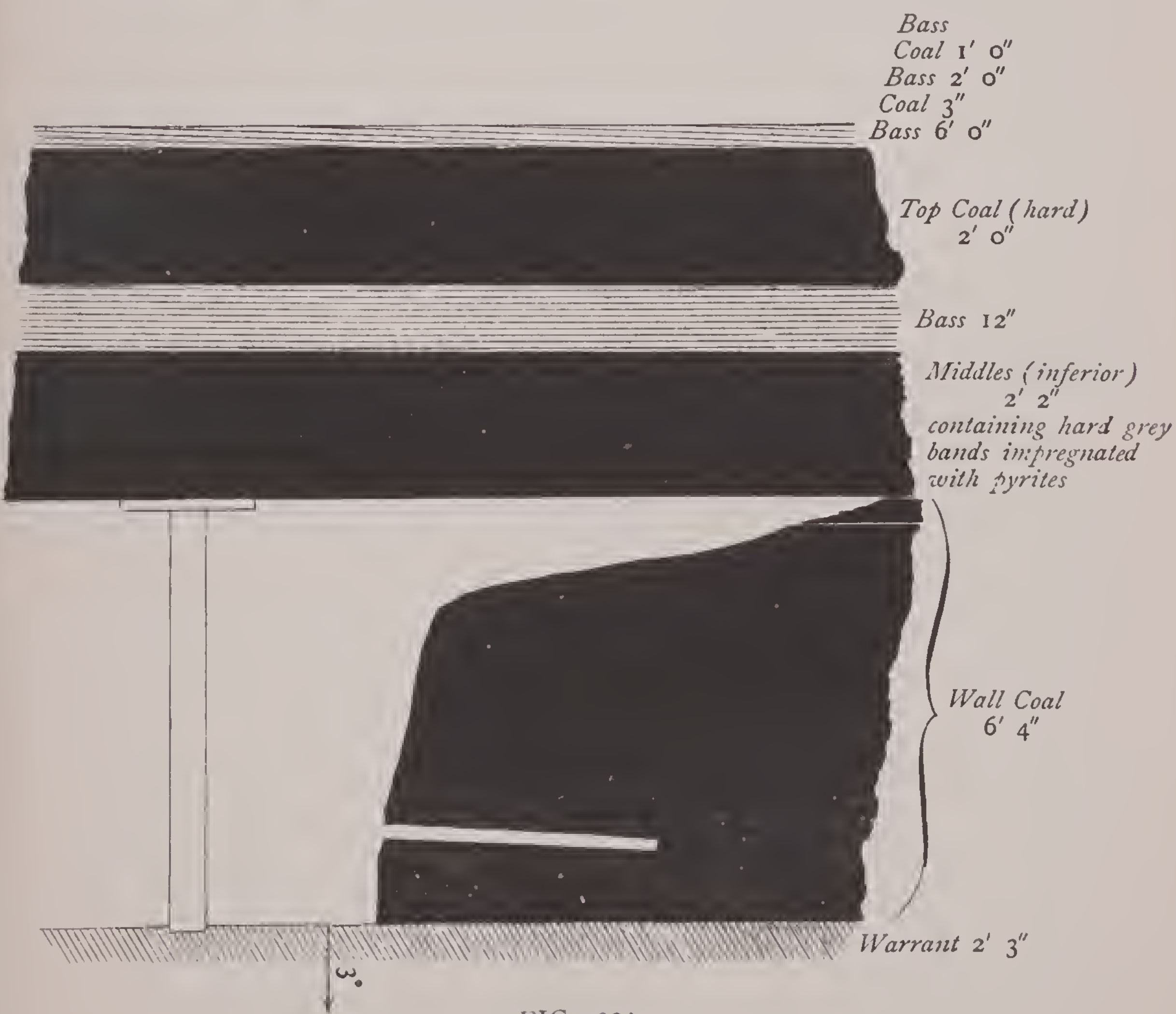


FIG. 92A.

Fig. 92A. Section of heading, extreme West. The headings are 12′ wide. The Middle Coal is taken down as soon as it shews signs of giving. The Top Coal forms a very good roof.

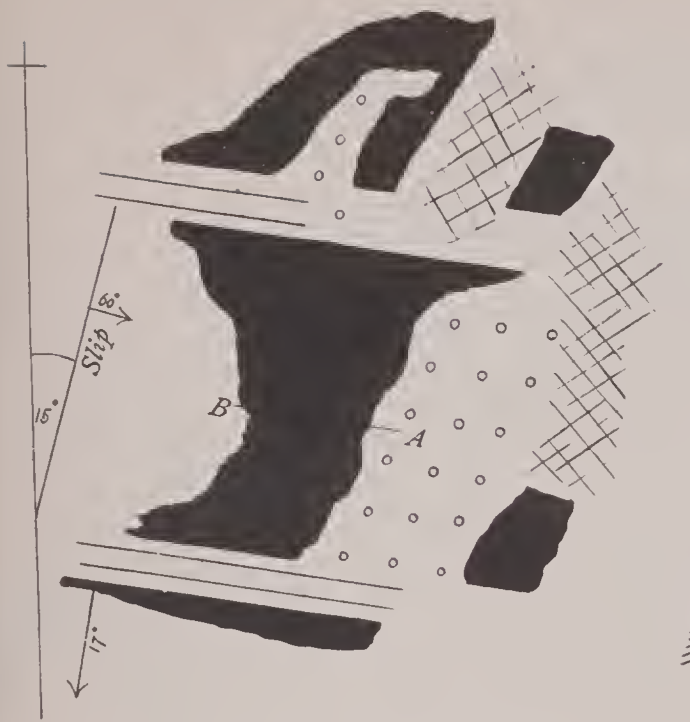


FIG. 93.

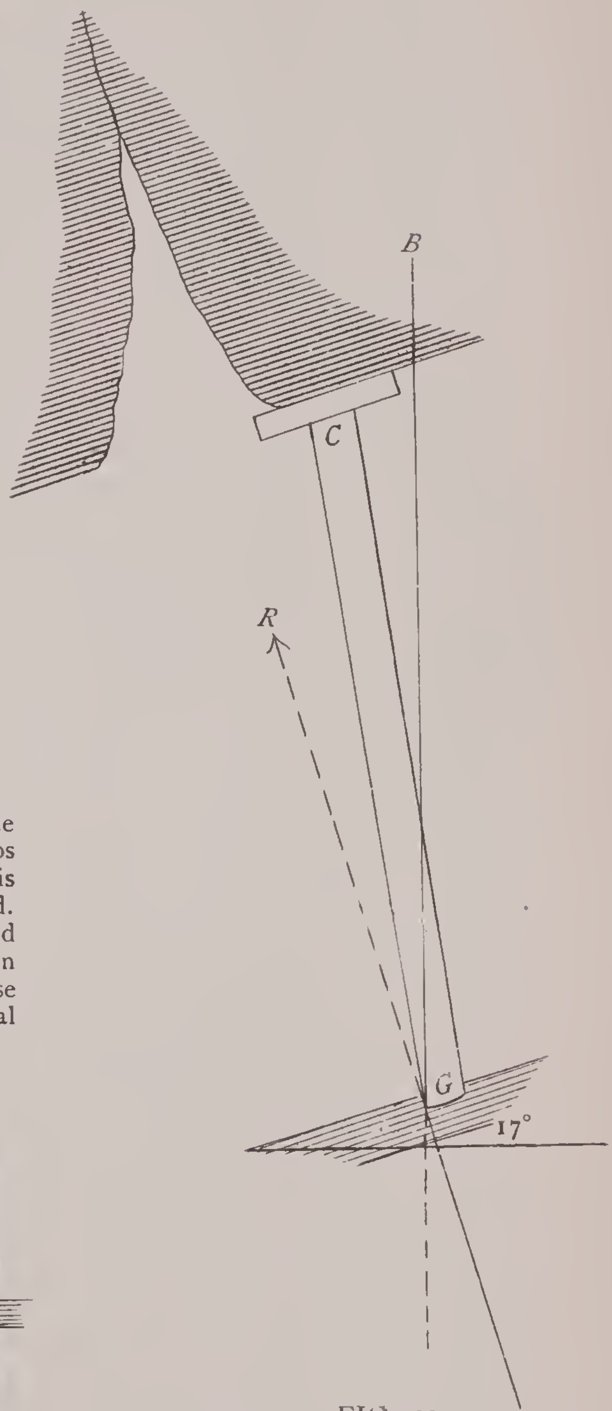


FIG. 95.

Figs. 93, 94 and 95. Plan and Sections N. The coal attains a thickness of over 9′ in places. Slips very frequent ; they do not run into the roof, which is pretty free from joints and slips. Lancashire method. Coal punches are left in places. The coal is wedged off. Overhanging or loose pieces are supported as in Fig. 94. Not being properly stamped, one of these sprags gave way, and a collier was killed by the coal which fell in consequence.

FIG. 94.

BULLHURST COAL.

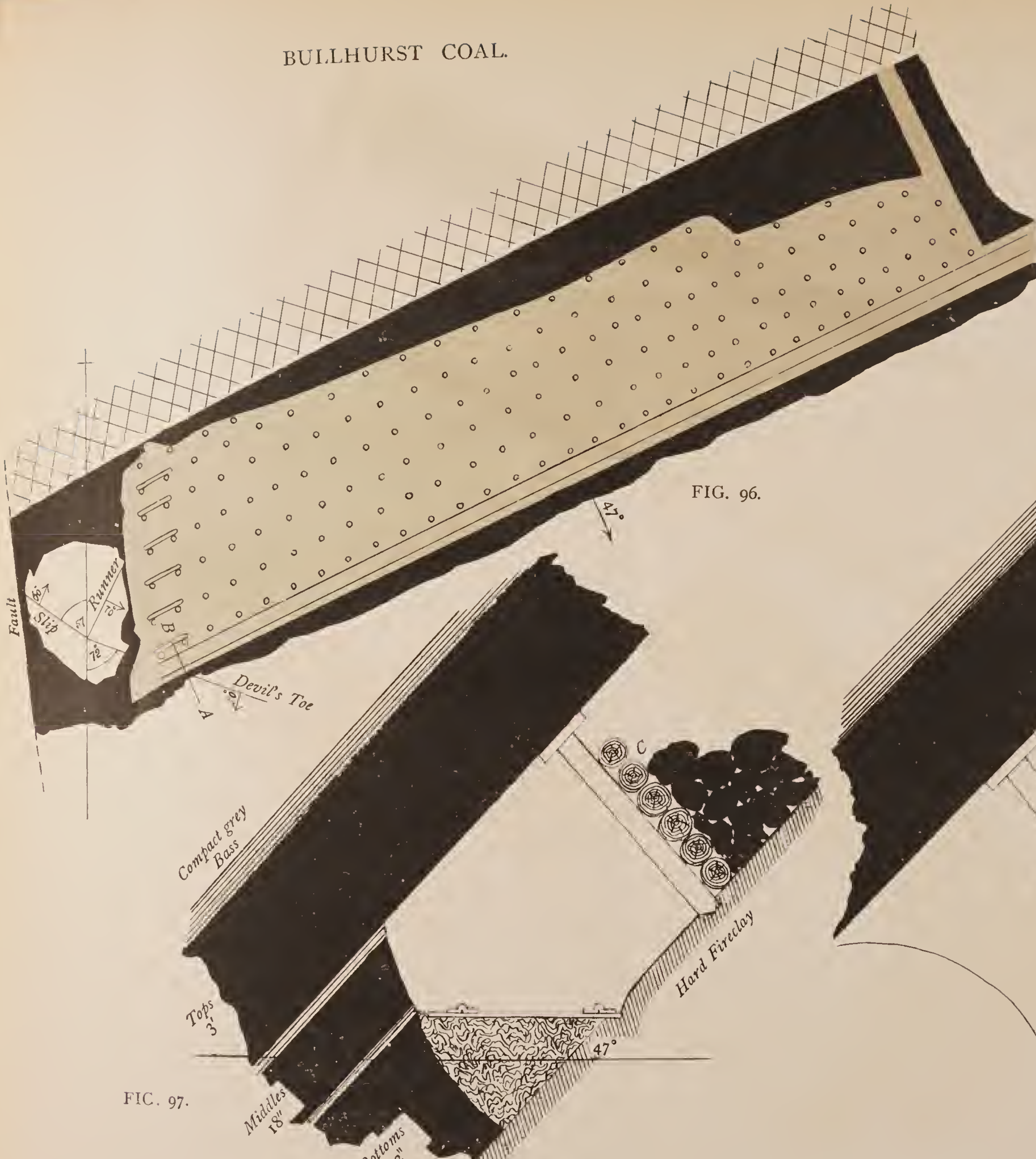


FIG. 96.

FIC. 97.

Figs. 96 and 97. Plan and Section (S.) of an exceptionally long drift, possible only from the top coal being very strong. (See page 59.) The Middles are first holed about 3′ and the Bottoms are then wedged up. On reaching the fault the Tops are cut and wedged down, and the high side of the pillar partly flitched back. The coal has no cleat; it breaks up easiest in the plane of stratification. Slips are frequent; they ride over in the different beds, and sometimes run out, but often run along the whole drift. Runners, which seldom extend further than 5′, and which are frequent, cut the slips out. Slips called "Devil's toes" occur occasionally. The floor is very hard, and the posts are pointed and let in slightly. Slabposts *C* are put up to collect the coal and protect the loader. When placed at the lower side of thurlings they are said to form a "battery." The headings stand well for some time without timber, but have eventually to be lined at the high side.

To the South-West, where the Eight Feet Banbury runs out, the Bullhurst thickens: the Tops remain 3′ thick; the Middles increase to 2′ 3″ and the Bottoms to 5′—5′ 3″ in thickness; and 1′ 10″ of inferior coal (Stools) underlies the Bottoms. The cleat is very distinct 4° NE. Slips frequent; they run 81° NW, and dip 85° S.W.

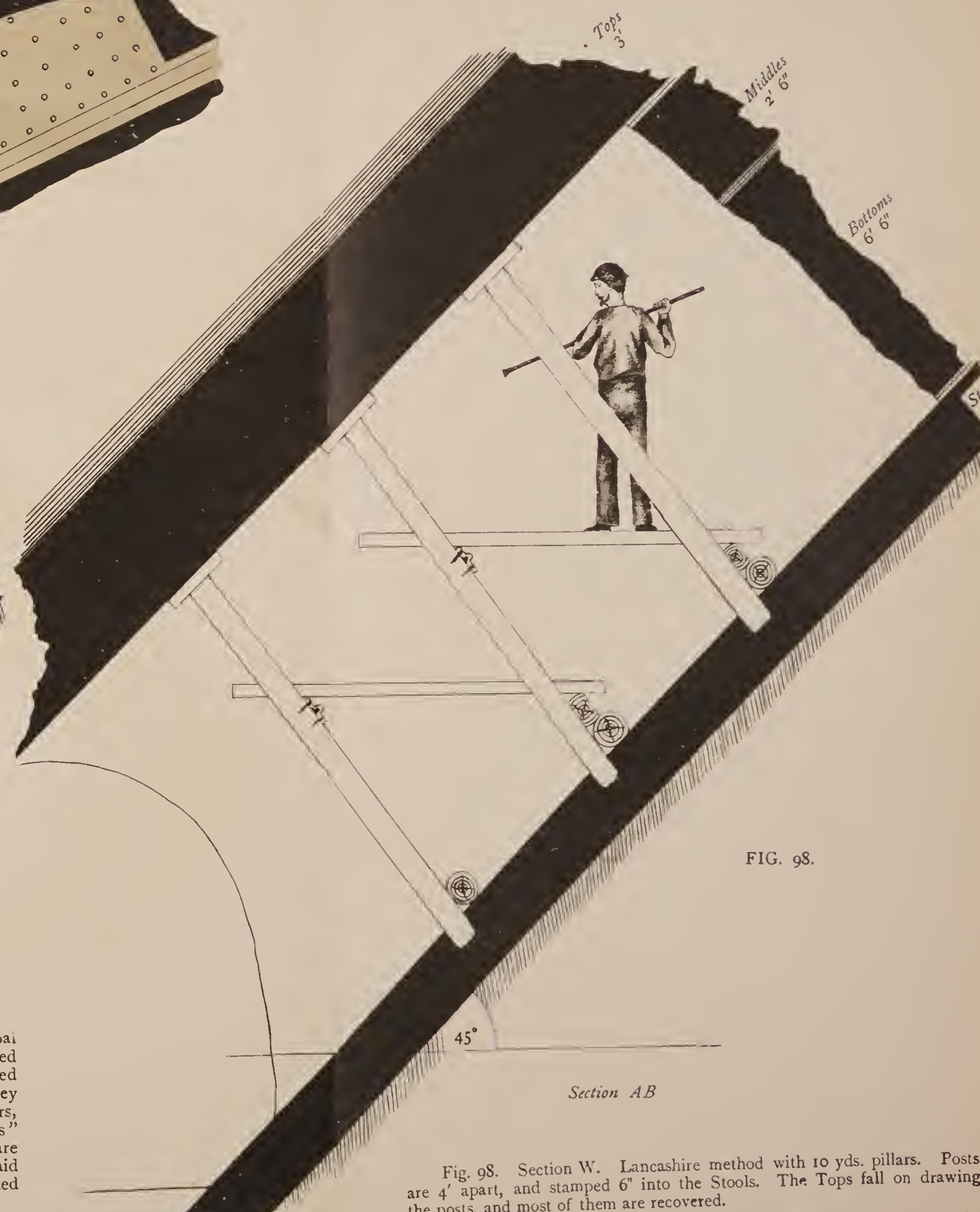


FIG. 98.

Section AB

Fig. 98. Section W. Lancashire method with 10 yds. pillars. Posts are 4′ apart, and stamped 6″ into the Stools. The Tops fall on drawing the posts, and most of them are recovered.

Fatal accidents have occurred from pieces of Middles falling on to the colliers whilst at work. It is the most dangerous part of the seam. On one occasion a piece 12″ broad at the bottom, 2″ at the top, and 6 yds. long, broke off the side of a cutting in which two men were at work, and injured them.

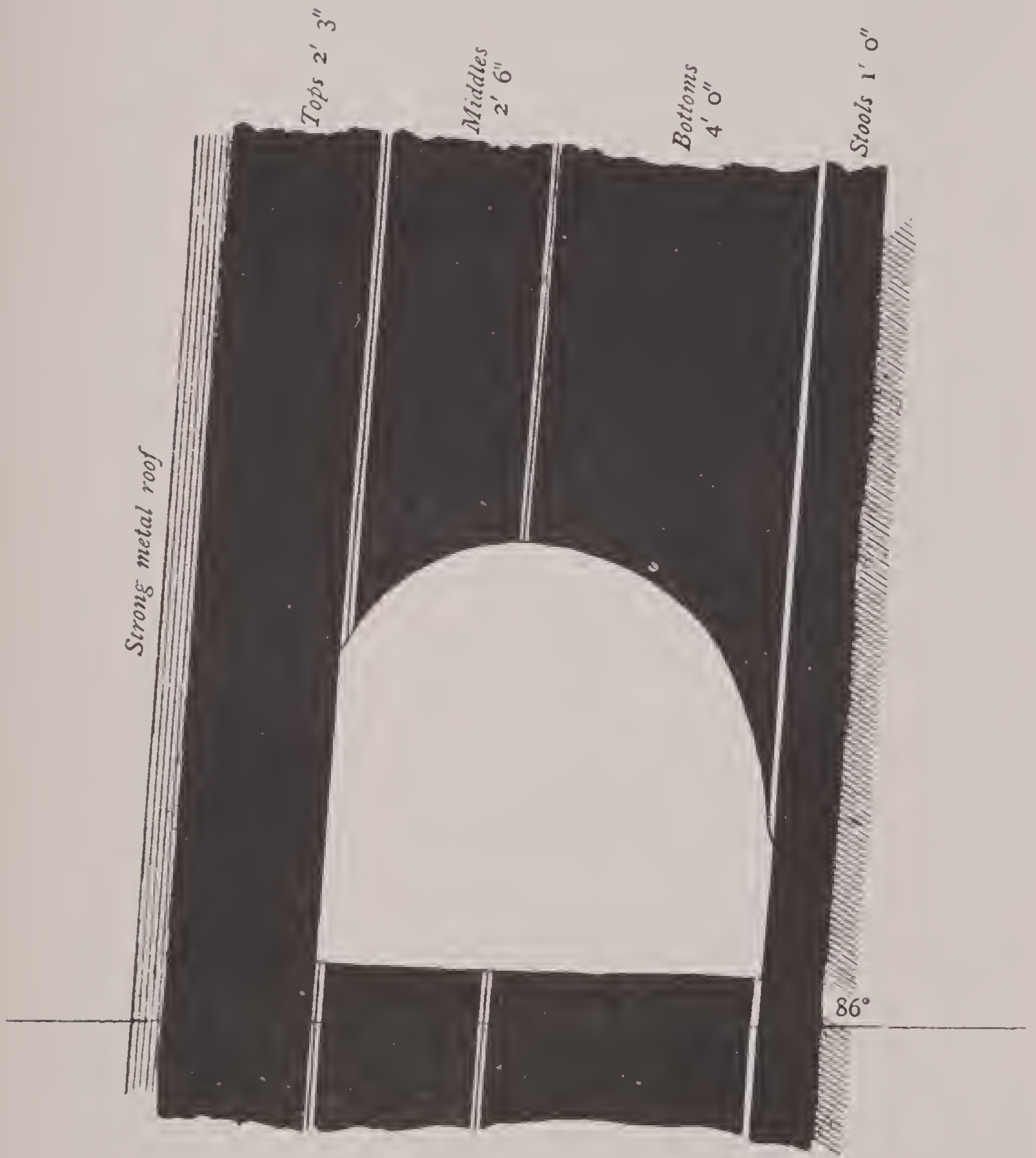


FIG. 99.

Fig. 99. Section W. N. of Fig. 98. The headings stand well without timber, except in the neighbourhood of faults.

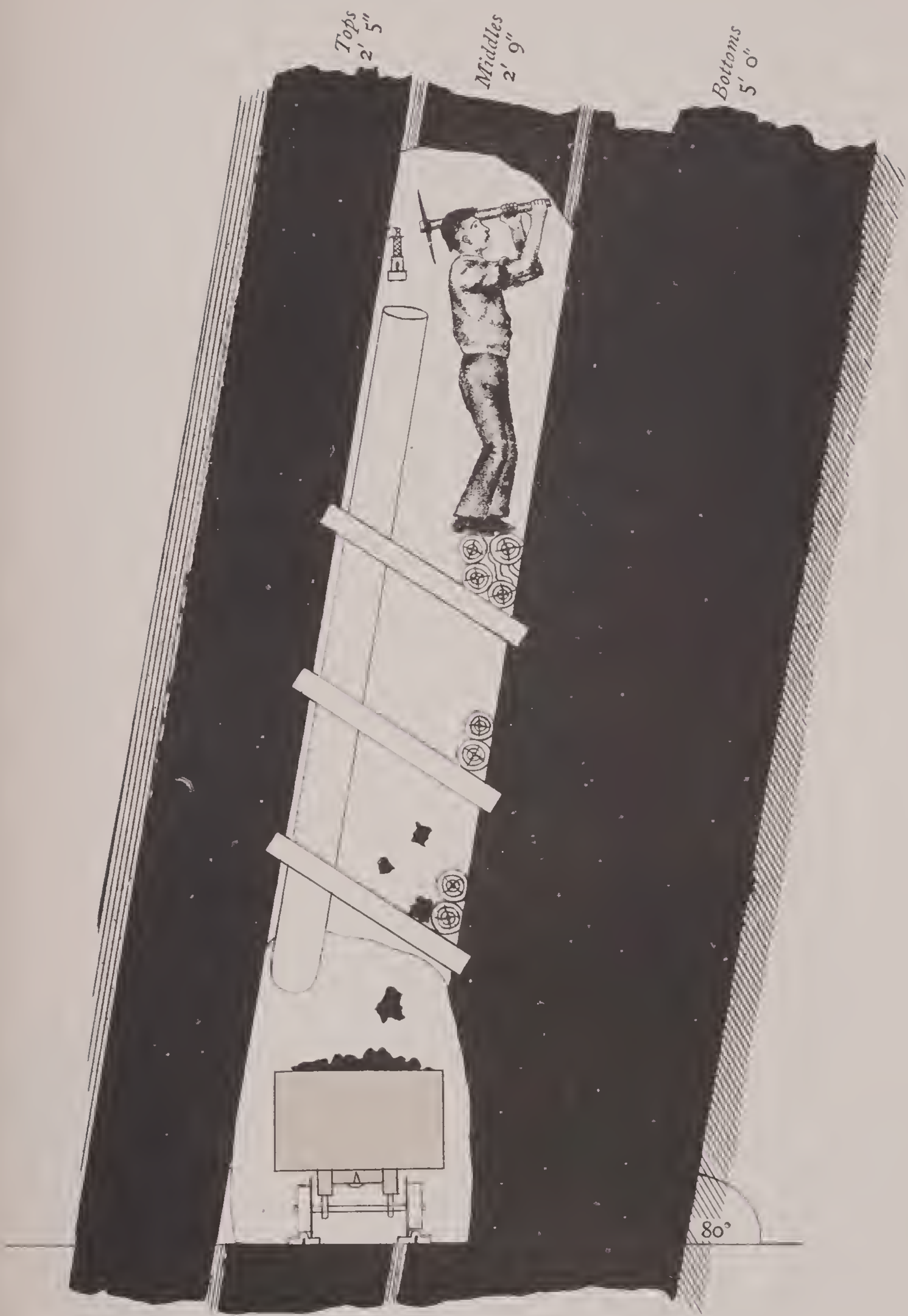


FIG. 100.

Fig. 100. Section W. N. of Fig. 99. Shewing a collier driving a thurling. The Stools have run out.

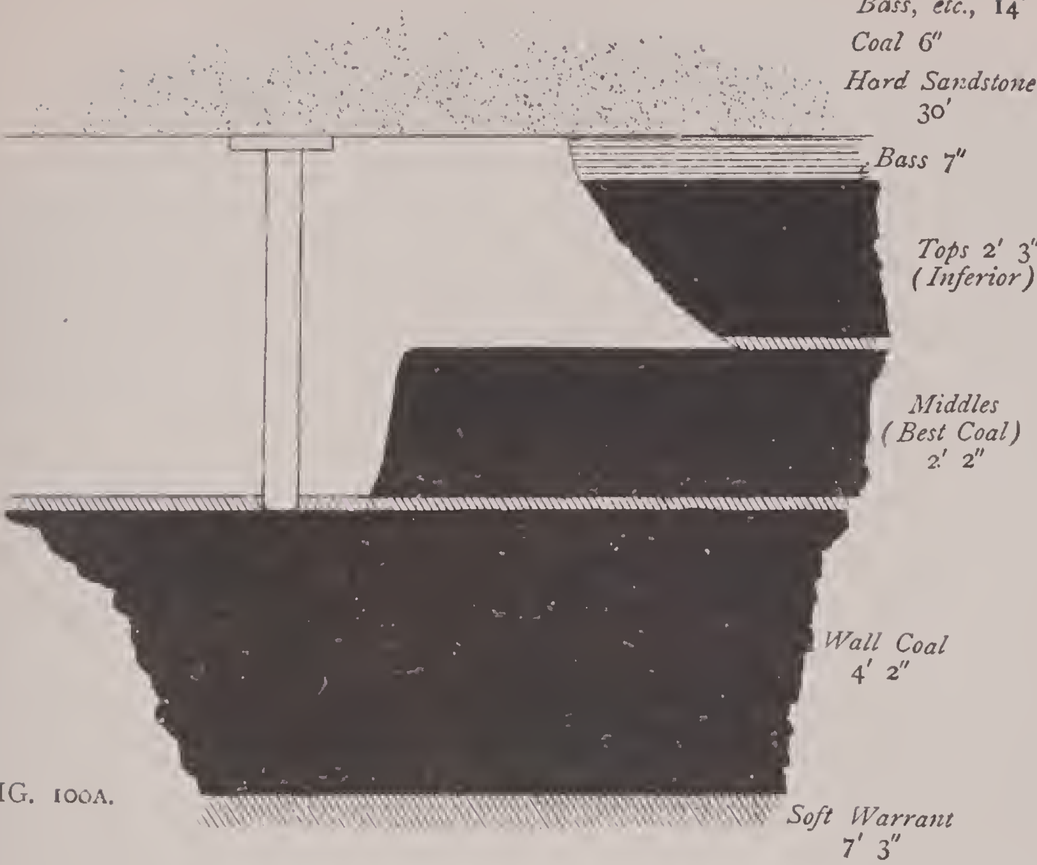


FIG. 100A.

Fig. 100A. Section of heading, extreme West. "Strait" places driven as shewn from 2 to 4 yds. wide. The wall coal is taken up 60 yds. behind.

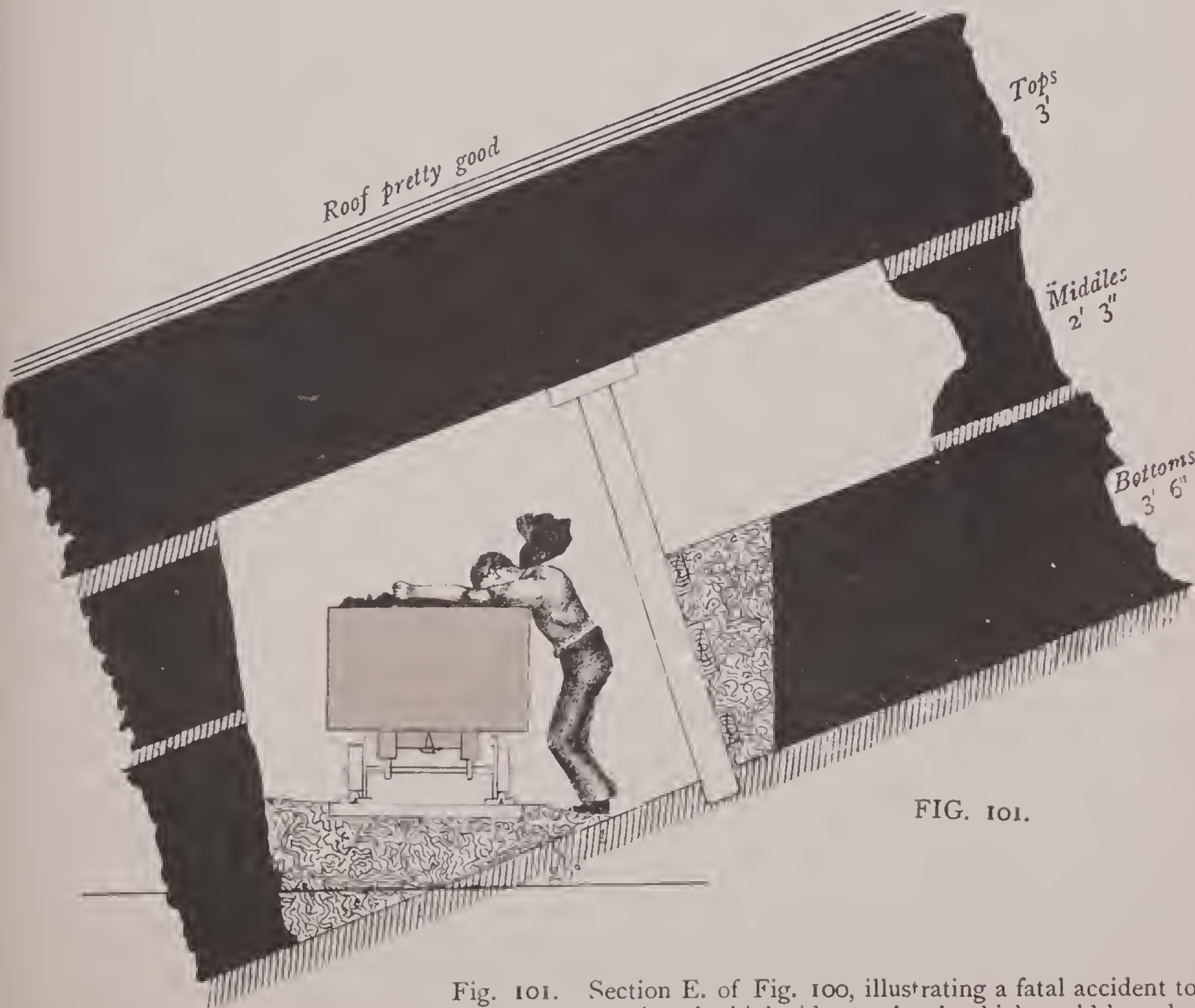


FIG. 101.

Fig. 101. Section E. of Fig. 100, illustrating a fatal accident to a boy, from not protecting the high side in a level, which could have been done with short posts and slabs.

The seam thickens to 14' over a small area.

Fig. 101A. Section N. Intended to be worked by 20—30 yds. longwall faces on the rise, with a jig in the middle; jig packs 4 yds. wide, and alternate wastes and packs. The bottom coal is left underfoot until the first weight occurs, which will supply builders for packs. It is expected that it will then be possible to work the whole thickness. The Top Coal forms the roof, and will be recovered in the wastes.

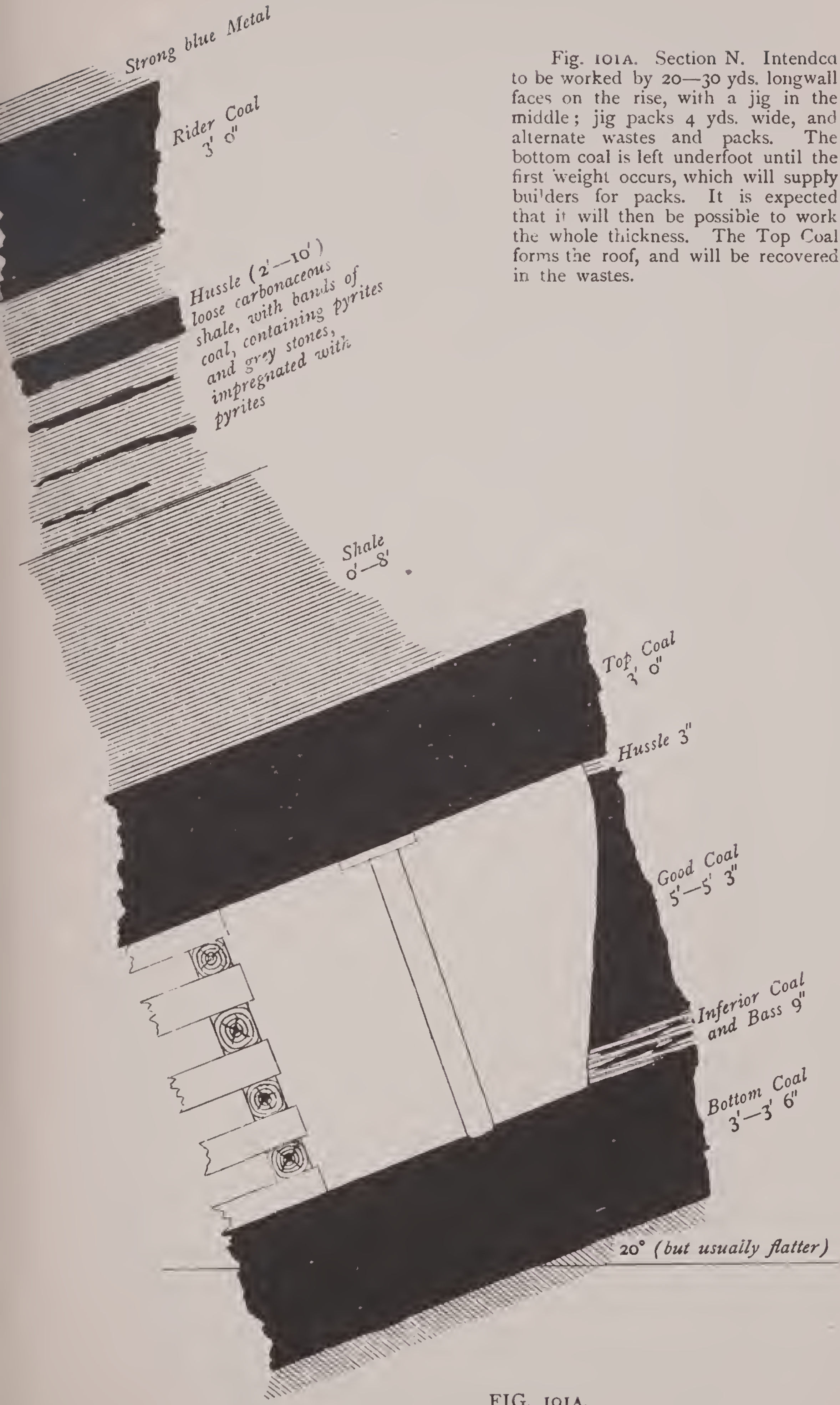


FIG. 101A.

LONGTON DISTRICT.

FIGS. 102—171.

Figs. 102 and 103. Plan and Section W, shewing the rails being taken up and a new buttock started near the jig. The chocks are taken out of the waste and moved forward. The roof breaks behind them.

Dips and levels are driven 4 yds. wide. Though the roof is extremely hard a row of posts is usually set on either side of the rails in the levels, one of which carries the brattice. The stone varies considerably in thickness, and when thin is sometimes of inferior quality.

Joints very distinct and regular; main joints from 4′—6′ apart, but closer in places; they are best defined in the bottom and middle bands; they do not run through into the roof, stones and bass, though the latter are jointy.

FIG. 102.

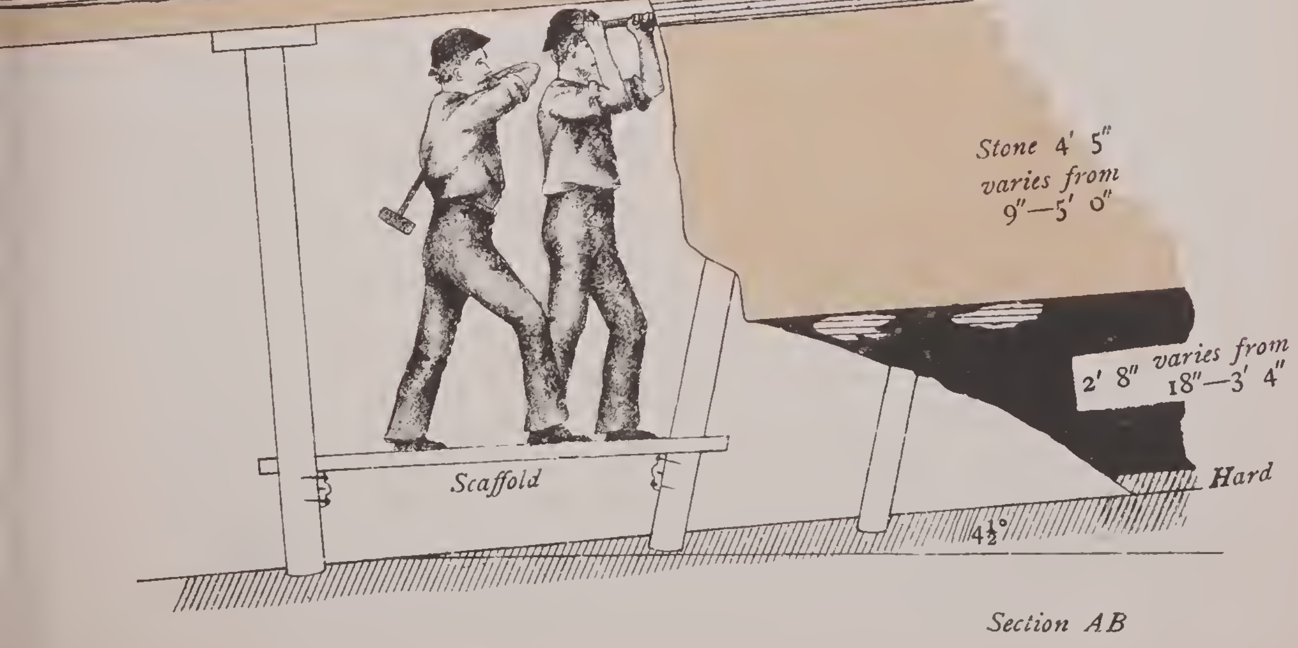


FIG. 103.

BASSEY MINE IRONSTONE.

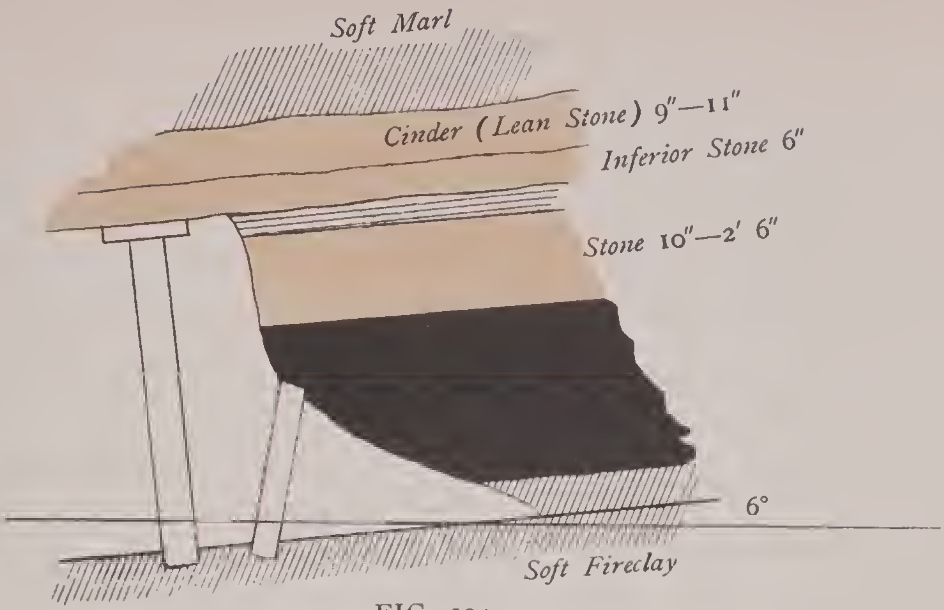


FIG. 104.

Fig. 104. Section about one mile Eastwards. The joints in the stone, which run 10° NE, are from 6″—18″ apart. The cleat of the coal is distinct, and is 22° NW.

SPENCROFT COAL.

FIG. 105A.

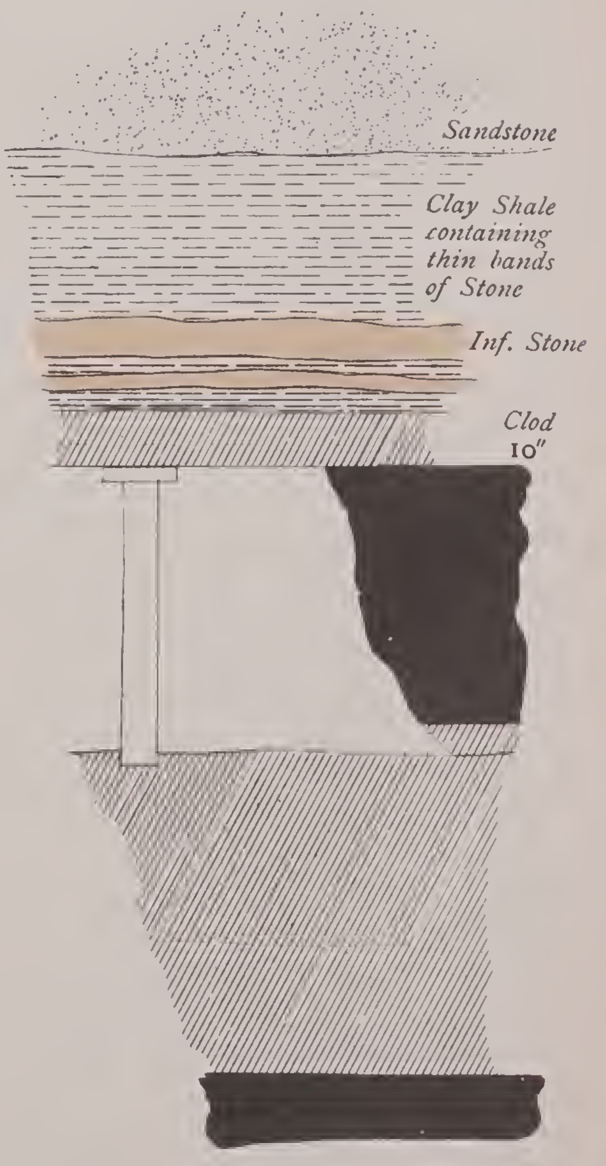


FIG. 105B.

Fig. 105 A & B. Plan and Section N. Opened out by "breasting." The roof, and especially the clod, is bad, and contains numerous slips. The clod is taken down in the main levels. The levels are usually barred; the lower end of the bars is sometimes placed on short 12″ posts (truncheons), which are set on the coal when it is hard and not likely to rate off. Cleat pretty distinct.

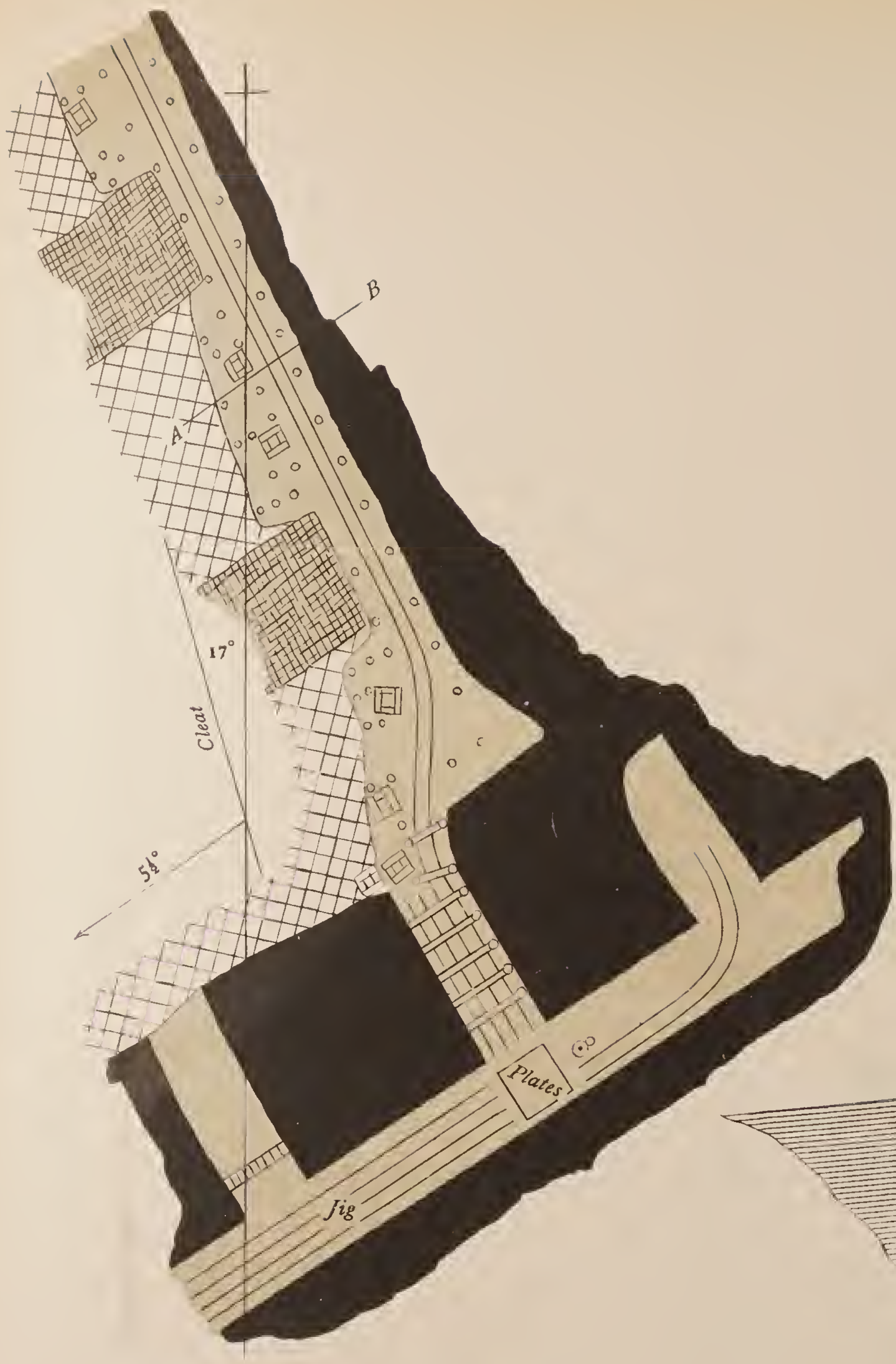


FIG. 106.

Figs. 106 and 107. Plan and Section W. The Top Coal is cut down in the wastes. It is well supported by at least two chocks between the wastes and the rails. A collier was killed by the fall of a piece of Top Coal. The cause of the accident is given on pages 51 and 52. The roof is hard, clunchy and very heavy; it breaks down close behind the Top Coal. The cleat is very distinct. A 10″ band of Cannel Coal runs half-way up the seam in places; it contains cleat planes half an inch and more apart.

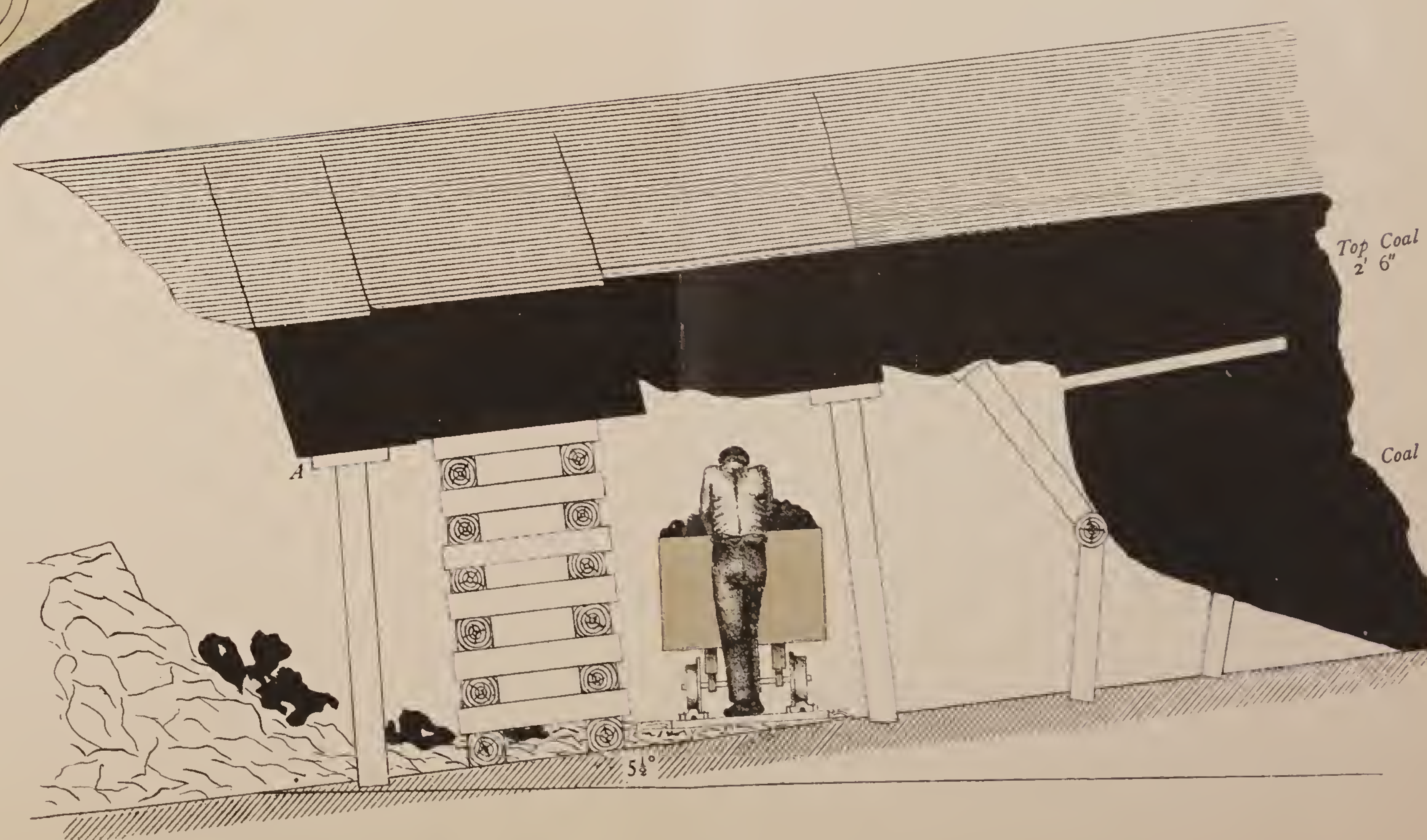


FIG. 107.

GREAT ROW COAL.

Fig. 108. Section about one mile Eastward. The same method of working prevails. The cleat runs 20° NW, and is very distinct.

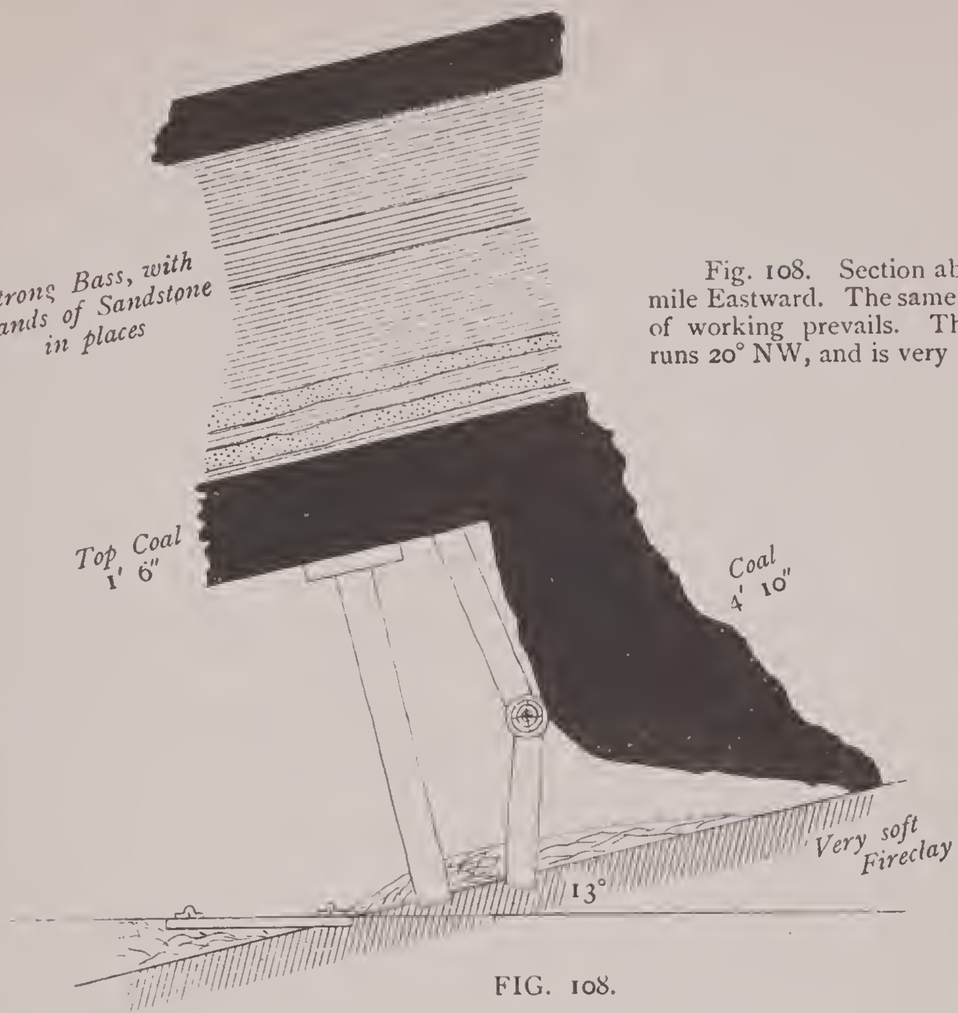


FIG. 108.

CANNEL ROW COAL.

Figs. 109 and 110. Plan and Section N. The roof is very stroug; it stands without much timber. The cleat is irregular and curly. The joints in the Cannel are very distinct and run from 6"—2' apart.

FIG. 109.

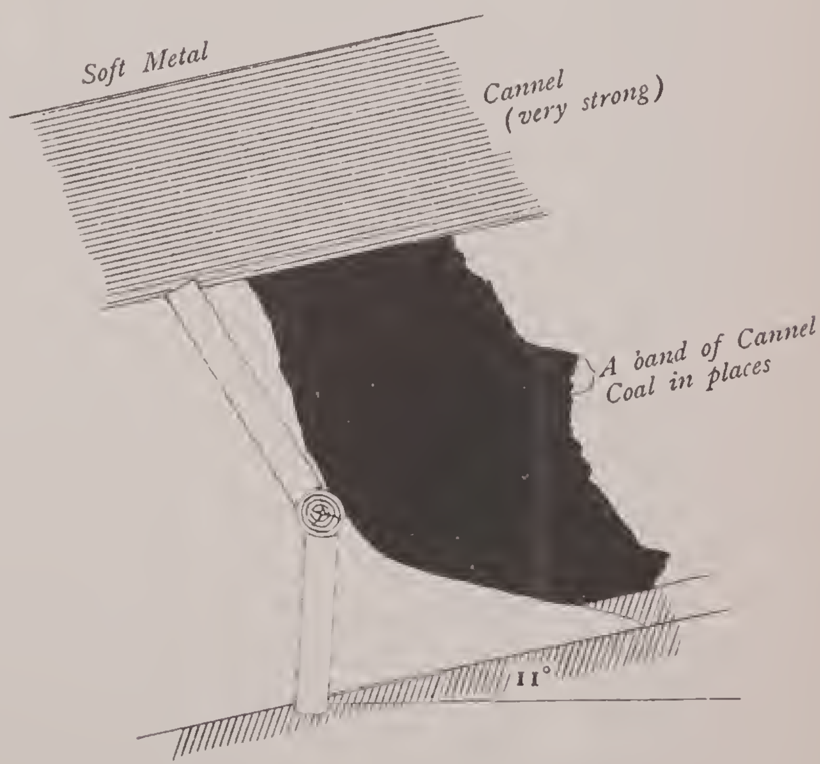


FIG. 110.

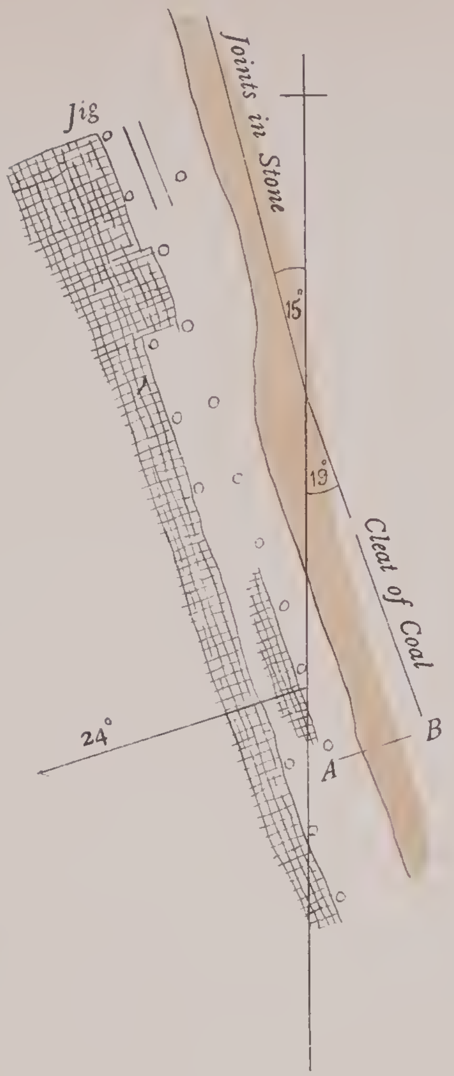


FIG. 111.

Figs. 111 and 112. Plan and Section W. The gob is completely packed, and not much timber is set.

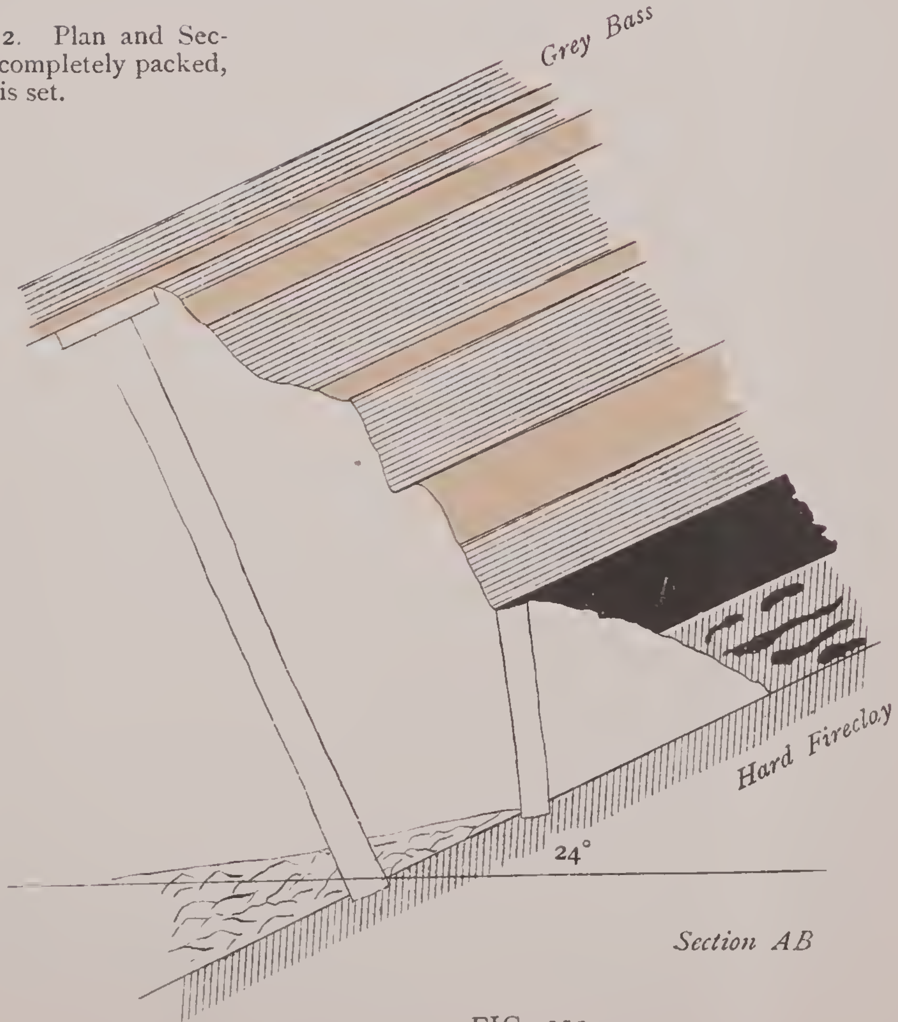


FIG. 112.

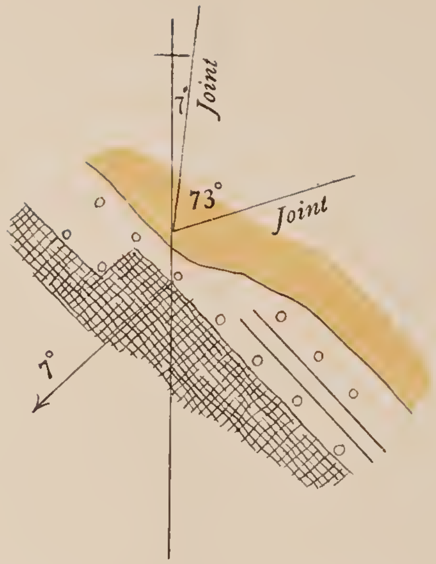


FIG. 113. *Top Work*

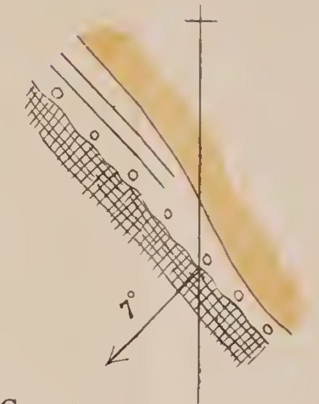


FIG. 115 *Bottom Work*

Figs. 113—117. Plans and Sections W. in Top and Bottom works. The Bottom bands are worked in advance of the Top bands. the gob of the former, which is tightly packed, forming the floor of the latter. The posts in the Top works are occasionally placed on footlids. The Top bands have distinct joints; but those in the bottom bands are indistinct.

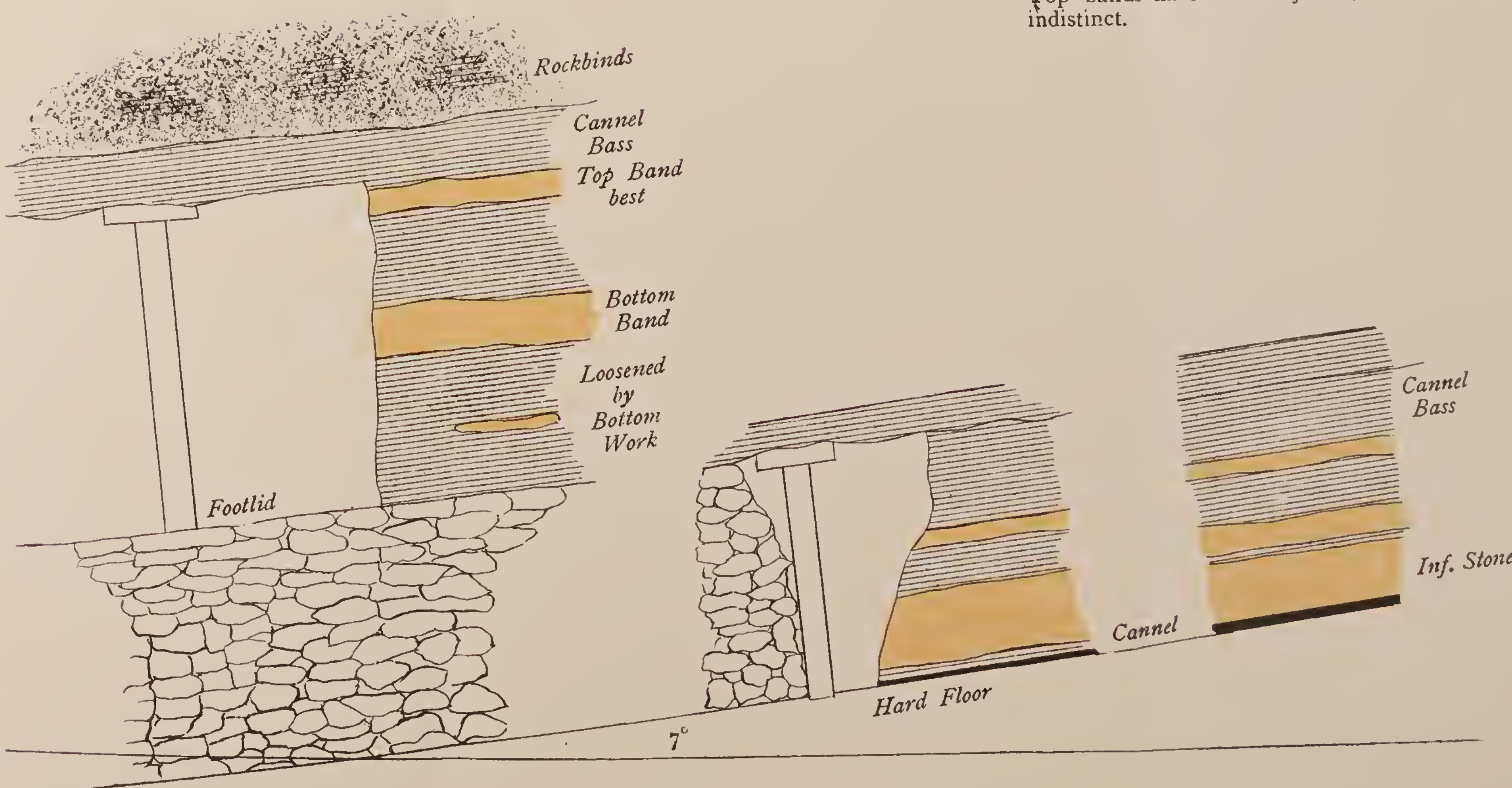


FIG. 114.

FIG. 116.

FIG. 117.

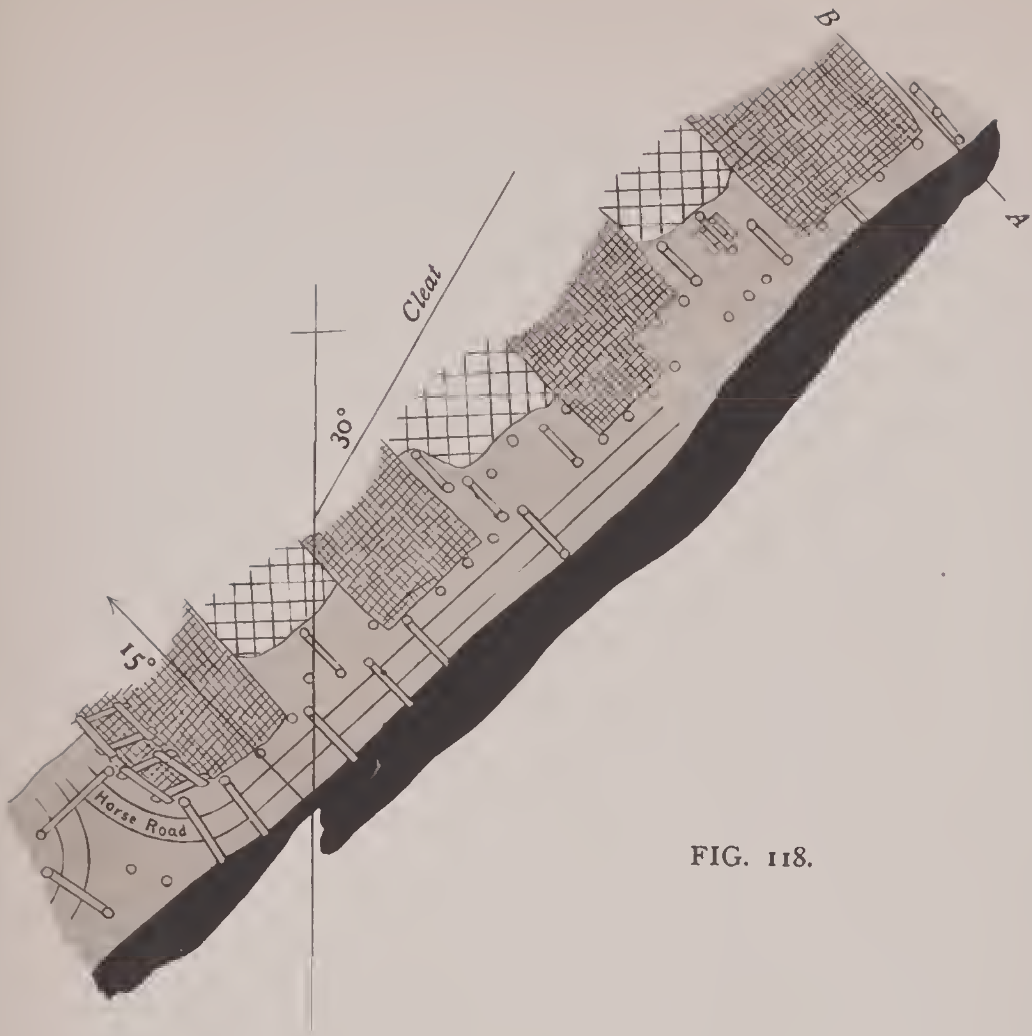


FIG. 118.

Figs. 118 and 119. Plan and Section N. The Top Coal is got in the wastes. It forms a pretty good roof in the drift, though bars are necessary in places. Cleat very distinct. Large tubs are used, and the gauge of the rails is 2′ 6½″, which necessitates wider roads than is advisable.

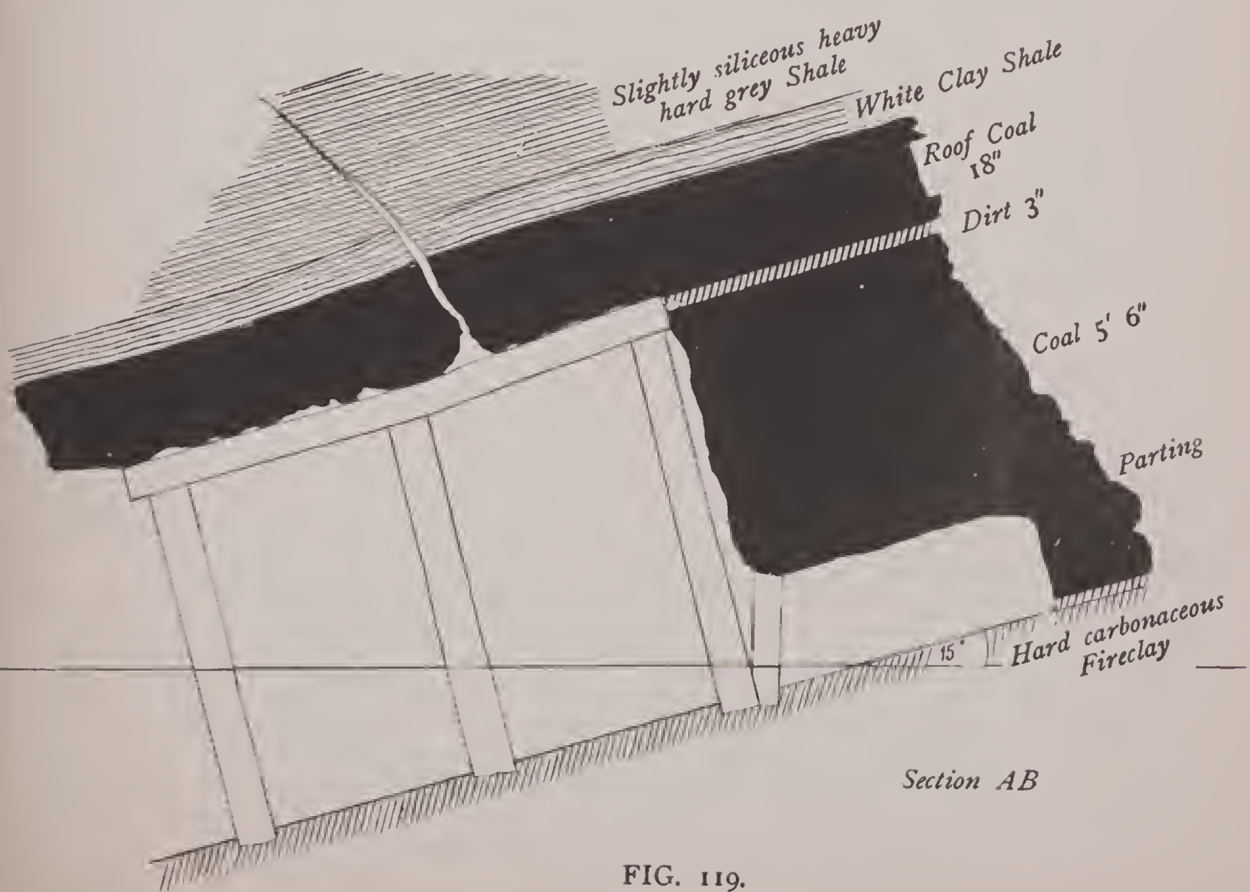


FIG. 119.

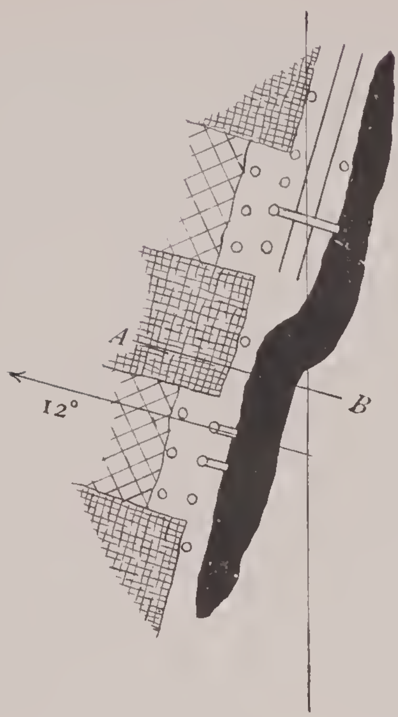


FIG. 120.

Figs. 120 and 121. Plan and Section N. over a small area. The Top Coal is about three yards above the working coal, and the intervening clay shale forms an exceedingly bad roof. The packs are built very close, and the coal holed only so far as it is required. Cleat not very regular ; N-S in the harder and 9° NW in the softer coal bands.

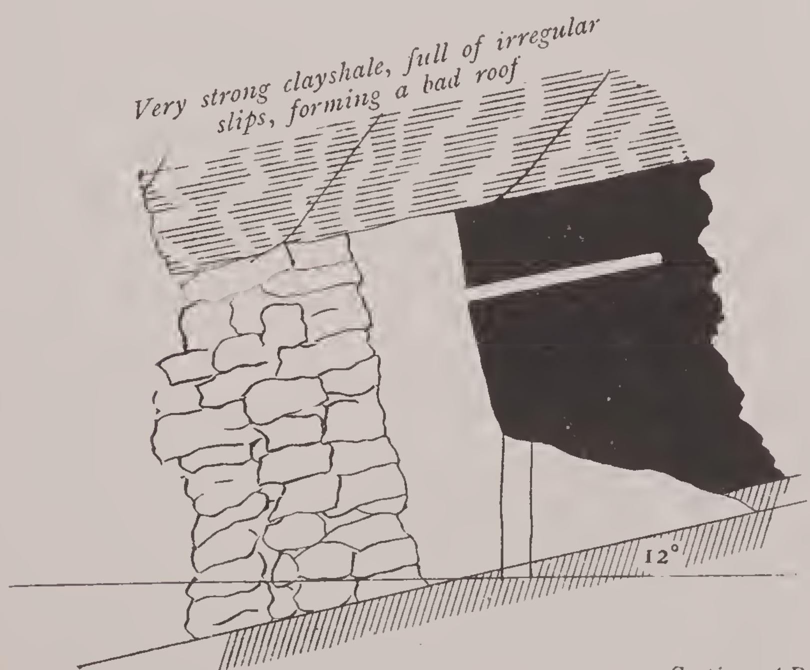


FIG. 121.

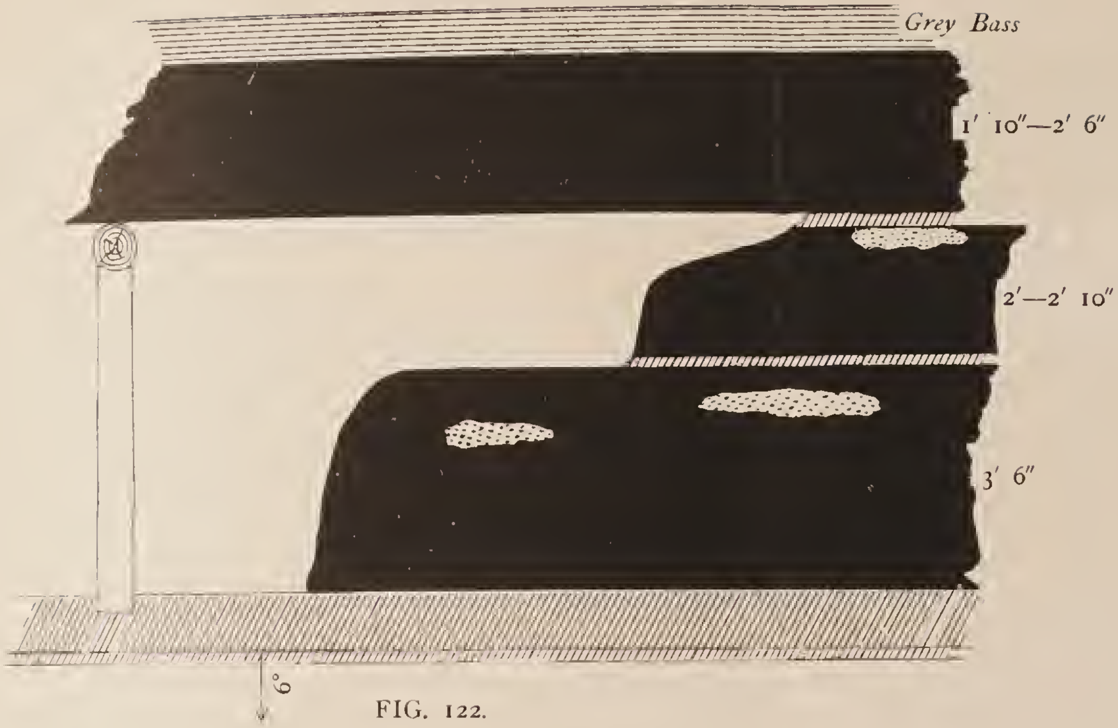


FIG. 122.

Fig. 122. Section W. The coal is dull and inferior. The cleat is distinct; 10° NW.

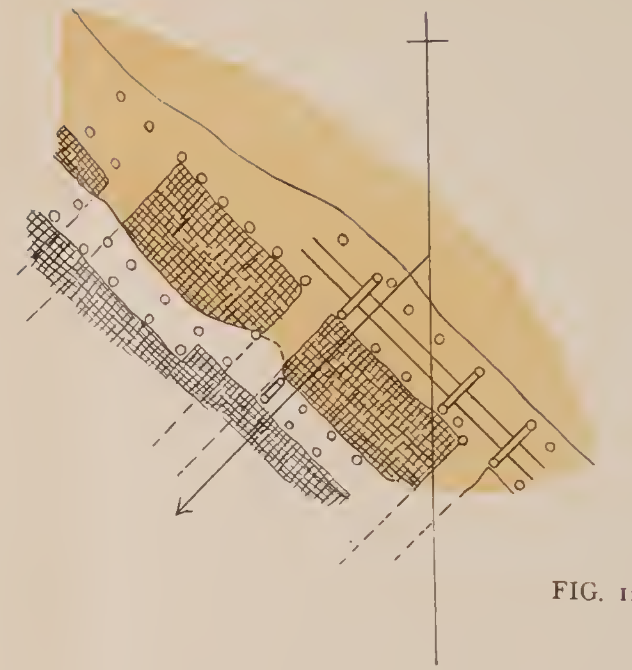


FIG. 123.

Figs. 123 and 124. Plan and Section W. The top bands are worked separately close behind the bottom bands. The stones and bass contain numerous slips (see Section), which pass through all the strata and make the roof very uneven, especially in the top work. Much timber is required, especially in the top work, where the lids have to be very strong, and footlids are used. There are no distinct joints in the stones, but the slips pass through them.

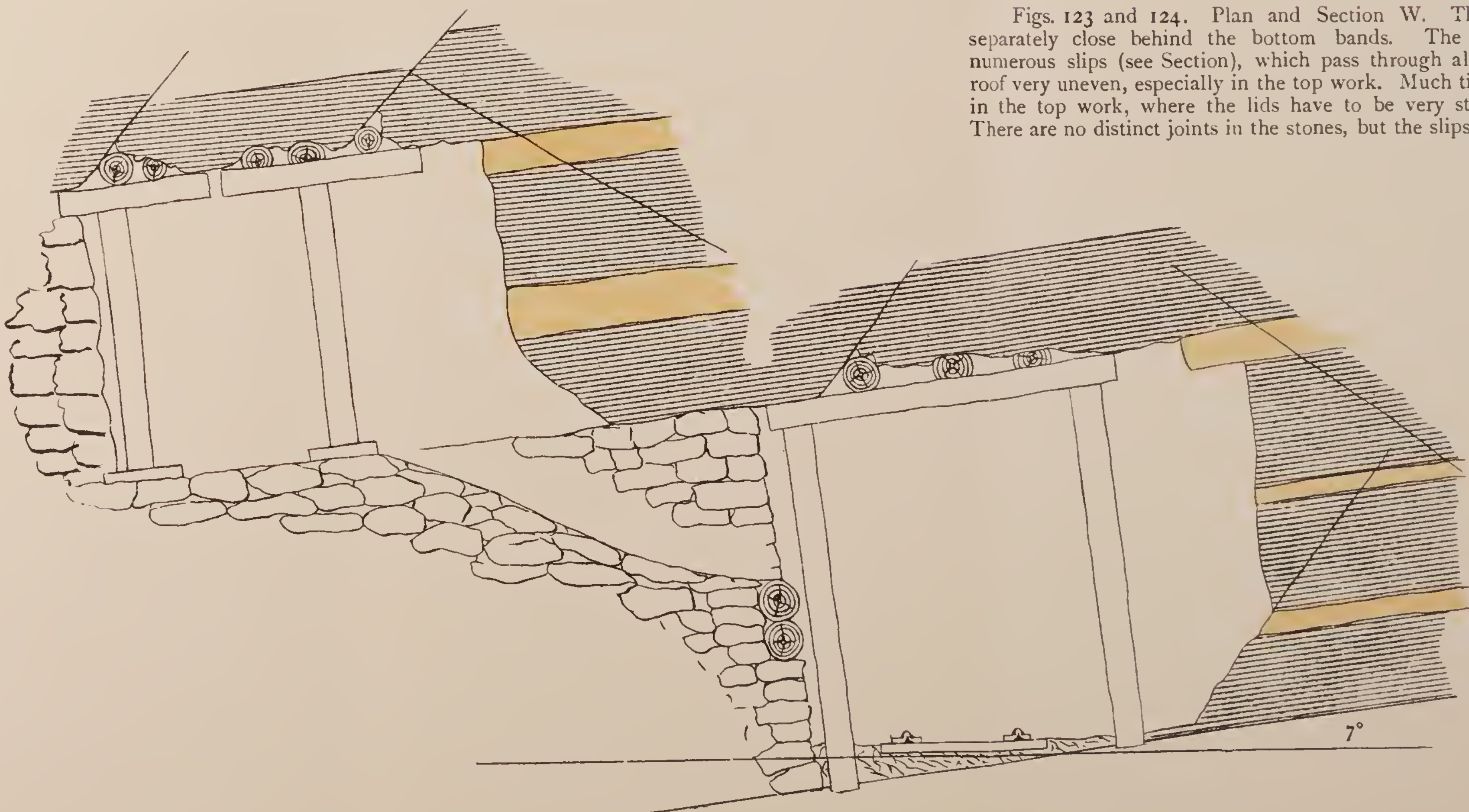
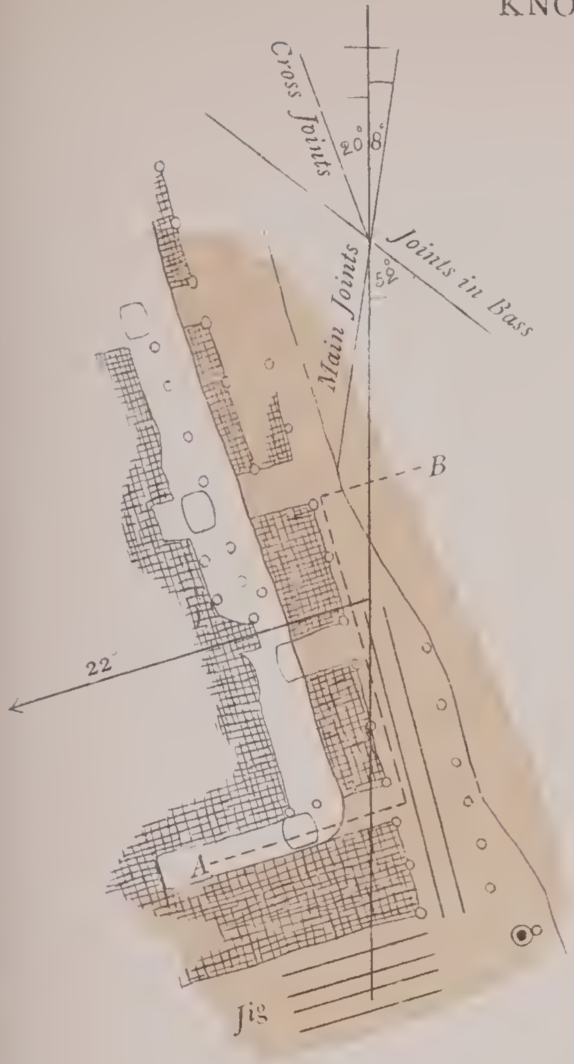
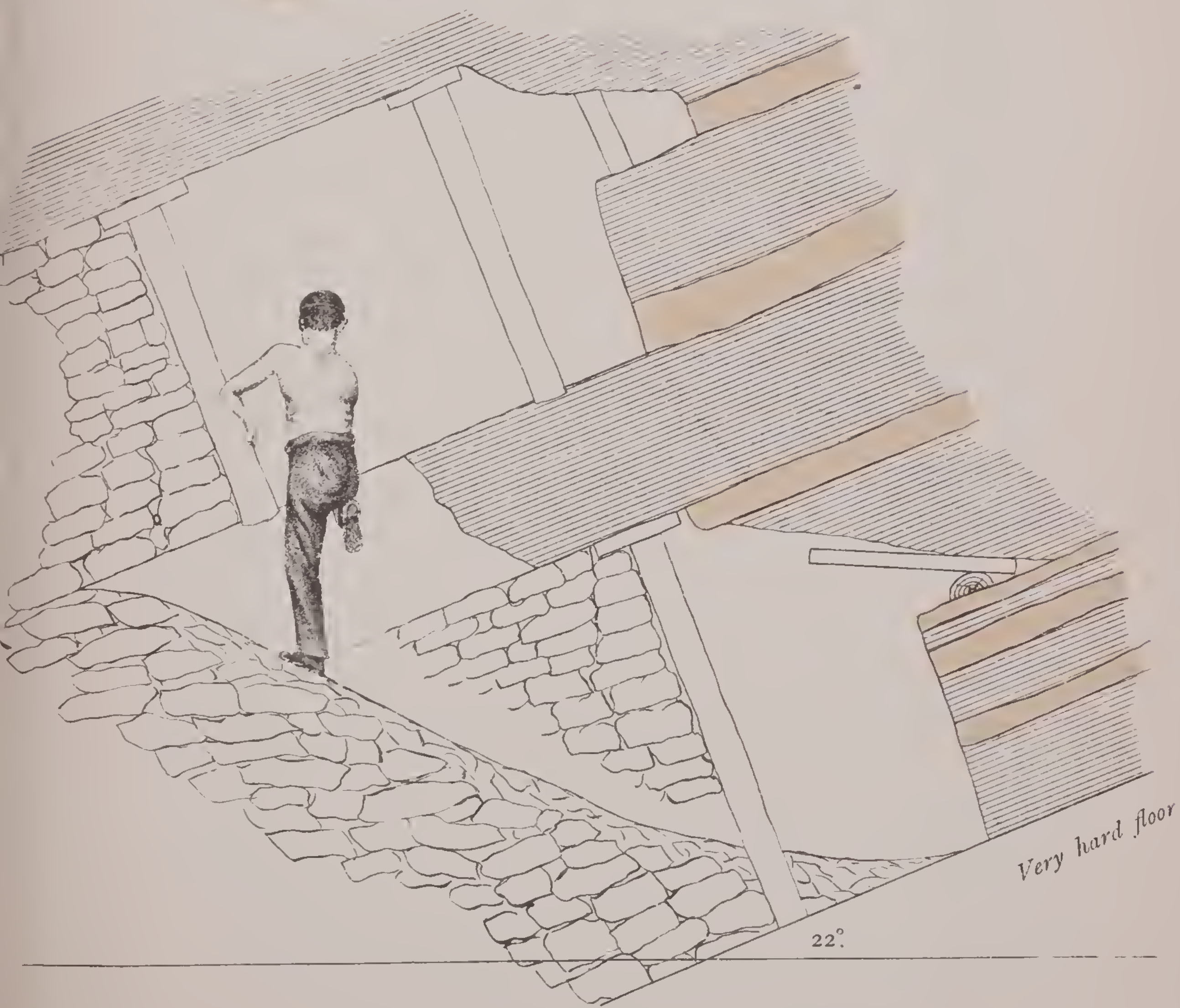


FIG. 124.



Figs. 125 and 126. Plan and Section, about one mile Eastwards. Worked on the same principle. The roof is much better and requires no bars or unusually thick lids. The joints, both in the stone bands and in the bass, are very distinct.

FIG. 125.



Section AB

FIG. 126.

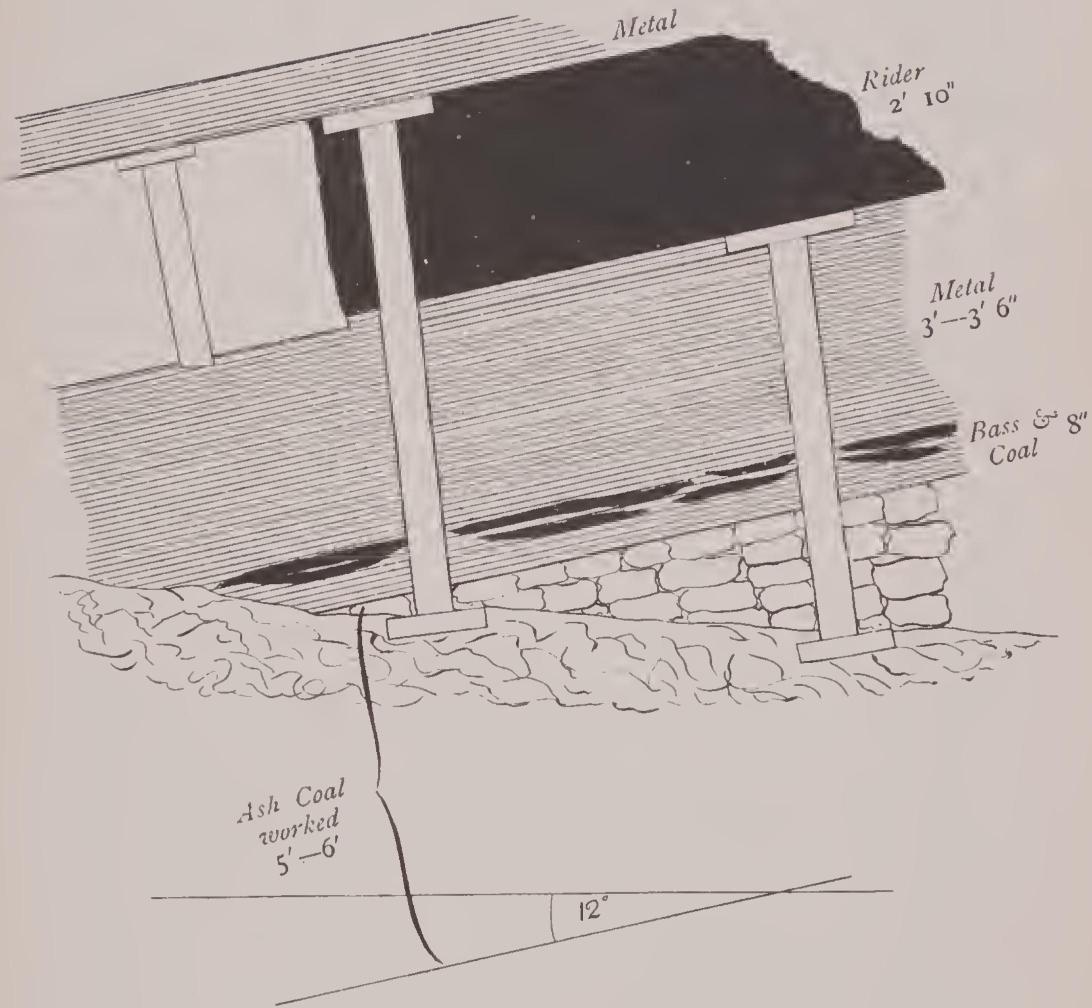


FIG. 127.

Fig. 127. Section N. Where the Rider Coal lies near the Ash Seam it is worked a few yards behind the Ash, either by getting it in the wastes only, or sometimes drifting it over the Ash packs as well (as shewn in Section).

North-West, where the Rider Coal lies 5—7 yards above the Ash Seam, it has been worked separately. It is 2′ 10″—3′ thick, and has a good strong metal roof.

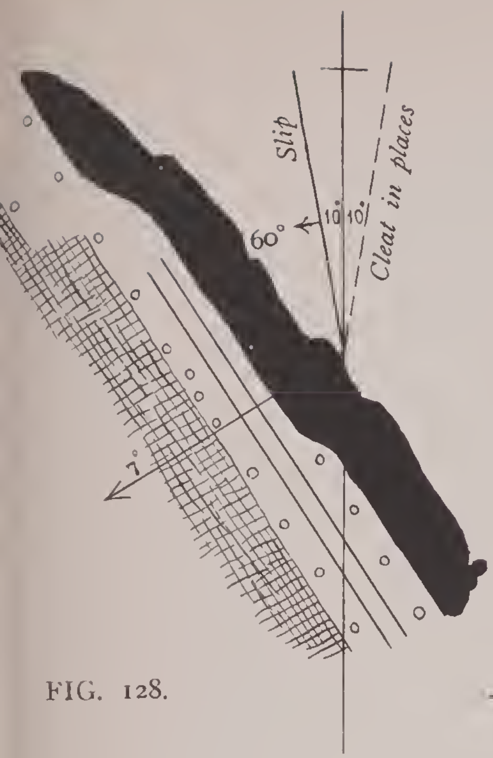


FIG. 128.

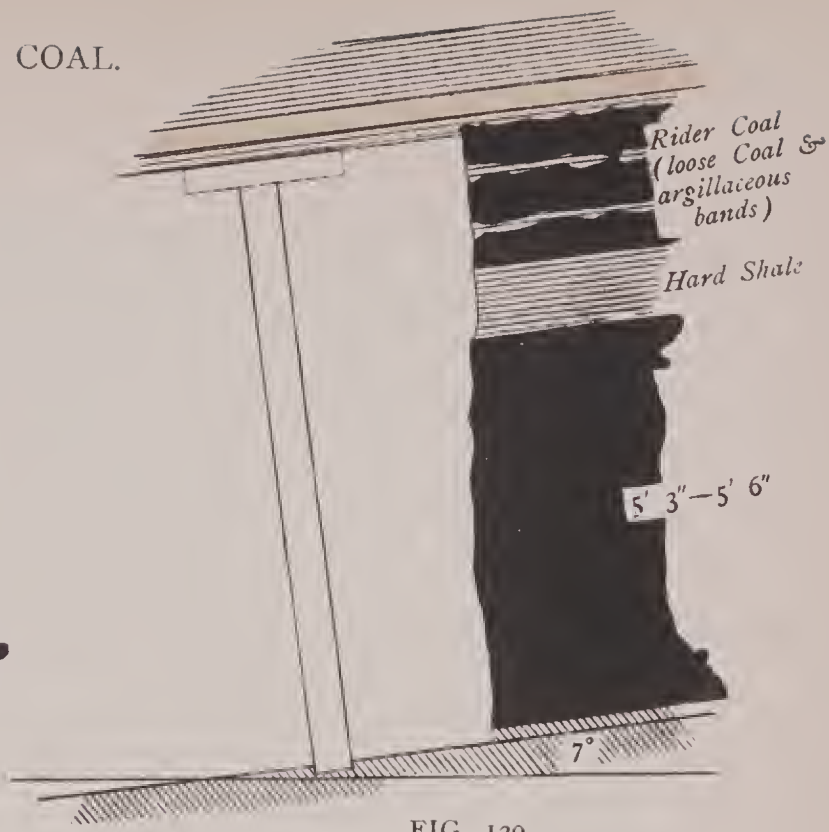


FIG. 129.

Figs. 128 and 129. Plan and Section W. The coal is bright, dense and hard, interspersed with irregular thin bands of hard, dull-looking coal. Small, hard grey argillaceous lumps occur in it, at times as large as 1′ thick × 3′ wide and 3—4 yds. in length. The roof is heavy and strong, and falls in the wastes in large pieces. There is abundance of packing material. The hard shale between the coal and the Rider is absent in places. The coal is usually rated off, but it is holed at the top (Rider) at times. The cleat is undefined and irregular. Slips occur frequently; they run from 2—12° NW.

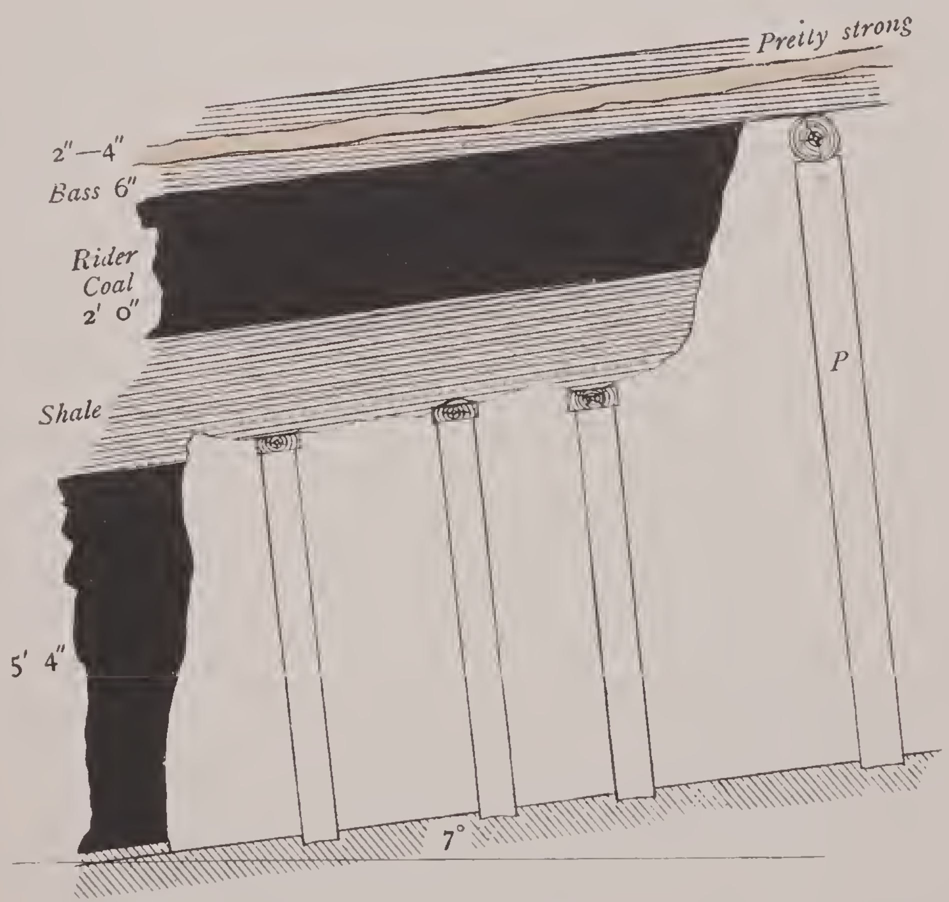


FIG. 129A.

Fig. 129A. Section of dip. Extreme East. The dip is 9′ wide, and is timbered every 4′ by two legs *(P)* and a bar, with slabs over them. The bars, which are 7′ 6″ long, are liberated at their ends to prevent their being easily broken by the side pressure. The legs are inclined. The Rider Coal, which is taken down 3 yards behind the face, is supported by temporary posts.

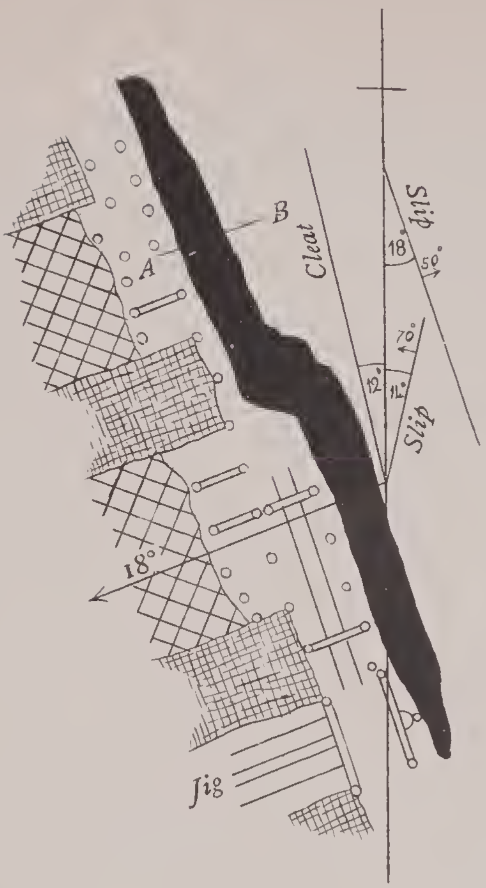


FIG. 130.

Figs. 130 and 131. Plan and Section about one mile East of last Figs. Cleat very distinct, and slips preponderating 18° NW. Where slips are few they are regular, and run through the whole seam, but when they are numerous they run in and out irregularly and unexpectedly. The coal hanging over the sprags has occasionally come off from a slip and injured the colliers. Overhanging coals should be supported by stretchers from posts, as shewn. The packing material is limited, and the roof generally breaks down in the wastes to the Rider Coal, 7 yards above. The ironstone is very good, and is collected and sent out at the rate of one ton of stone to 15 tons of coal. The roof is not strong.

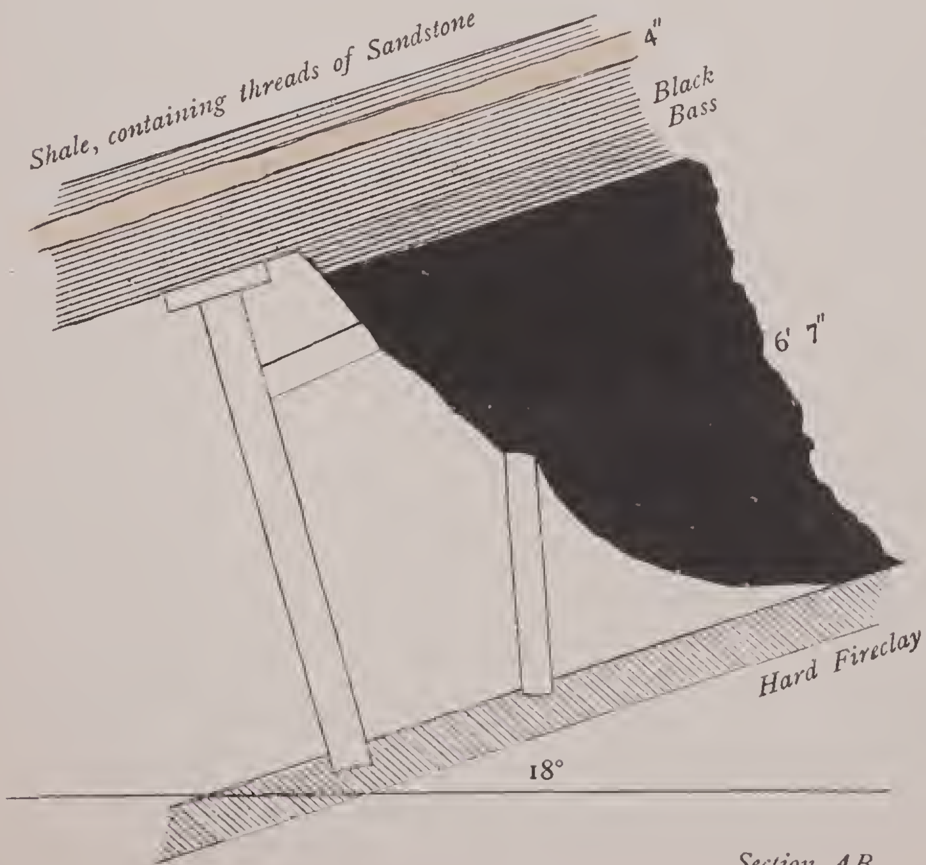


FIG. 131.

ASH COAL.

Fig. 132. Section S. Cleat very distinct 13° NW.

N. the cleat is very distinct 15° NW.

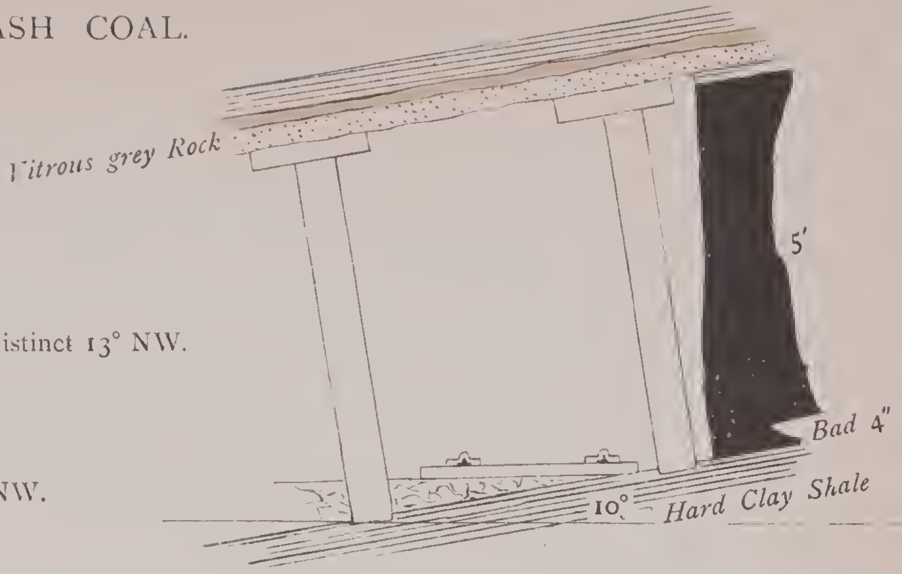


FIG. 132.

LITTLE MINE IRONSTONE.

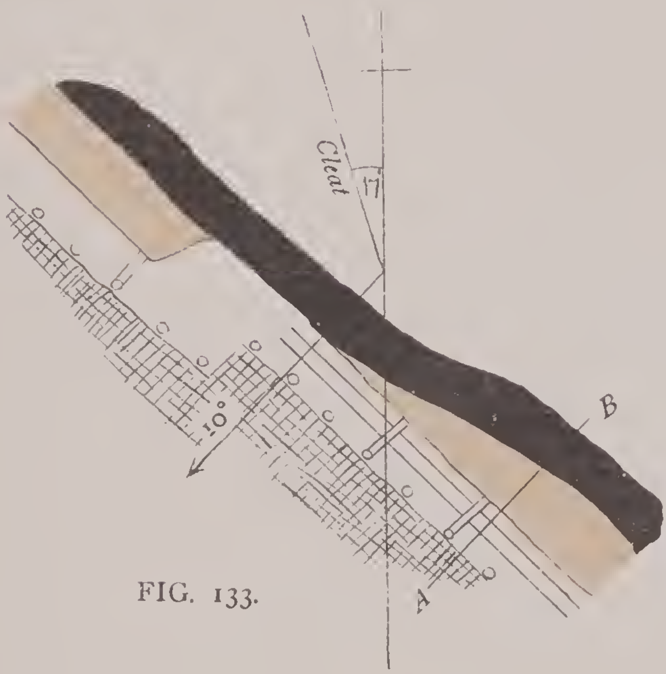


FIG. 133.

Figs. 133 and 134. Plan and Section W. Cleat very distinct.

Further East the bass turns to fireclay and the chance bands are thicker near the coal. In that case only about 2′ are turned over above the coal.

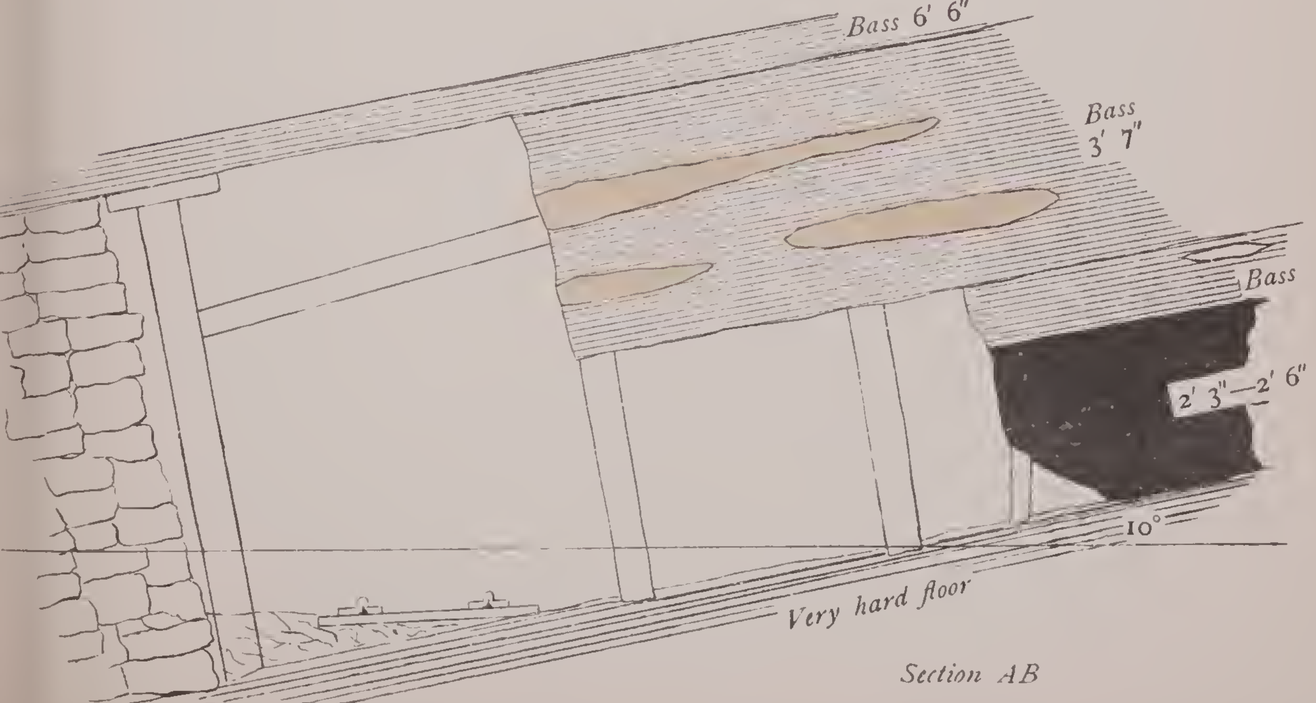


FIG. 134.

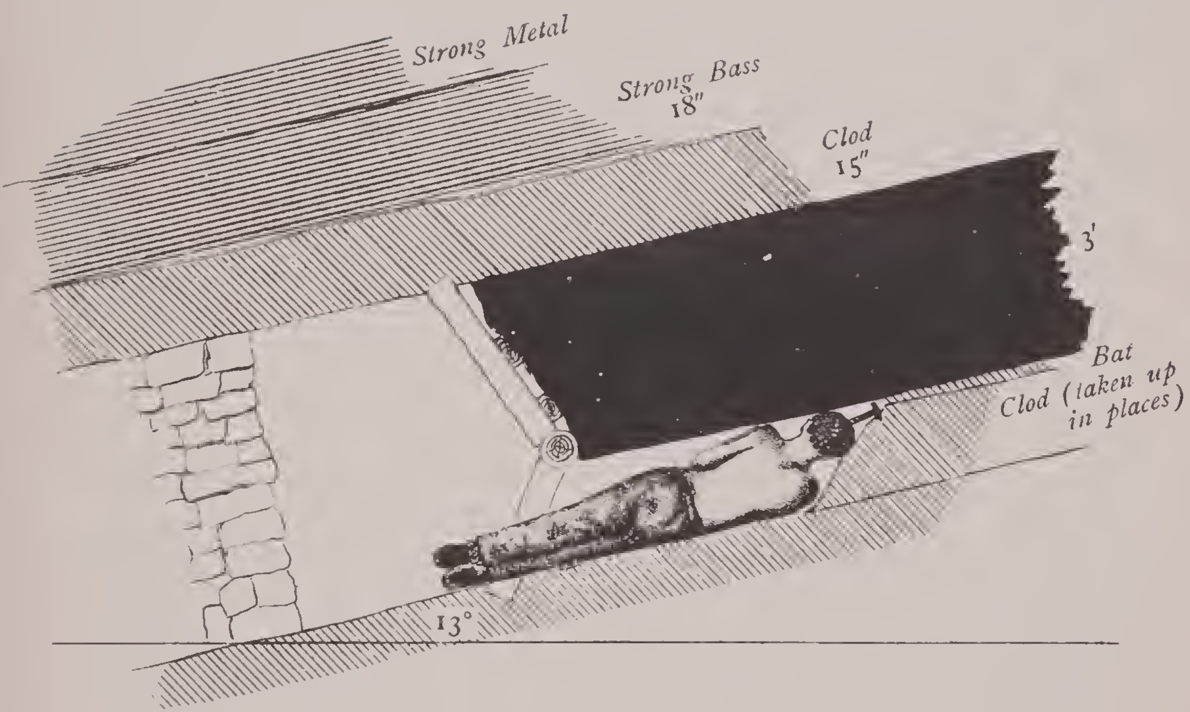


FIG. 135.

Fig. 135. Section S. Longwall, with 70 yds. faces. The clod is treacherous, containing smooth surfaces, and requires to be carefully supported. It is taken down in the jigs. On one occasion it had been taken down to about 4′ from the jig post, the jig being 9′ wide. A piece of the projecting clod, 7′ 6″ × 3′ 6″ and 18″ thick, broke off and killed the jigger. A bar should be placed under such projecting pieces of roof, or the latter should be taken down to nearer the jig post.

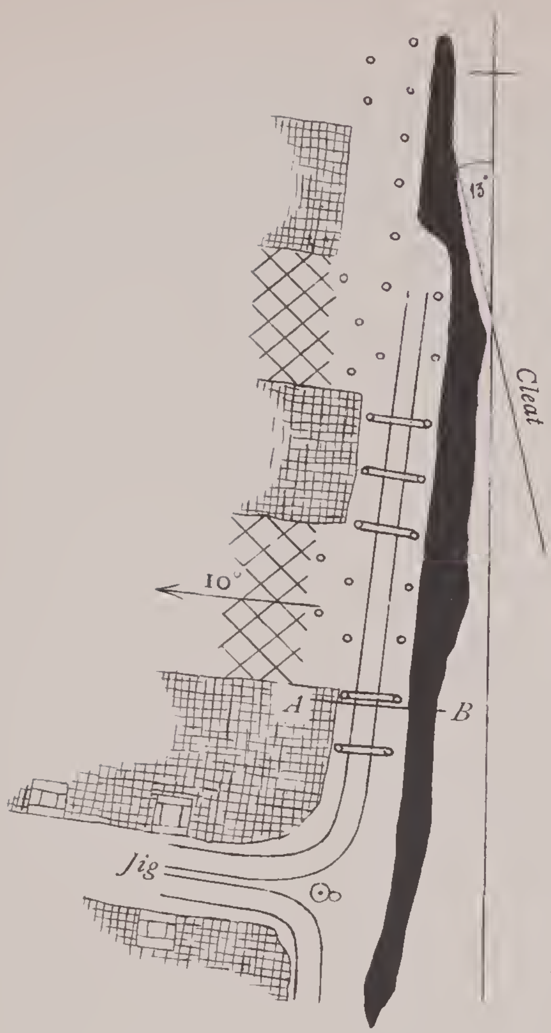


FIG 136.

Figs. 136 and 137. Plan and Section S. Cleat very distinct; cleat planes being as near as $\frac{1}{8}''$ apart in places. Slips like the one shewn in Section run in the coal at intervals. The shale roof breaks up small easiest in the direction of the coal cleat; it forms a very bad roof, and necessitates much timber. Lids are formed of broken posts and bars are frequently put up. The jig post is shifted after two falls, so that the rails are bent as in plan for the second fall. The roof is too bad to allow of a back fall.

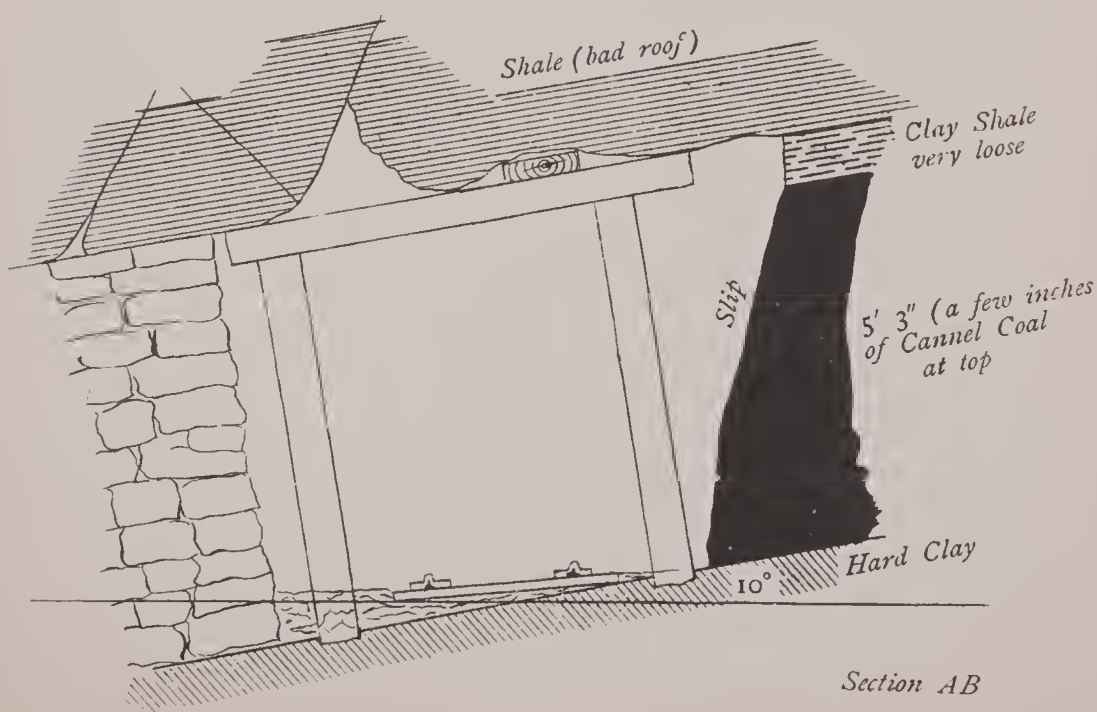


FIG. 137.

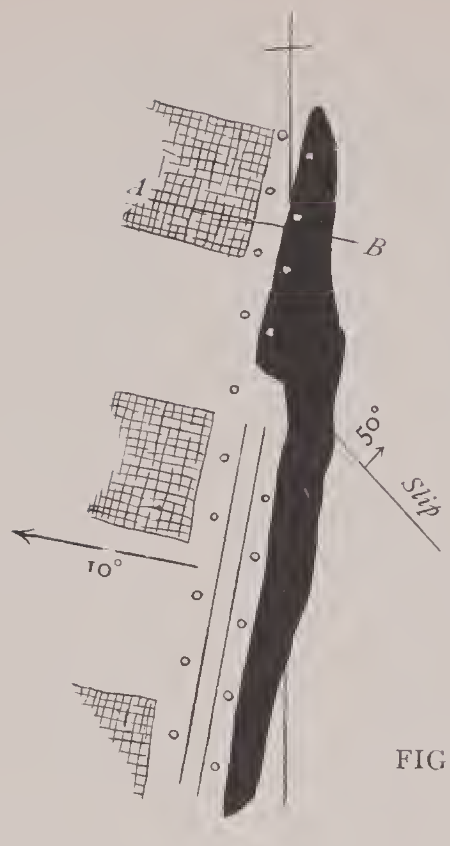


FIG. 138.

Figs. 138 and 139. Plan and Section NW. The nature of the seam varies considerably. The roof is strong, and bends down in the wastes ; it seldom breaks. The drifts are 25 yds. on each side the jig, but are all in one long straight face. The cleat planes run due NS, at intervals of a few inches. The coal between them has a slight tendency to split in the same direction, but it has a greater tendency to break in the plane of stratification. The coal comes off in long pieces. Slips occur in the coal in places at intervals of from 1′—4′

The Cannel Bass contains very straight joints, at intervals of about ½″, in the same direction as the cleat planes. It breaks in long, square, thin pieces. The curly cannel contains curly planes of division, ⅛″ apart, in the same direction.

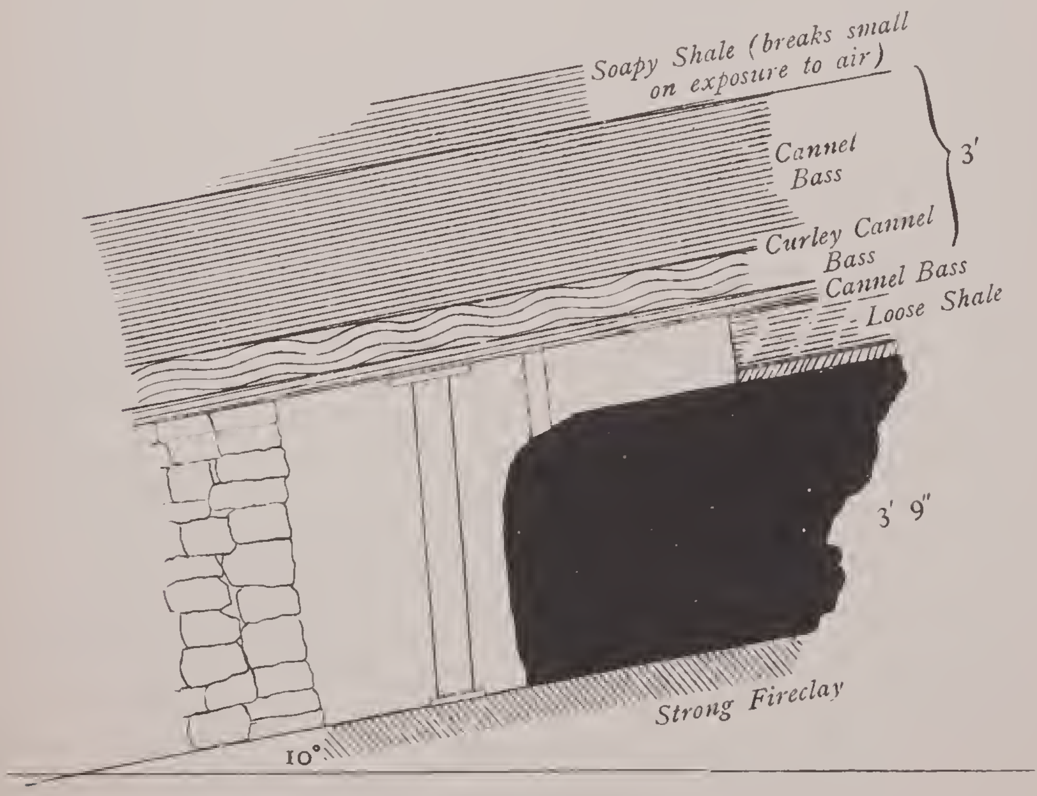


FIG. 139. *Section AB*

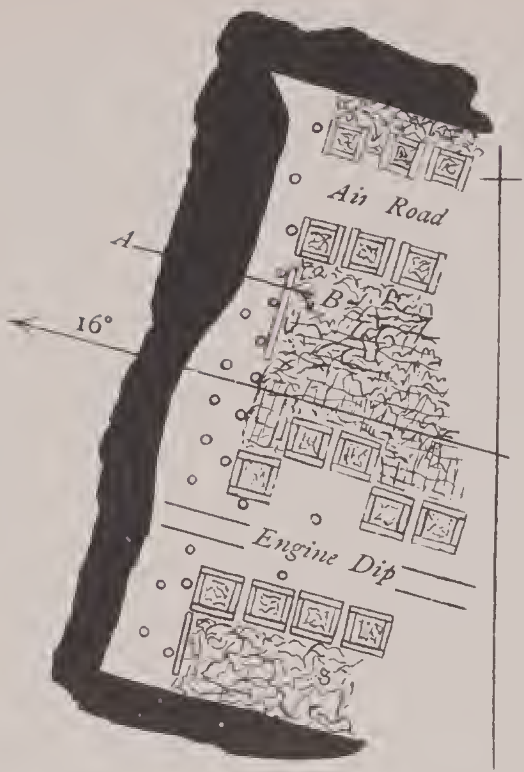


FIG. 140.

Figs. 140 and 141. Plan and Section of a "breasting" down dip N. The roof is good. The coal long-grained and dull. The chocks very regular; made of 4″ square timber, about 4′ 6″ long.

FIG. 141.

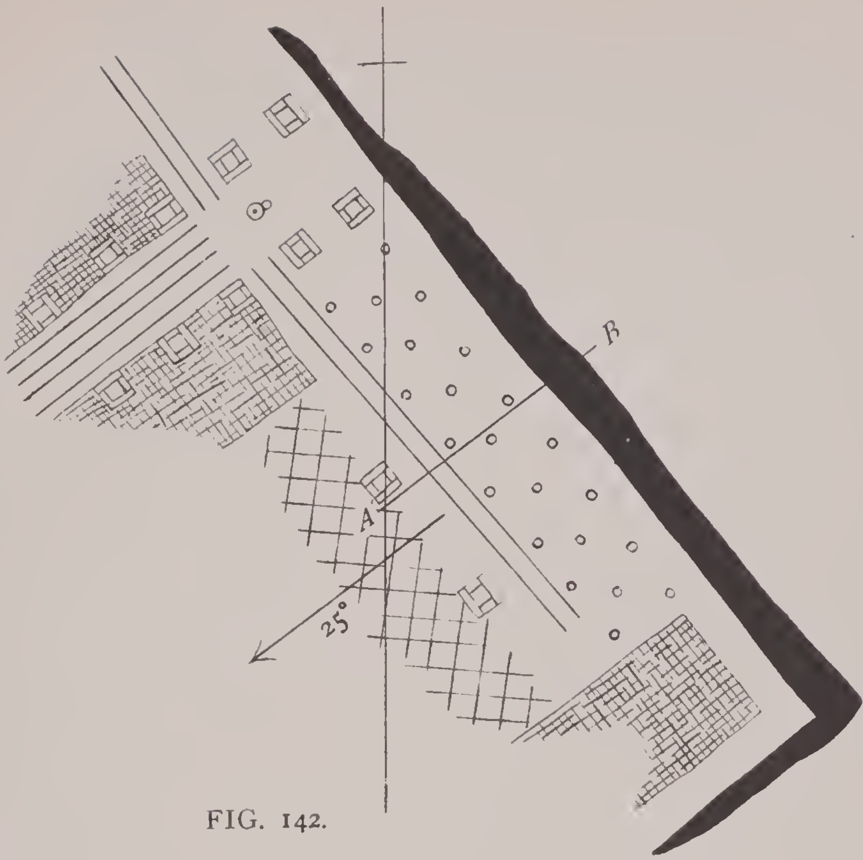


FIG. 142.

Figs. 142 and 143. Plan and Section SE. The jig post is shifted every 6 yards when the roof sinks down in a body, as shewn. The floor is hard, and the posts are not stamped. The floor is roughened where posts are set.

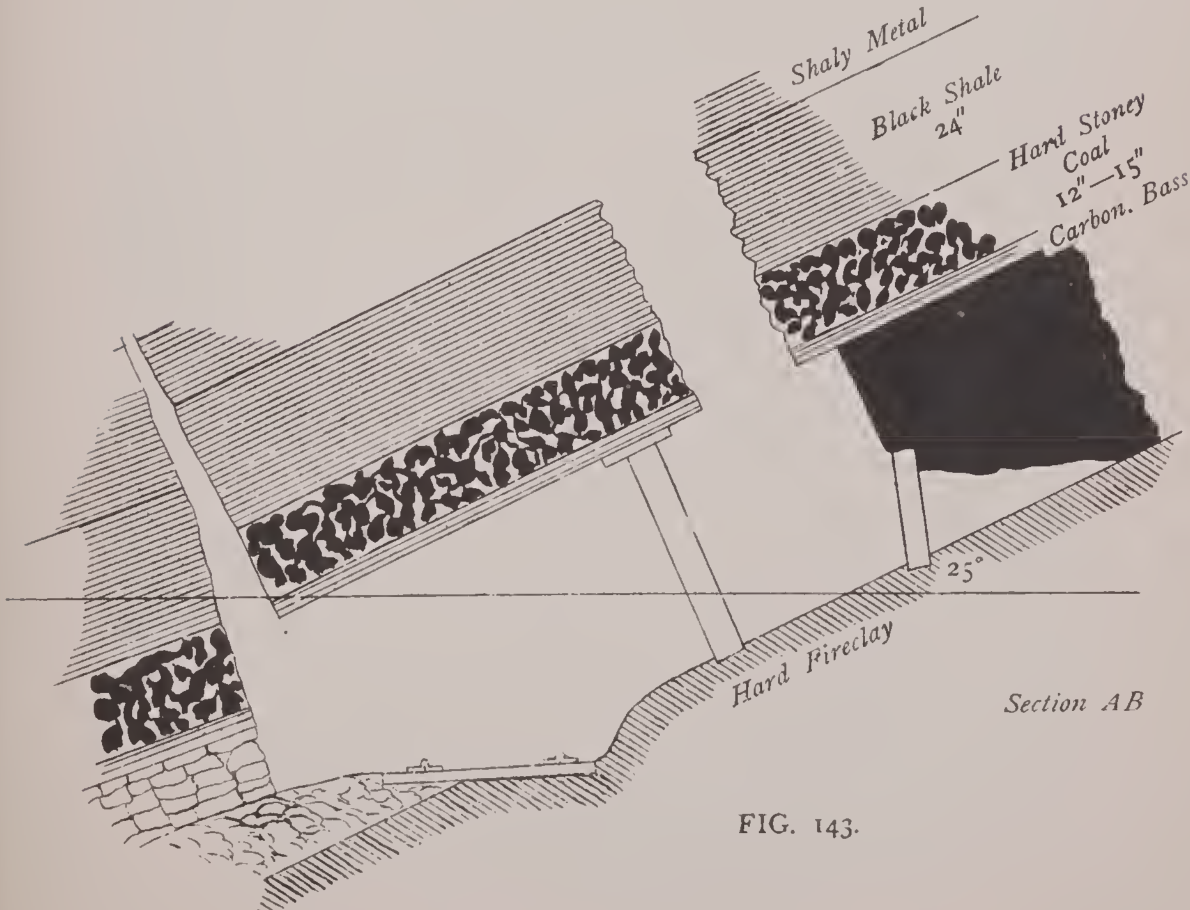


FIG. 143.

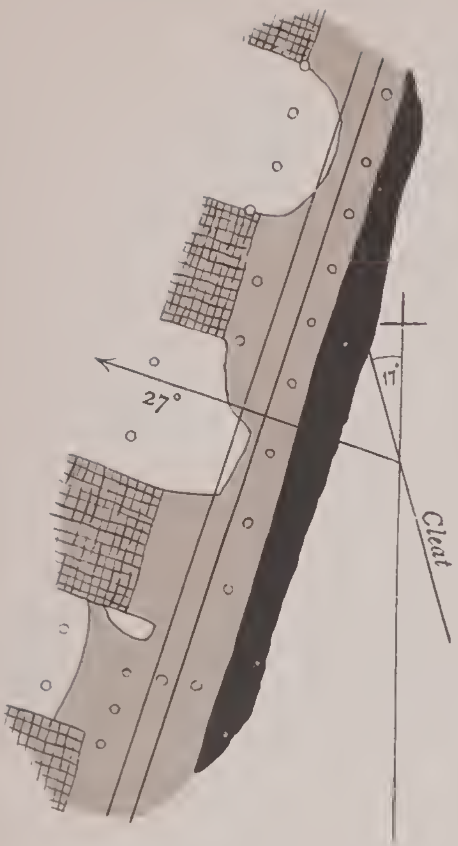


FIG. 144.

Figs. 144 and 145. Plan and Section N. The drifts are from 50—60 yards long on each side the jig. A breadth of 6′ is holed and drifted ; the tops are then got down in the wastes, as shewn in plan, the back timber drawn, and packs built close to the top row, as shewn in section.

Cleat distinct. Slips run through bottom coal and dirt at intervals of about 2—3 yards, in the direction of the face.

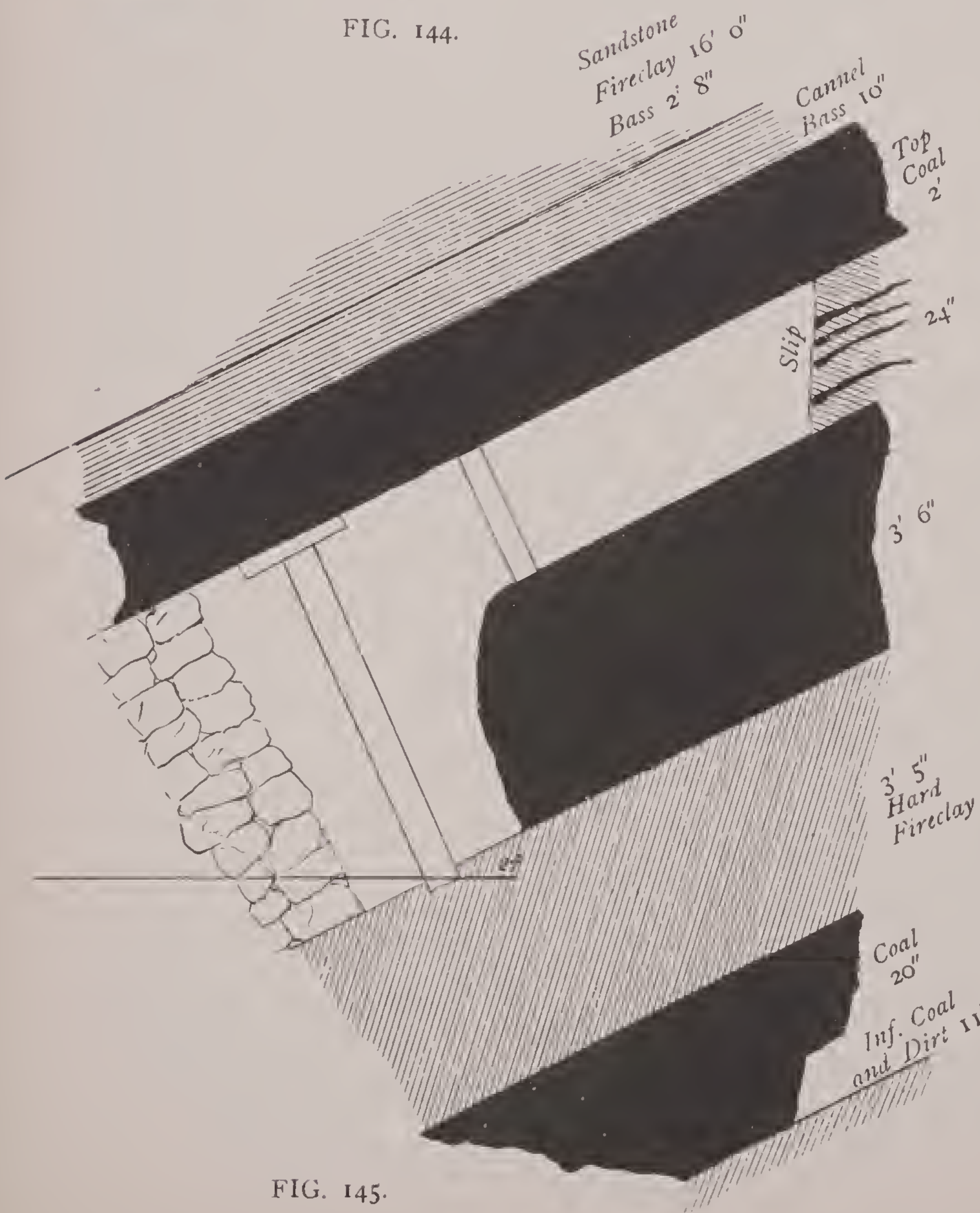


FIG. 145.

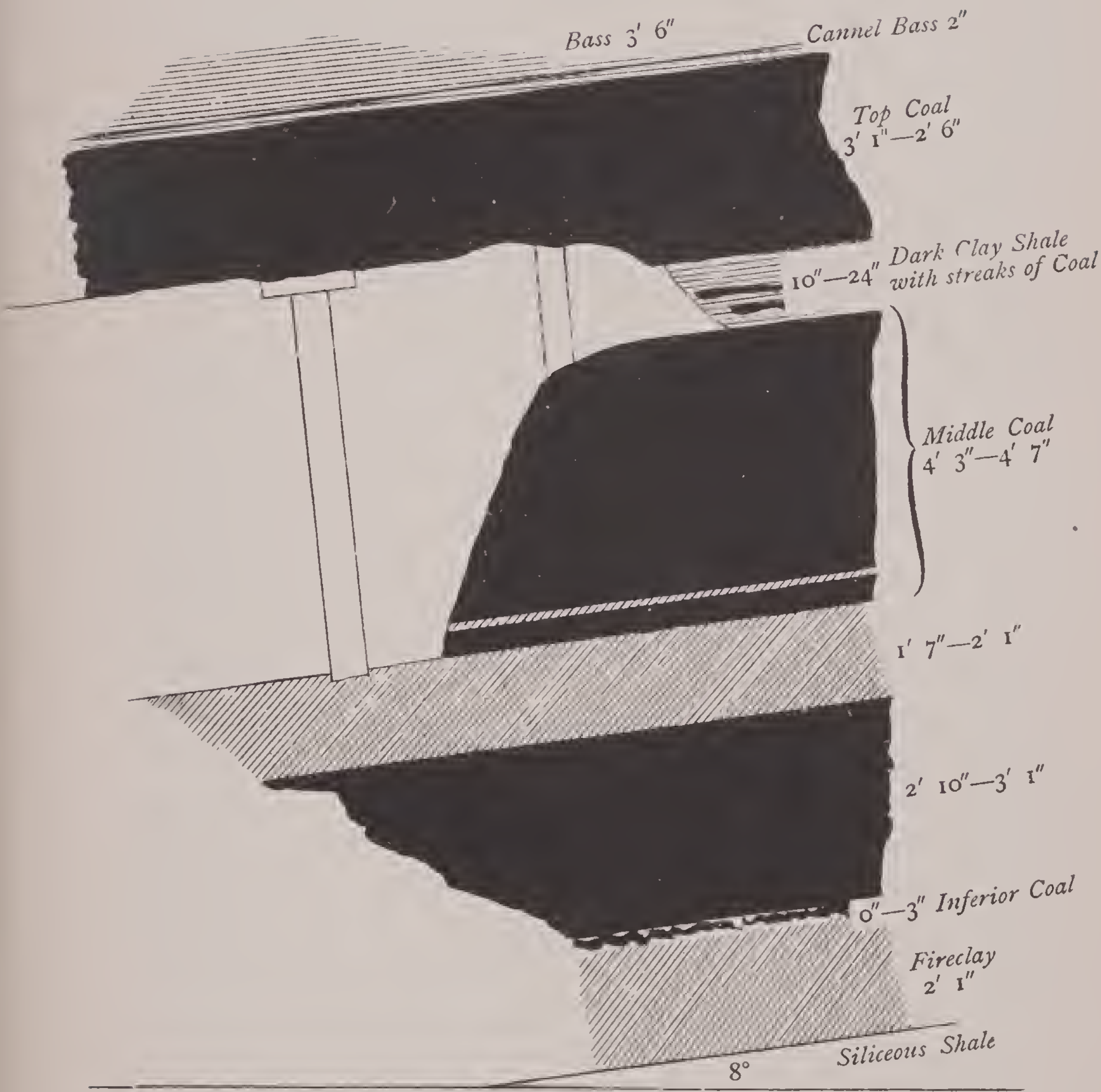


FIG. 145A.

Fig. 145A. Section NW. Longwall, as in Fig. 144. The Bottom Coal may probably be worked separately afterwards.

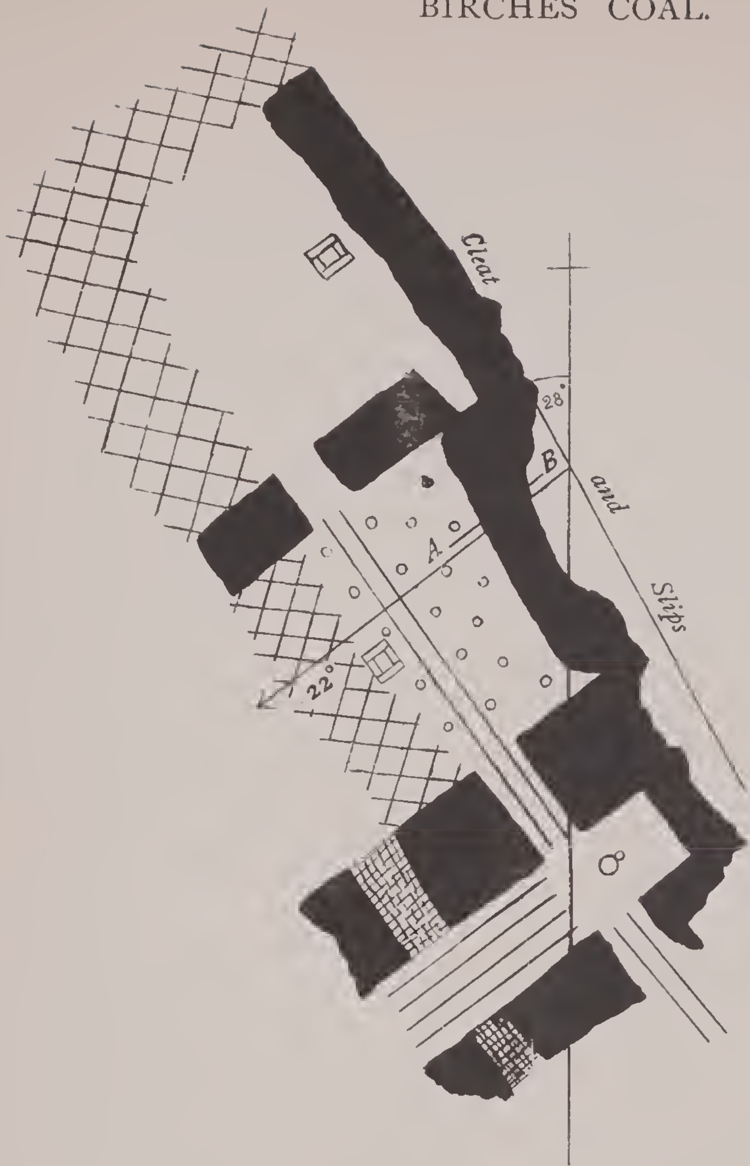


FIG. 146.

Figs. 146 and 147. Plan and Section SE. The drift extends 25 yards on each side the jig. Coal posts are left in part, but where the roof breaks and builders are obtainable, pinnings are built, especially between the coal posts near the jig. The chocks are 2′ 6″ square, and are filled. The cleat is distinct. Very pronounced cleat planes, coated with flakes of pyrites, occur at intervals of from 3′—4′ and more. The coal, which is not holed, only just pricked, is got down from them, after being cut at the sides. A secondary cleat, not so distinct, runs nearly at right angles to the first. The roof is pretty good, but contains slips in places.

Northwards the coal is inferior, and is not worked.

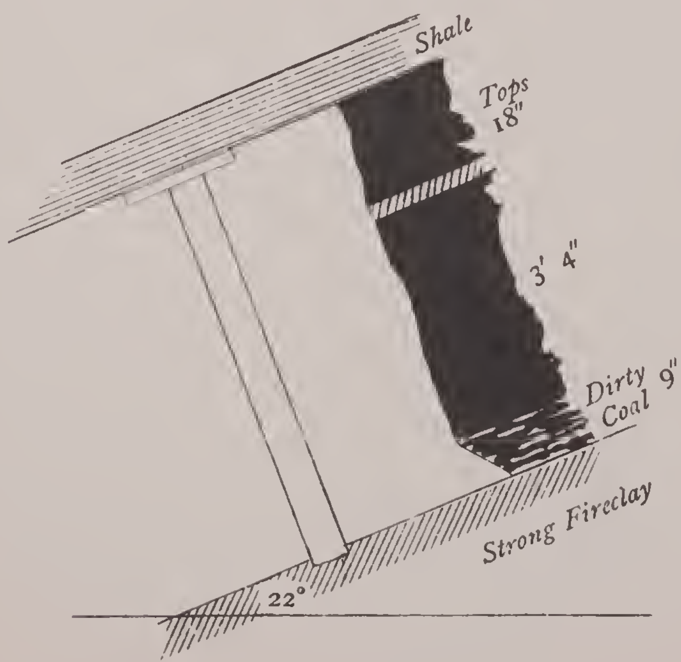


FIG. 147.

Section AB

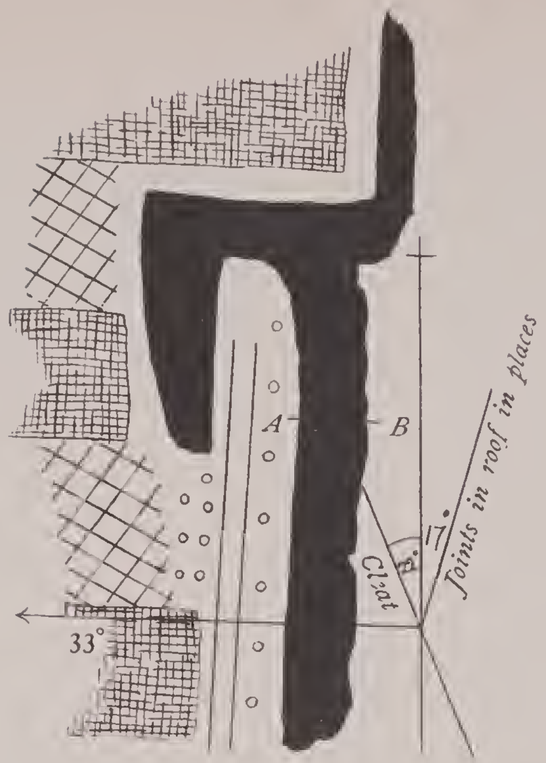


FIG. 148.

Figs. 148 and 149. Plan and Section NE. The roof is very short and jointy, and occasionally falls in at the face, in which case pillars are left to recover a new roof, as in Plan. It very soon cuts at the face, and the floor lifts, as in Section. Where the bass is exceptionally loose 15″ of Top Coal are left over the packs. Where the roof is stronger a back fall of 1½ yards is got in going back. Cleat very distinct. The coal is rated off, very little holing being done.

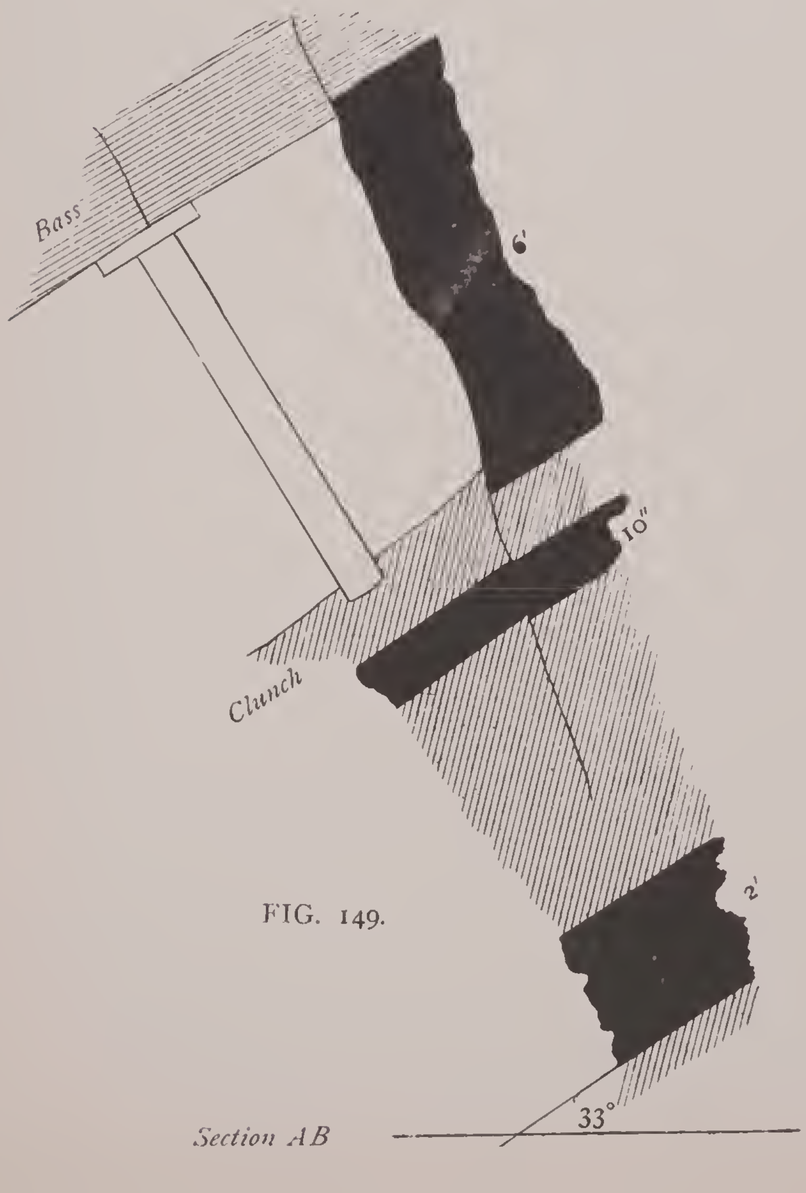


FIG. 149.

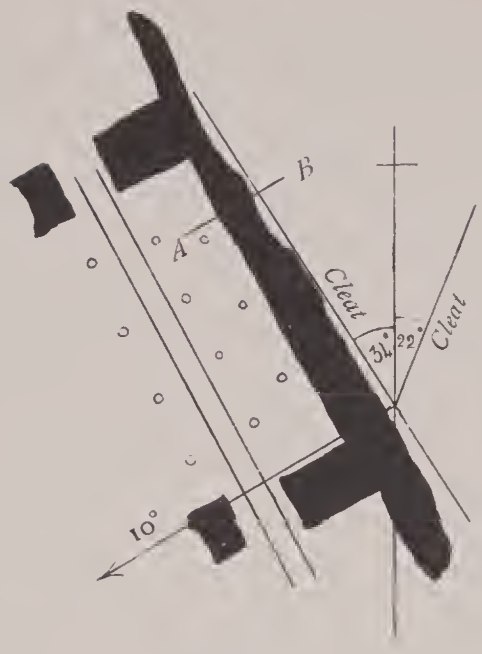
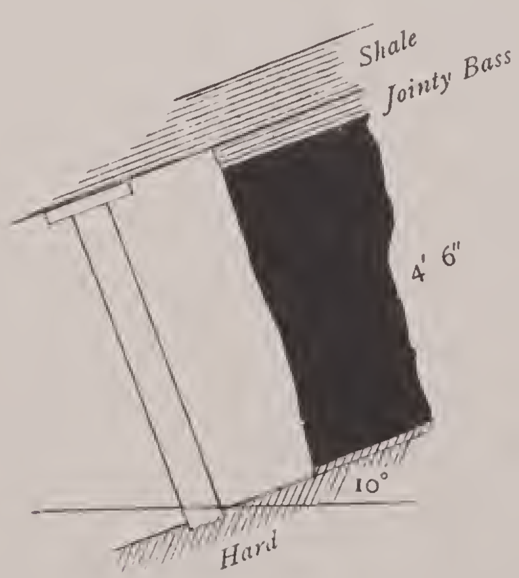


FIG. 150.

Figs. 150 and 151. Plan and Section SE. Post and thurl. The roof is strong, and contains fossils; it falls in large pieces after the coal posts are removed. The floor heaves very much, and tends to lift the posts up in the head. The coal splits up very small, and is rated off. Cleat well defined in E. direction, but best 34° NW. The coal is worked by longwall in places. The roof has to be blown for builders; it is slightly more expensive to get, but more round coal is made and much less powder is used Chocks are built at the face, and are afterwards drawn from the wastes. Less timber is required. The floor does not heave, and the effects of weighting in the roof are not seen at the face, as with the other method. Jigs stand well on 3′ chocks, 6′ apart.

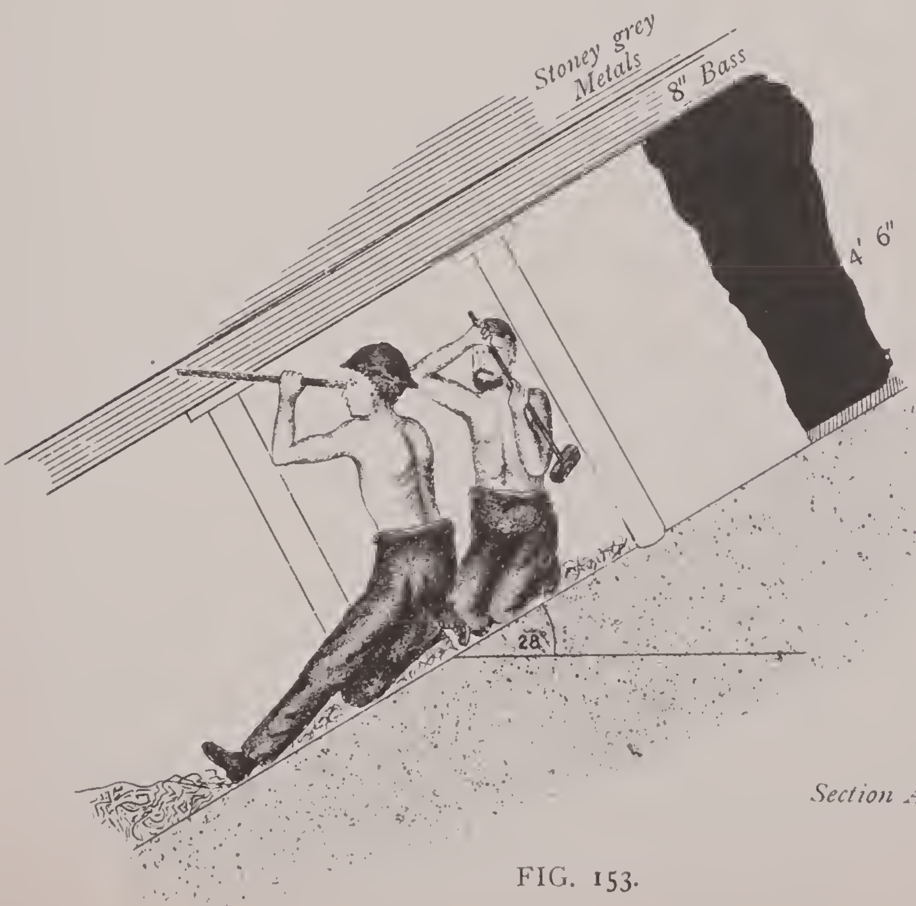


Section AB

FIG. 151.

FIG. 152.

Figs. 152 and 153. Plan and Section NE. The roof is strong, and contains a fossil band. Section shews a shot hole being bored to blow down the bass, to form builders for the packs. The bass is down over spaces S, S. The coal is soft, and requires little holing. Cleat very distinct, but varies from 8°—18° NW. The clay underneath it varies much in thickness. The bass contains two very distinct series of joints, from 6″ and more apart.



Section AB

FIG. 153.

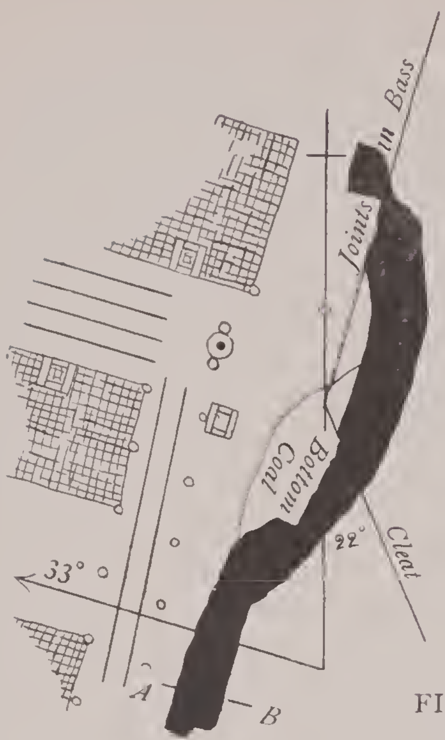


FIG. 154.

Figs. 154 and 155. Plan and Section NE. Longwall drifts 50 yds. on each side the jig. Cleat very distinct, longer in Top than in Bottom Coal ; cross cleat in places. Joints run pretty parallel in the bass, 18″—24″ apart. The roof is good ; it weights in large pieces. The coal adheres strongly to the bass.

The levels have lately been "breasted" in, 32 yds. wide, and three roads formed ; the upper and the lower one for ventilation, and the centre one, in which the roof is taken down for a drawing road. The drifts are started from the upper road.

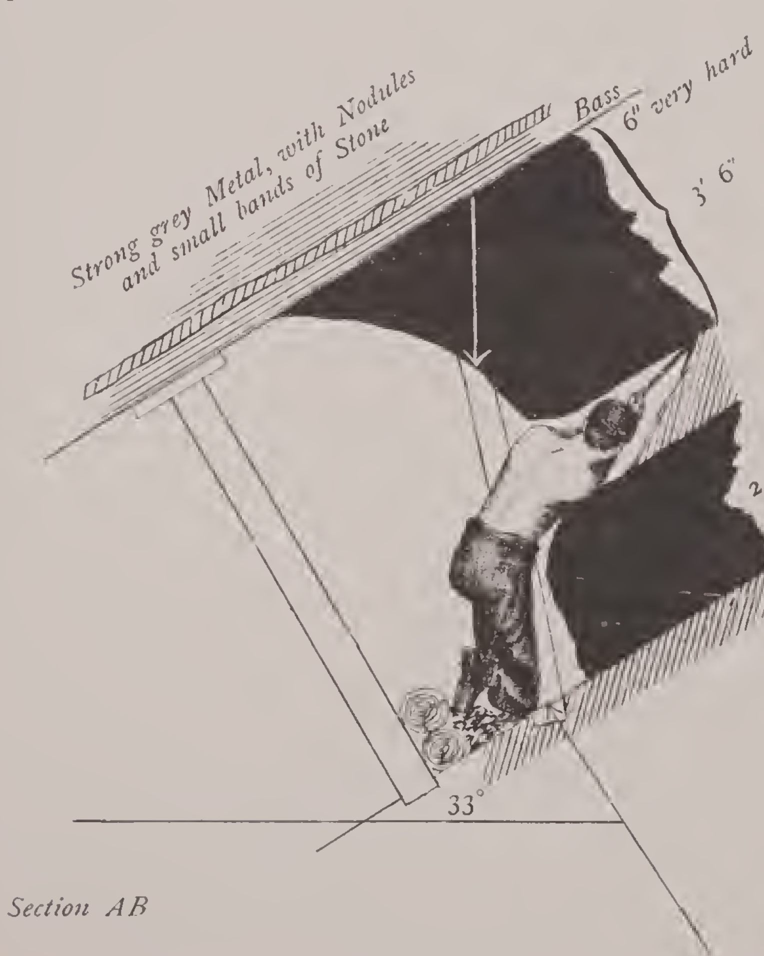


FIG. 155.

Figs. 156 and 157. Plan and Section E, illustrating the falling in of the roof in a drift over an area of about 150 sq. yds., by which a collier was killed.

There is a layer of clay shale, 2′ 4″ thick, which forms the roof. It is usually strong, but owing to the presence of slips and to the drift having stood for some weeks it was tender, and was loosened from the roof above along a smooth parting. There was an ample supply of timber; × × represent the posts, and × – – – × the posts and bars which were knocked out by the fall, about 50 in number.

This large fall of roof occurred owing to the packs being so far apart, and the back timber not having been drawn in consequence. The pack had also not been built close up to the face. The two back rows of posts, by supporting the roof, threw additional weight on to the coal and the timber at the face. The posts were easily knocked out, from being set too square with the dip, which, with a loose roof, was wrong. The other five men who were in the drift at the time escaped almost miraculously.

Southwards the Top Coal is 3′ 3″ and the Bottom Coal 2′ thick; the floor is hard. The drifts are 45 yds. on each side; the jig packs 3 yds. and wastes 6 yds.

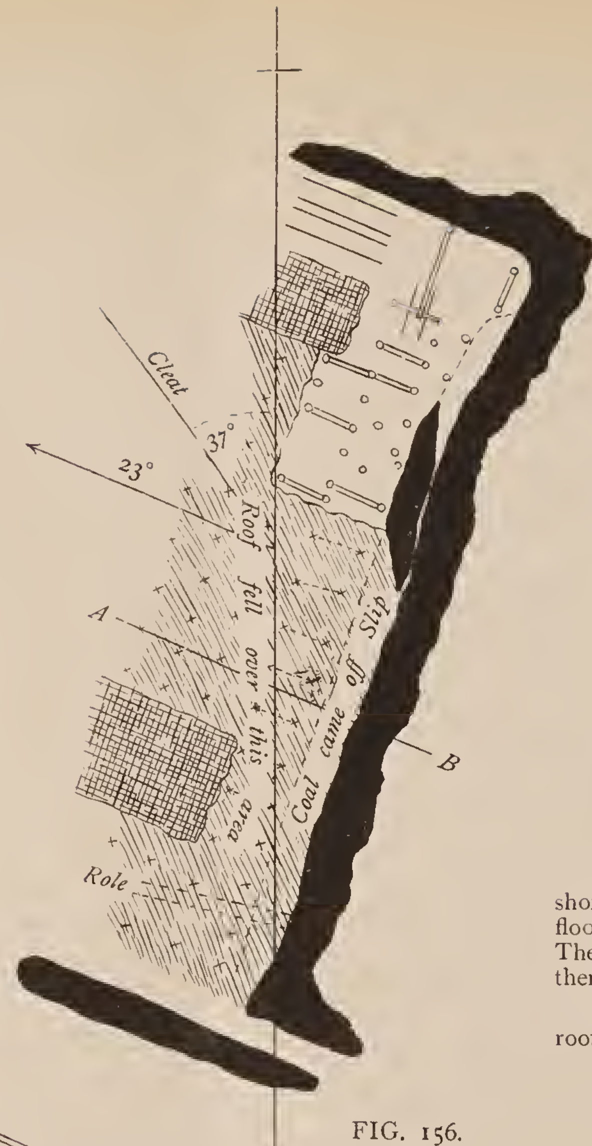


FIG. 156.

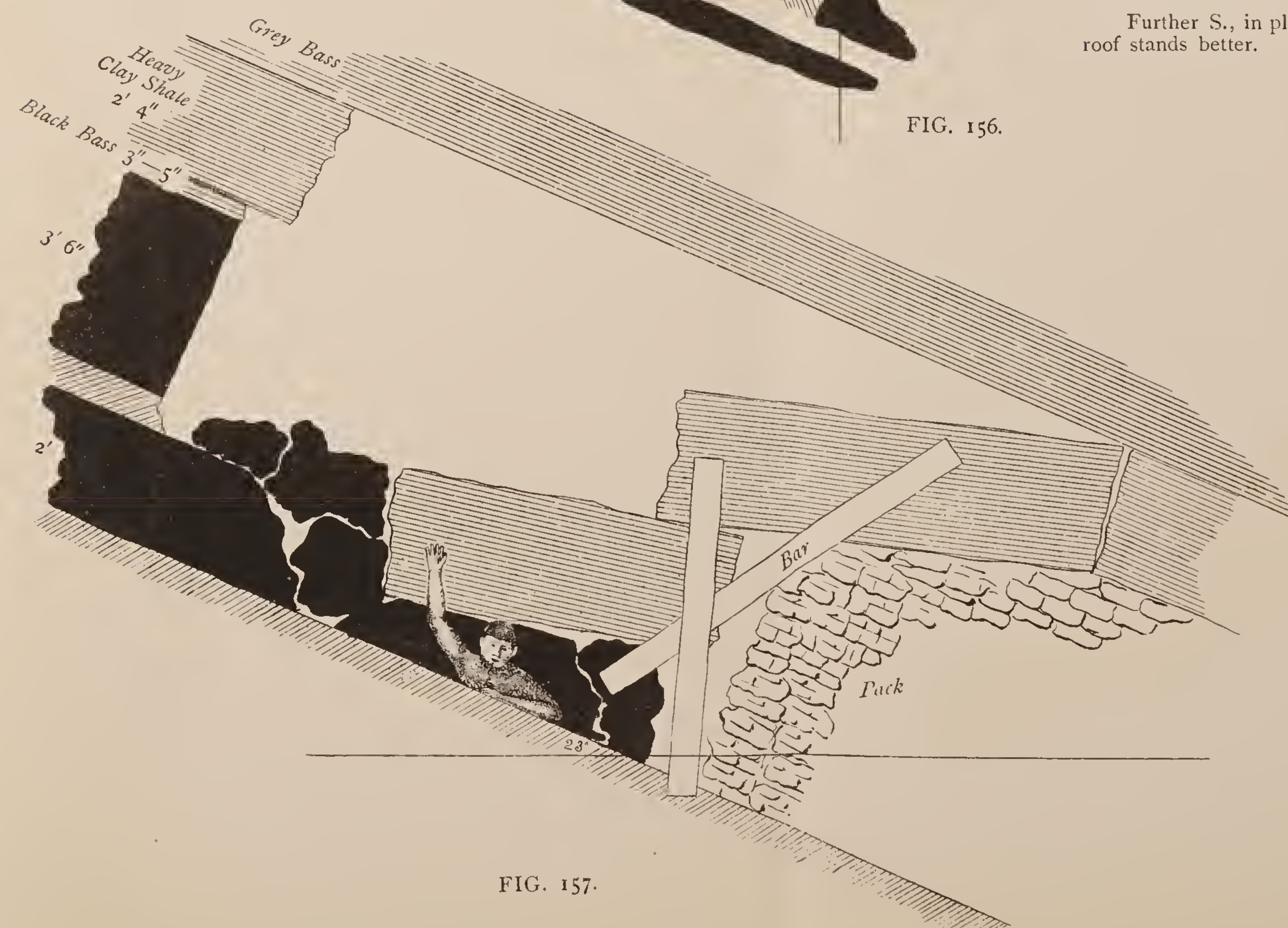


FIG. 157.

Figs. 158 and 159. Plan and Section NE. The roof is bad and short, heavy and full of slips, and contains stone nodules. The floor is very hard in places, so as to prevent posts being stamped. The coal is rated off and very little holed. Cleat very distinct; there is an occasional cross cleat, 18° NE.

Further S., in places where the coal is worked quickly, the roof stands better.

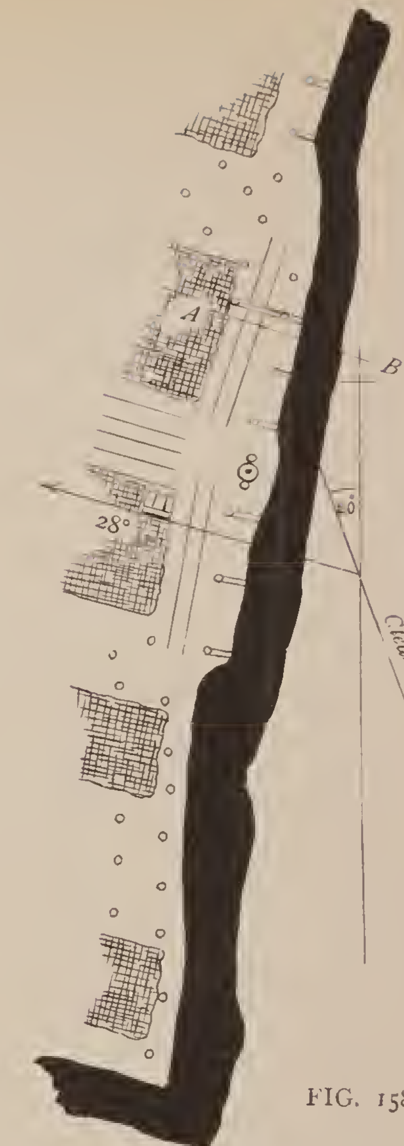


FIG. 158.

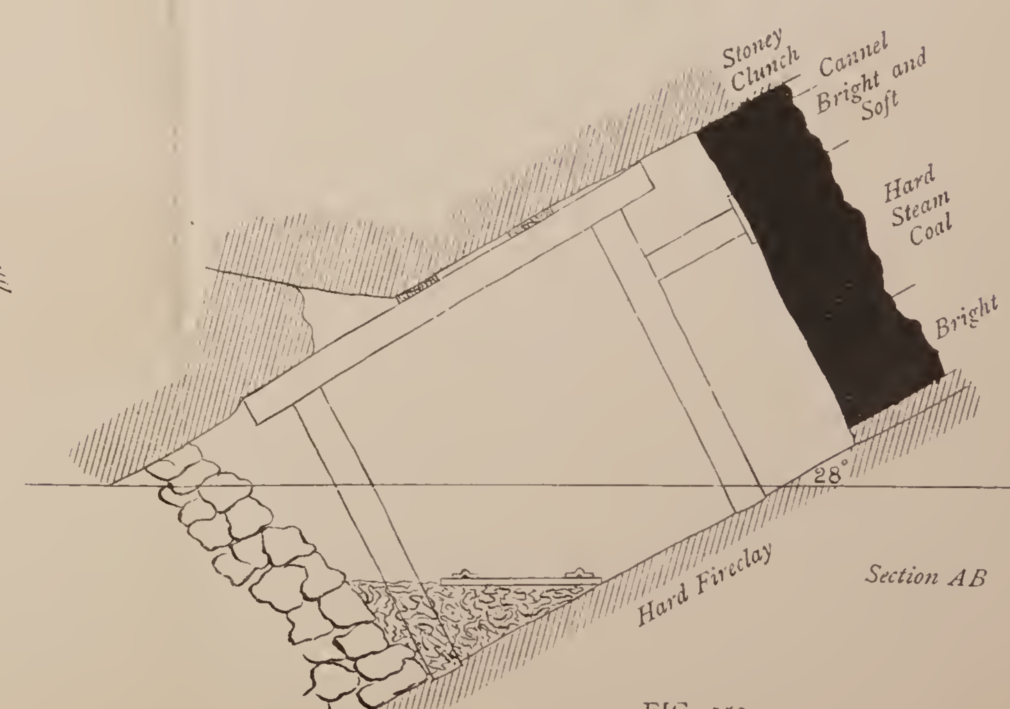
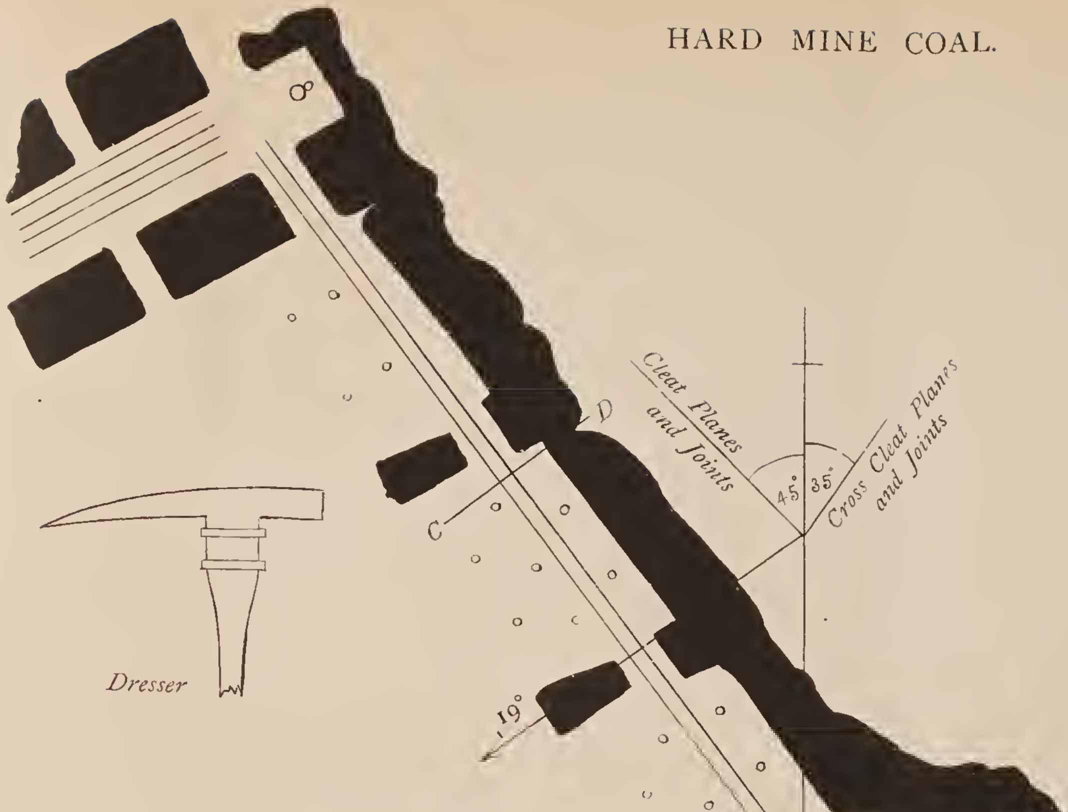
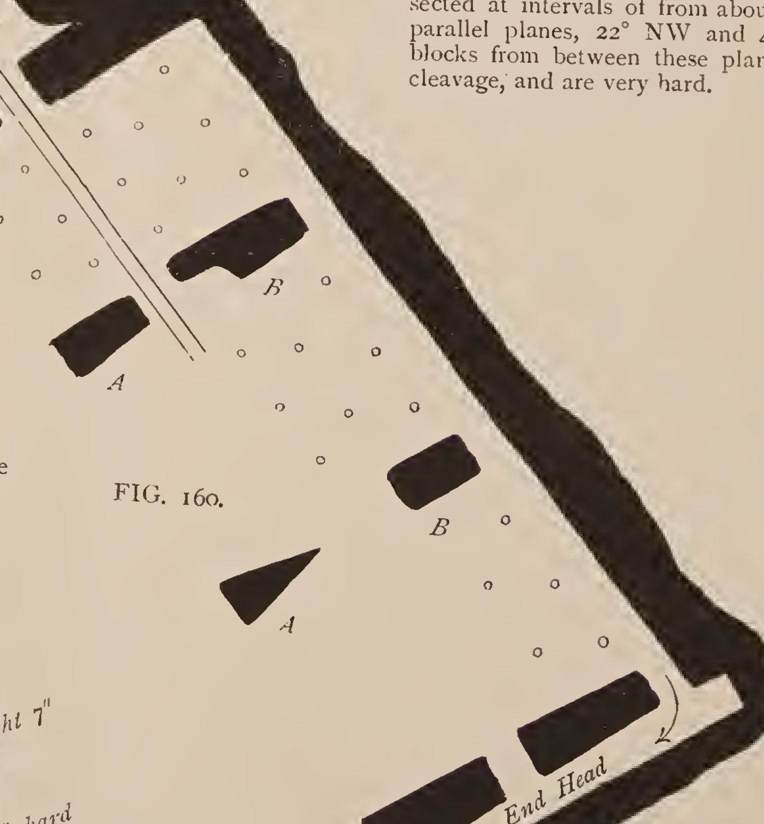


FIG. 159.





Figs. 160 and 161. Plan and Section SE. Post and thurl; 50 yds. on each side the jig. Walls from 6—8 yds., according to the nature of the roof and occurrence of a weight. The three end walls are completed before the near walls are begun. Before taking up the rails, pillars *A* are robbed as much as possible, and also the bases of pillars *B*. After the rails have been taken up, pillars *A* are worked at still further, with a view to prevent the roof from weighting at the face. As much coal is got off as possible, and the remaining pillar is smashed. This is a dangerous operation, and requires great care and judgment. Fatal accidents have occurred at this work. Temporary posts have often to be set whilst this work is going on. The coal is wedged after being holed, and then brushed off with a dresser. The coal contains cleat planes from 6″—18″ apart in the Bottom Coal, but oftener in the Top Coal and bass, in which they run in the same direction. There are cross cleat planes in the Top Coal and bass, but seldom in the Bottom Coal. (See page 15.)

FIG. 160.

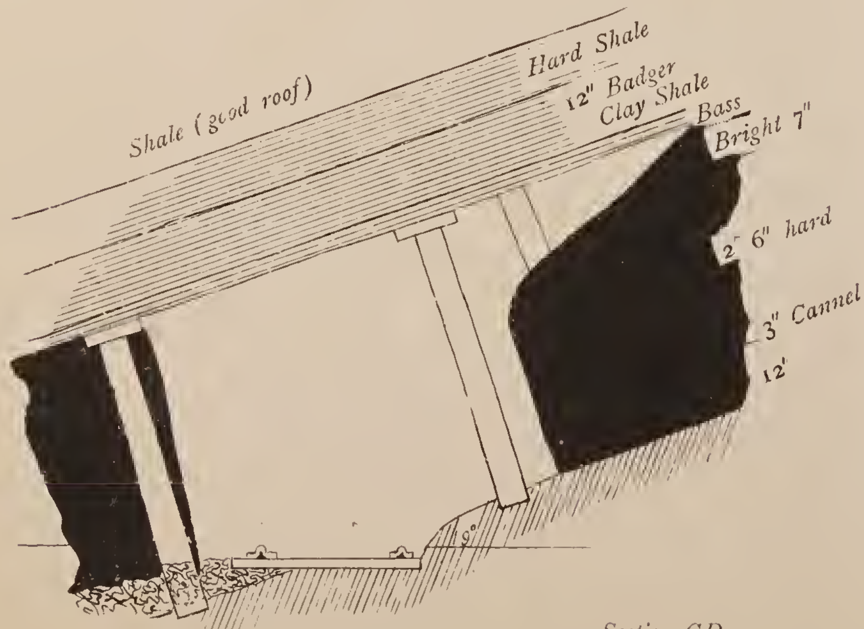


FIG. 161.

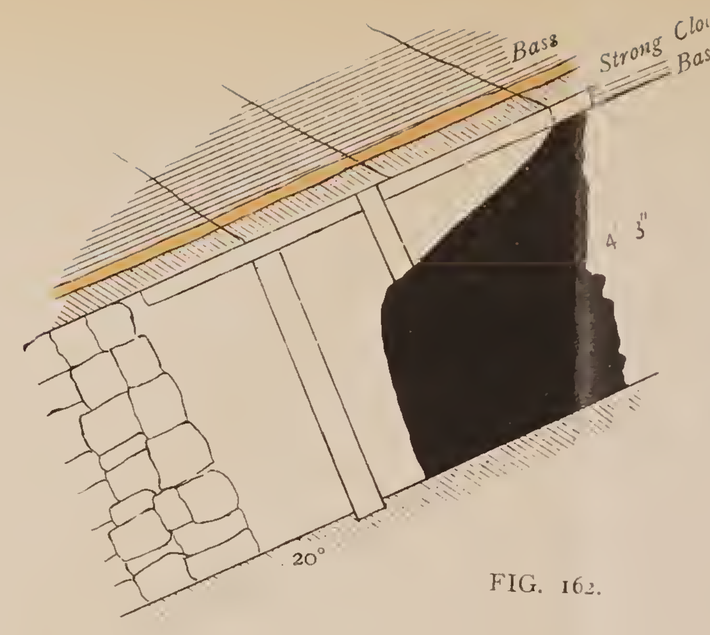


FIG. 162.

Fig. 162. Section of a drift N. of last Figs., which is only occasionally worked, and in which the roof consequently breaks so badly that bars have to be placed up to the end of the holing, to support the roof before the sprags are taken out. Both the coal and the 3″ bass are intersected at intervals of from about 6″ to 18″, by two sets of parallel planes, 22° NW and 45° NE. They break in blocks from between these planes, and shew no sign of cleavage, and are very hard.

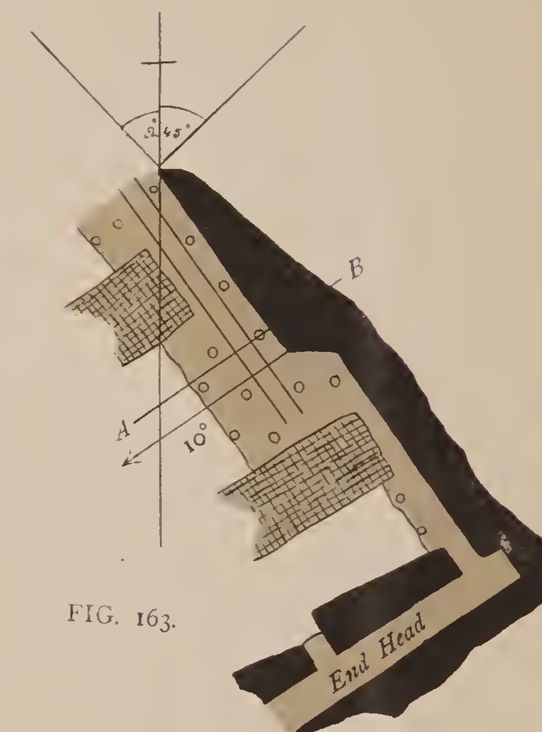


FIG. 163.

Figs. 163 and 164. Plan and Section SE. Drifts are kept 50 yards on each side the jig. The Top Coal is cut down in the wastes. Usually two falls are got before moving the jig post, and occasionally also a backfall, as shewn in plan. There is a parting in the roof, 4′ 6″ above the coal, above which it stands well, and forms the roof in jigs and other roads.

Cleat planes, presenting reddish-brown surfaces, run 42° NW, 3″—12″ apart; cross cleat, 45° NE, pretty distinct. The coal breaks in little blocks; it yields gas, which smells of SH_2 pretty freely.

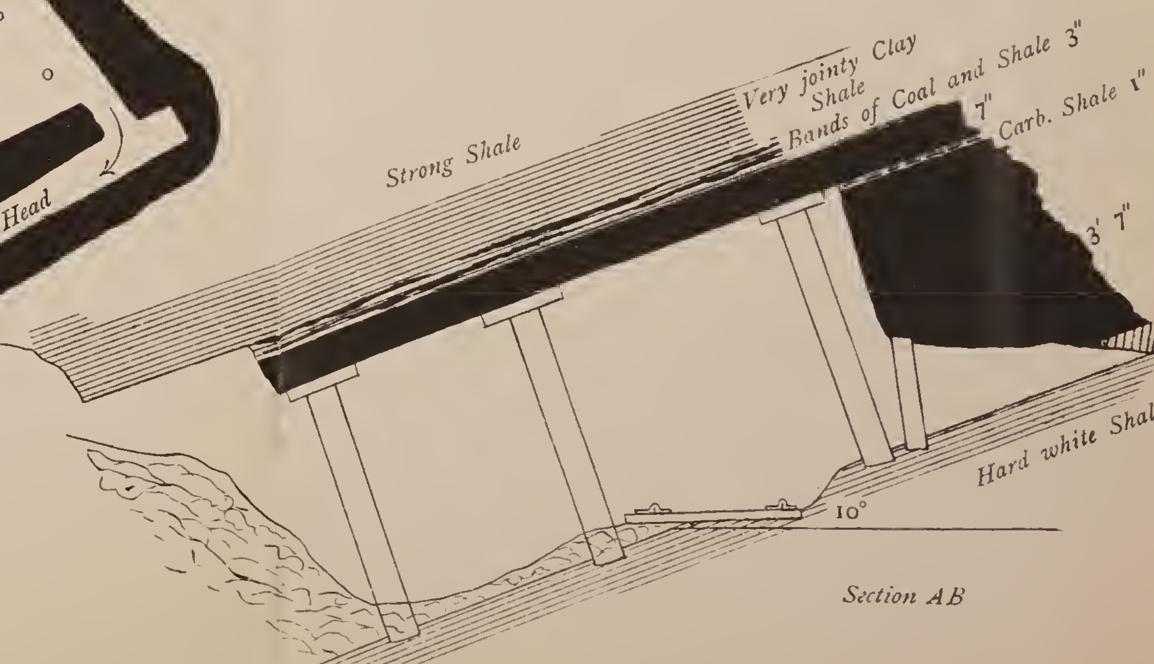


FIG. 164.

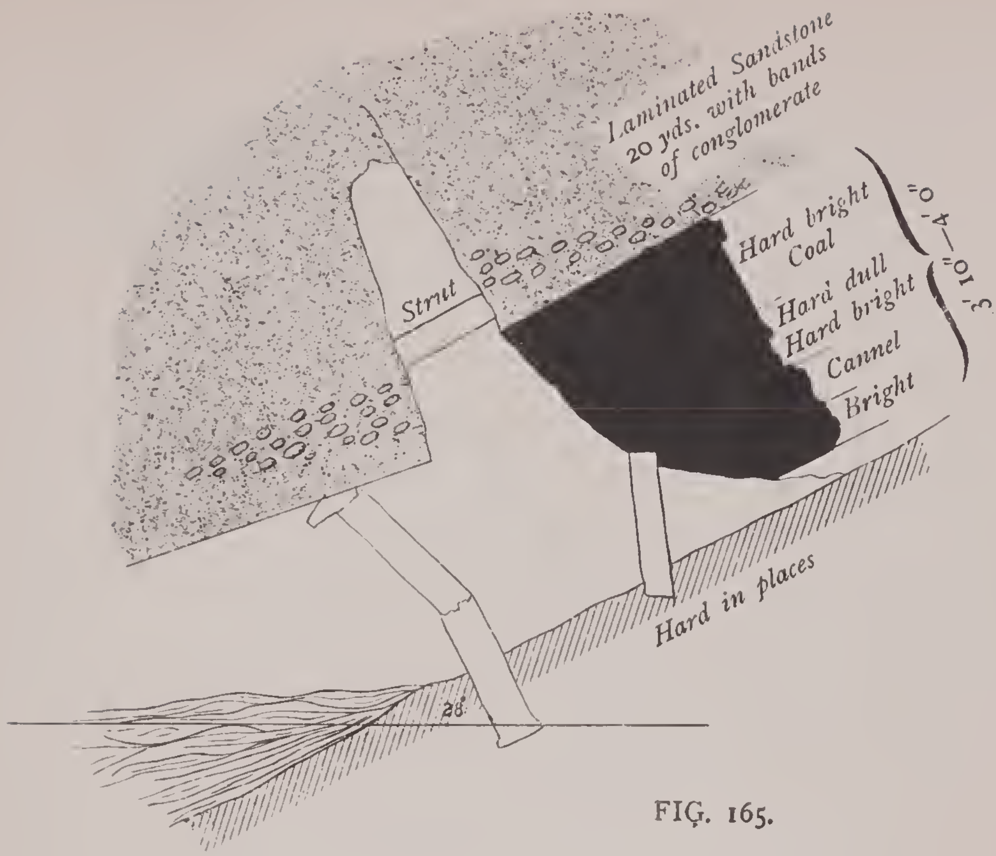


FIG. 165.

Fig. 165. Section N. Worked by 30—40 yds. drifts on each side the jig. Jig packs, 4 yds.; others 2 yds. Wastes, 6—8 yds. A large weight comes on about every 12 yds. It gives from one to six days warning. The roof sinks gradually about one foot, and breaks off at the face (see Fig.), presses the posts into the floor, or breaks them and flattens the packs. On the roof beginning to weight in a drift, the rails are at once pulled up and the men withdrawn until the weight has had its fling. To get under new roof the jig is first moved up, and the coal "breasted" from 6′—12′ on each side, the new roof being timbered and supported by struts placed against the old roof, which are of great assistance. A back fall of coal is brought back and the new packs are begun. The old timber is all lost.

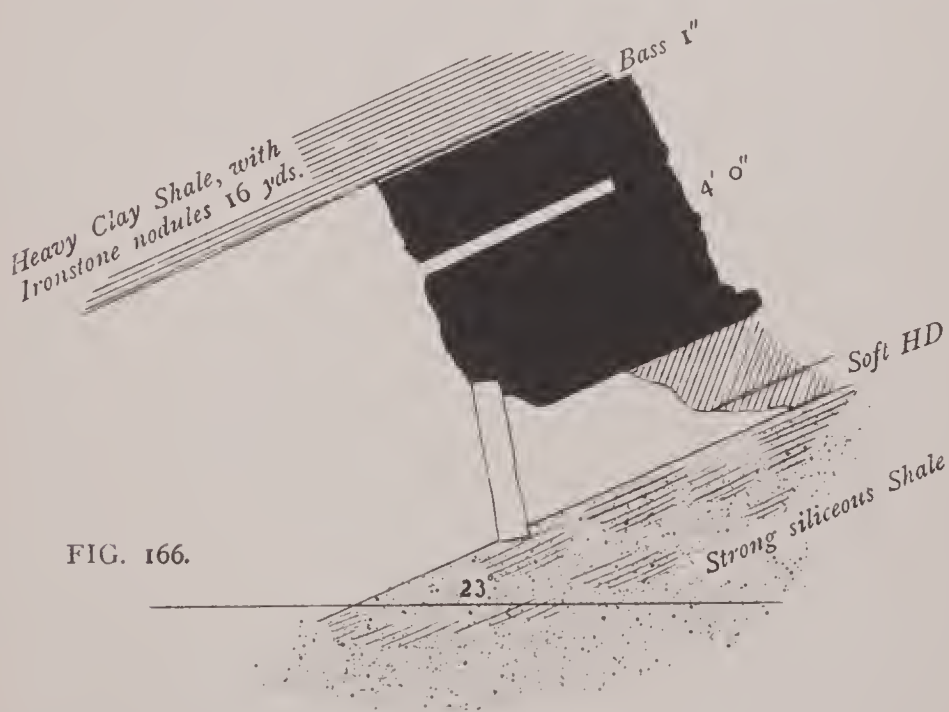


FIG. 166.

Fig. 166. Section E. The roof is very good; it contains no slips. The first peel which falls in the wastes is 4′ thick. 1″ bass sticks to the coal and comes down with it; a very smooth parting separates it from the roof above. The gob is nearly filled. Cleat, which runs 30° NW, is not very distinct. The coal breaks readily in plane of stratification.

Figs. 167 and 168. Plan and Section E. Longwall, pannel work. Drifts from 26—30 yards. Cleat distinct, and slips 12° NE, which pass through the whole seam, are not frequent.

Slips occur in the Top Coal only, in the same direction as the cleat (see Section and Plan); they are smooth, and run through into the roof. They may be breaks formed when the Top Coal is first exposed to pressure by holing.

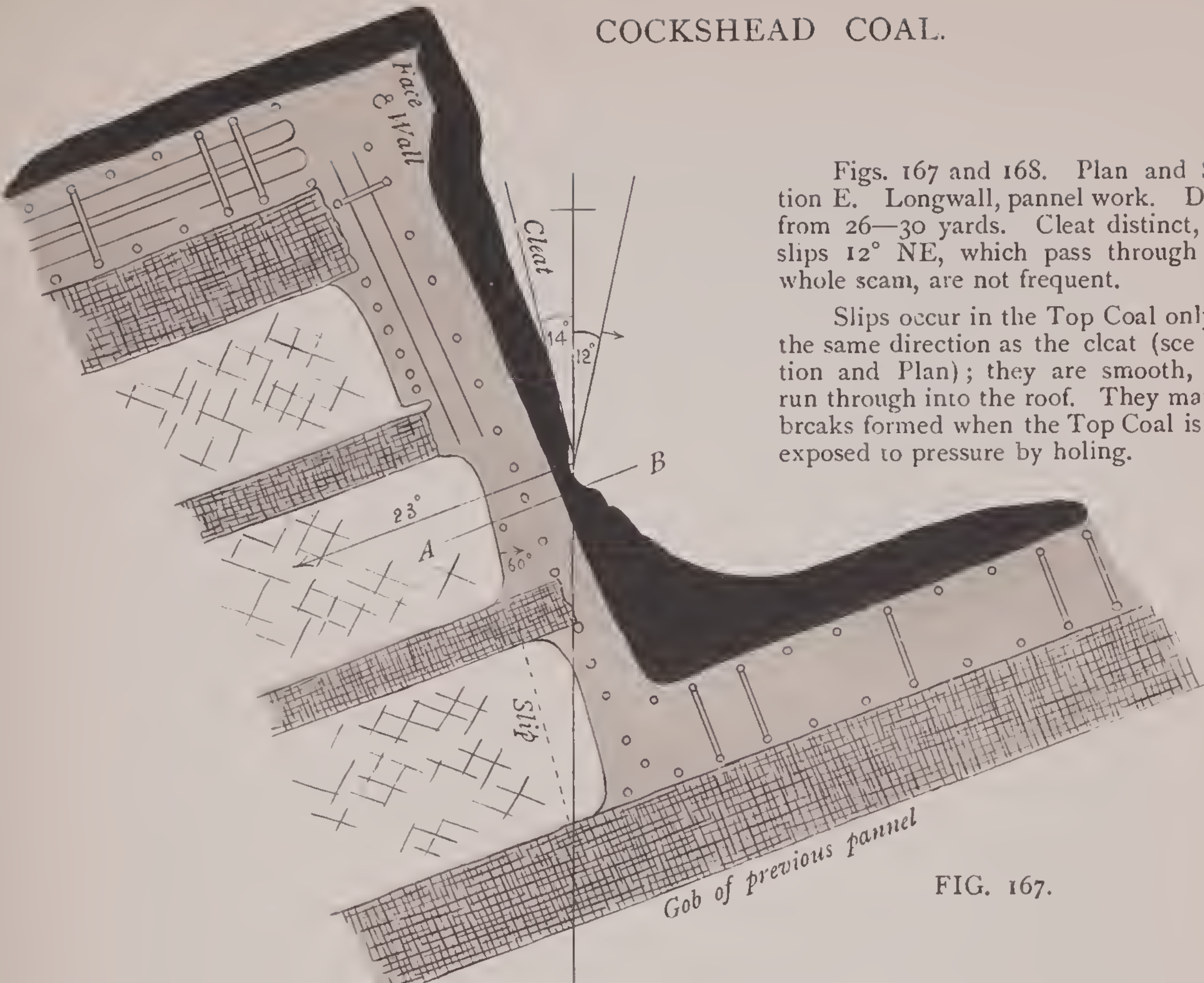


FIG. 167.

On one occasion the whole of the Top Coal in a drift fell, burying all the posts. This was either due to the first weight having been too long deferred, or to the Banbury roof, which was 45 yards above, and which had stood for years, falling in suddenly.

Northwards: A fatal accident occurred from the Top Coals falling on to the buttocker, who was pulling the Bottom Coals off. There was a post and bar 6′ from the end of the buttock, and the pack was 4′ from it. The coals came off a large slip, the presence of which was known. A post, or a post and bar, should be set not further than 4′ from the buttock end under tender coals.

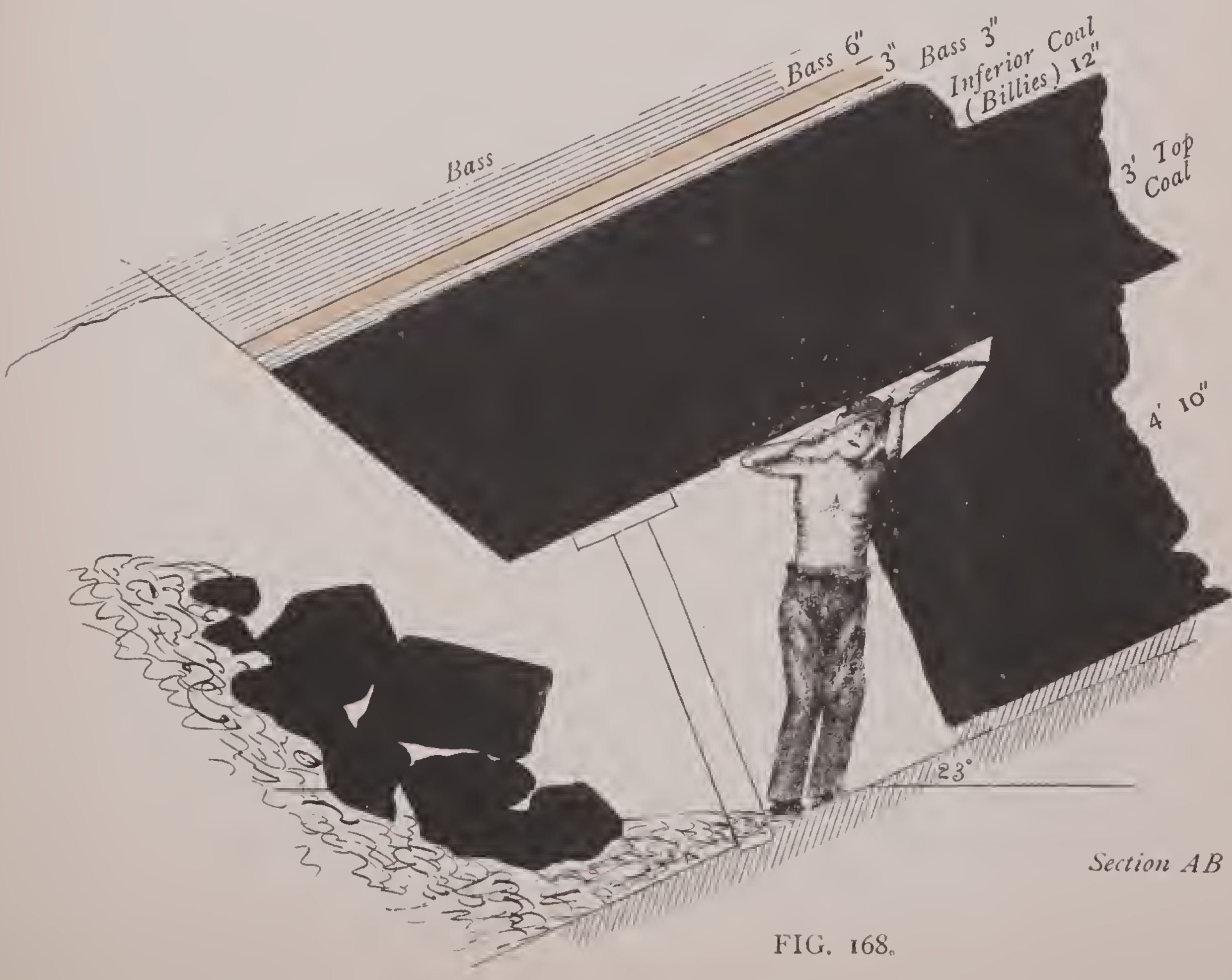


FIG. 168.

BULLHURST COAL.

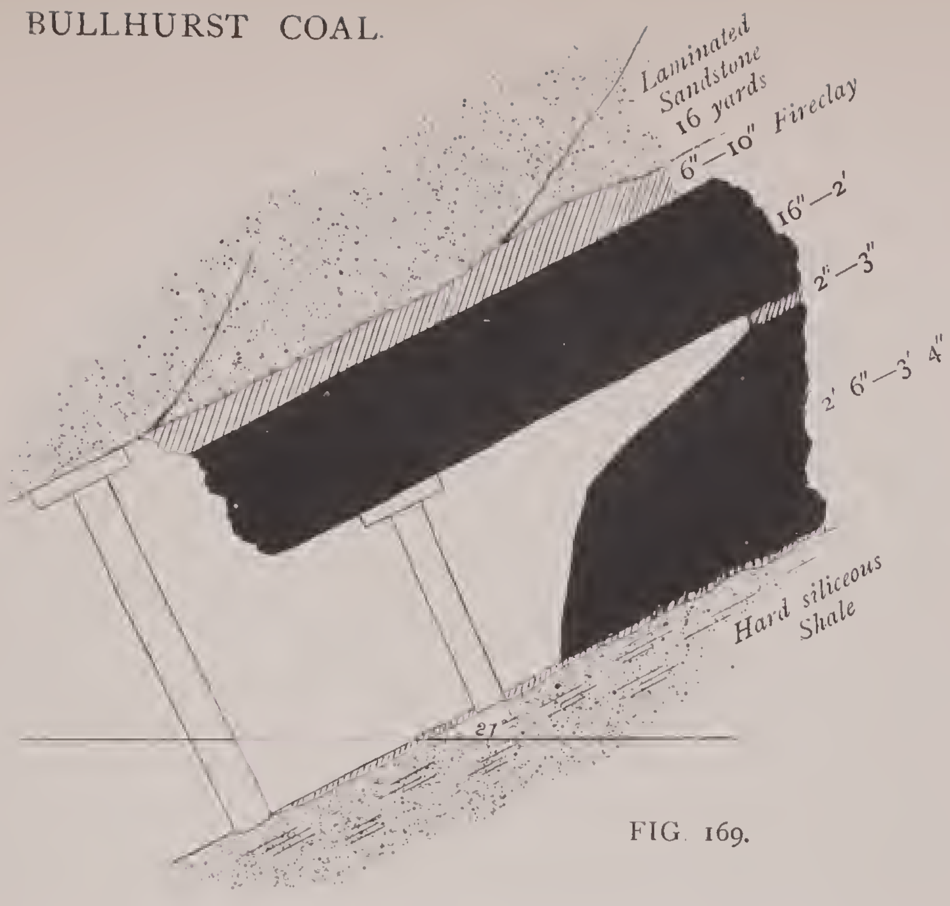


FIG. 169.

Fig. 169. Section NE. Cleat not very regular, except in places where it runs 43°—50° NW. Usually worked by post and thurl, walls from 6—10 yds. wide; the coal posts being quite lost. The Tops are cut down behind, usually when the wall is completed. The roof does not fall, so that there are no builders, and if coal posts were not left the roof would take the face on the occurrence of a weight. The sandstone contains numerous slips, from which large pieces fall. The coal is much ground between the hard roof and floor, and much slack is made. Fatal accidents have occurred whilst cutting the Tops down incautiously.

Further South, the clay between the coal and sandstone increases in places to as much as 15′. The clay has been worked for tile-making, etc.

WINPENNY COAL.

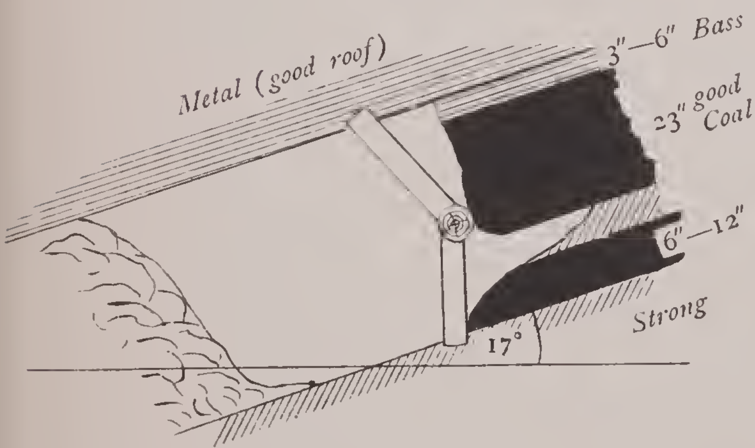


FIG. 170.

Fig. 170. Section E. Longwall to the rise. The coal is soft and cleat distinct. Gob almost entirely packed with dirt and slack.

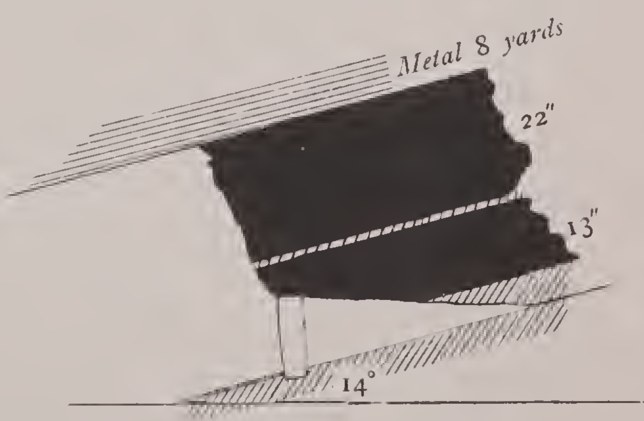


FIG. 171.

Fig. 171. Section further North. Longwall, 60 yds. drifts on each side the jig. Wastes and pinnings 3 yds. each.

NORTON DISTRICT.

FIGS. 172—252.

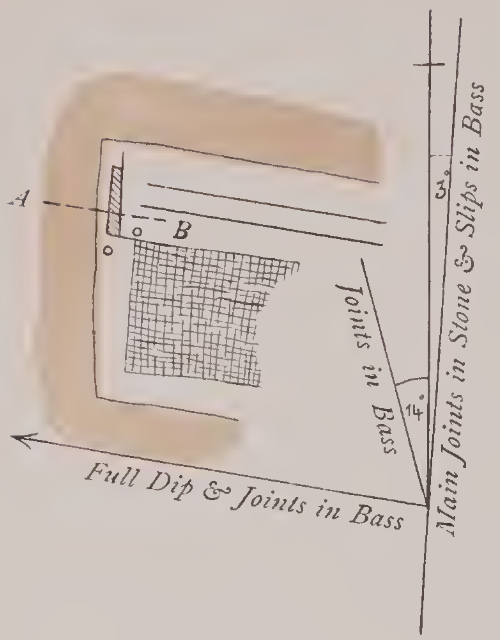


FIG. 172.

Figs. 172 and 173. Plan and Section S, shewing the face of a dip in which a fatal accident occurred. Joints in stone very frequent; they lean over on passing into the roof in the form of slips. (Fig. 173.) A projecting piece of bass, which the collier failed to secure, fell upon him from off one of these slips, and caused him fatal injuries. The cohesion along this slip had been further loosened by water, which dropped from the roof abundantly. Longwall drifts: 20—30 yds. on each side the jig; packs 4′—5′; wastes 9′. Two rows of posts are kept up.

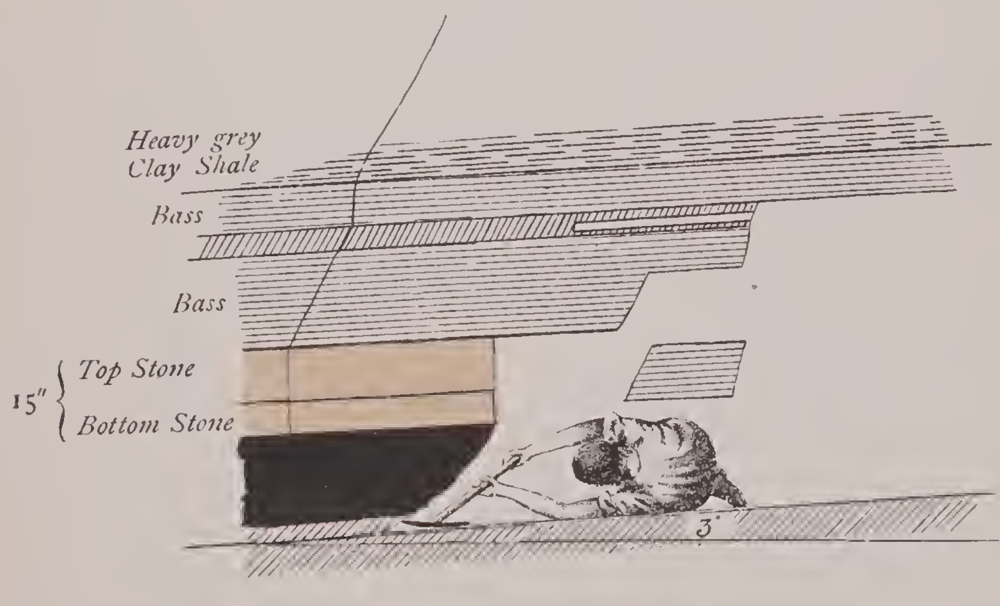


FIG. 173.

Northwards, the stone is from 12″—14″ thick and the coal about 20″. As the stone thickens in places the coal thins and *vice versa*. Holing is done in 18″ of fireclay under the coal; it is called alum shale, and was formerly worked for alum, but is now made into firebricks.

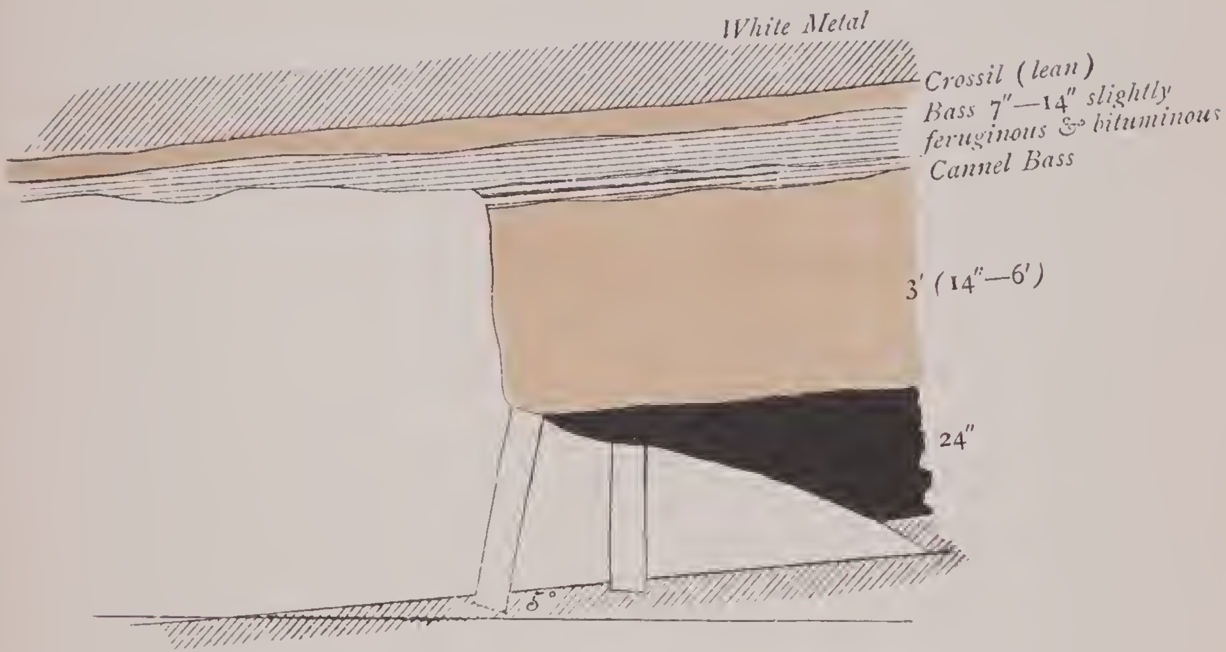


FIG. 174.

Fig. 174. Section W. The stone varies much in thickness. It is worked by longwall outwards, with as long faces as possible ; 6 yds. packs and 8 yds. wastes. The roof breaks in the wastes and affords packing material. The turn of the dip destroys the parallelism of the joints, which run through bass and crossil. It used to be worked by headings and 20 yds. pillars, but this necessitated more timbering. A small coal seam (12") lies 8 yds. above the stone.

Southwards the stone has an average thickness of 2' 3", but varies from 16"—3' 6". It is topped by 9"—18" of "cinder." The underlying coal is 1' 6" thick. The drifts are 40 yds. on each side the jig. When starting a drift from the solid rib the cinder is left up at first, as the white dirt above it forms a very bad and heavy roof. Large wooden chocks, 4' × 6', are erected 4' from the rib and 6' apart. The cinder is then dropped between the chocks, and forms builders for packs, which are built continuously with the chocks. A fatal accident occurred through neglecting to erect a chock as soon as there was room. Twenty tons of roof fell over a space 12' × 17' reeling out three posts. The fall was accelerated by a shot in the stone.

To the South the stone thins down to 18", is worthless, and has consequently not been worked.

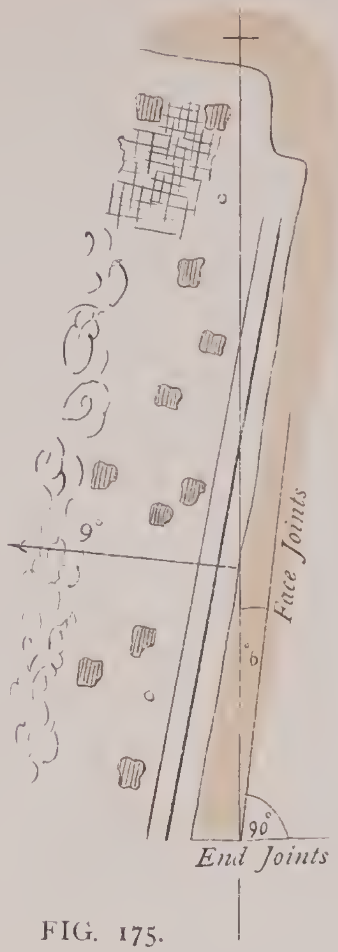


FIG. 175.

Figs. 175 and 176. Plan and Section SW. The grey clay shale roof being bad, both flannels and top band are left, and form a strong roof. It is supported by cogs made of pieces of oil bass (which here is too thin to send out) 2′ 9″ square, and at intervals of 6′—9′. The remainder of the gob is filled with holing dirt and slack. The face or main joints run very regularly, from 2′—4′ apart ; the end joints are not so regular.

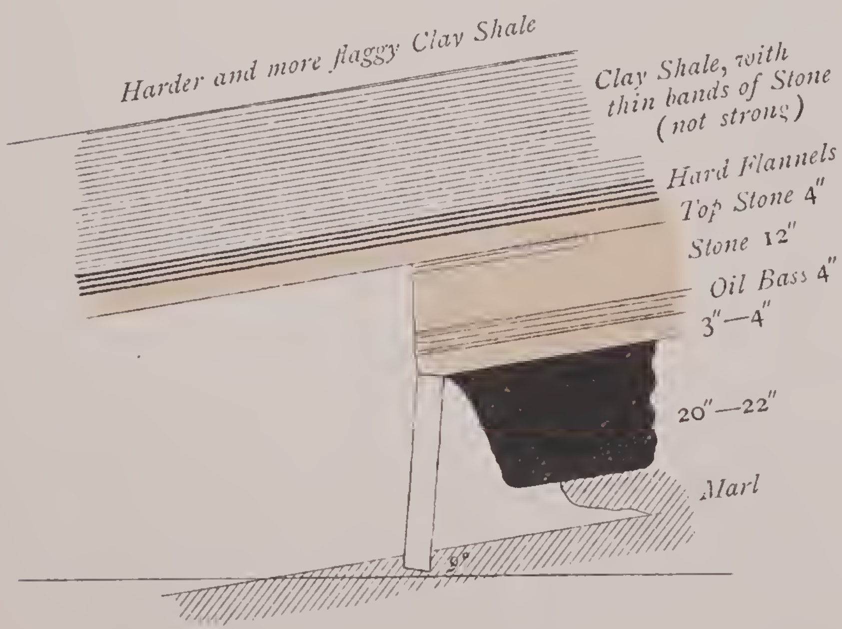


FIG. 176.

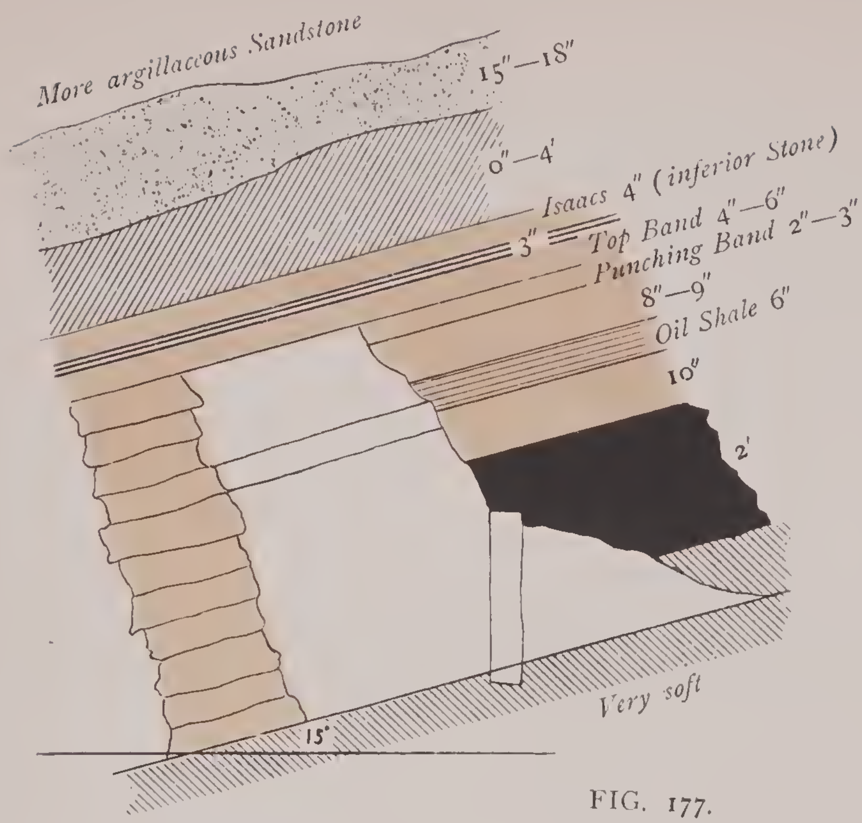


FIG. 177.

Fig. 177. Section further North. Joints as last Fig. Worked as last Fig., but Riflemen placed in a line with each other, so as to get the top band down between them, as it is of good quality. The floor is very soft, and a piece of oil bass is often placed under the posts.

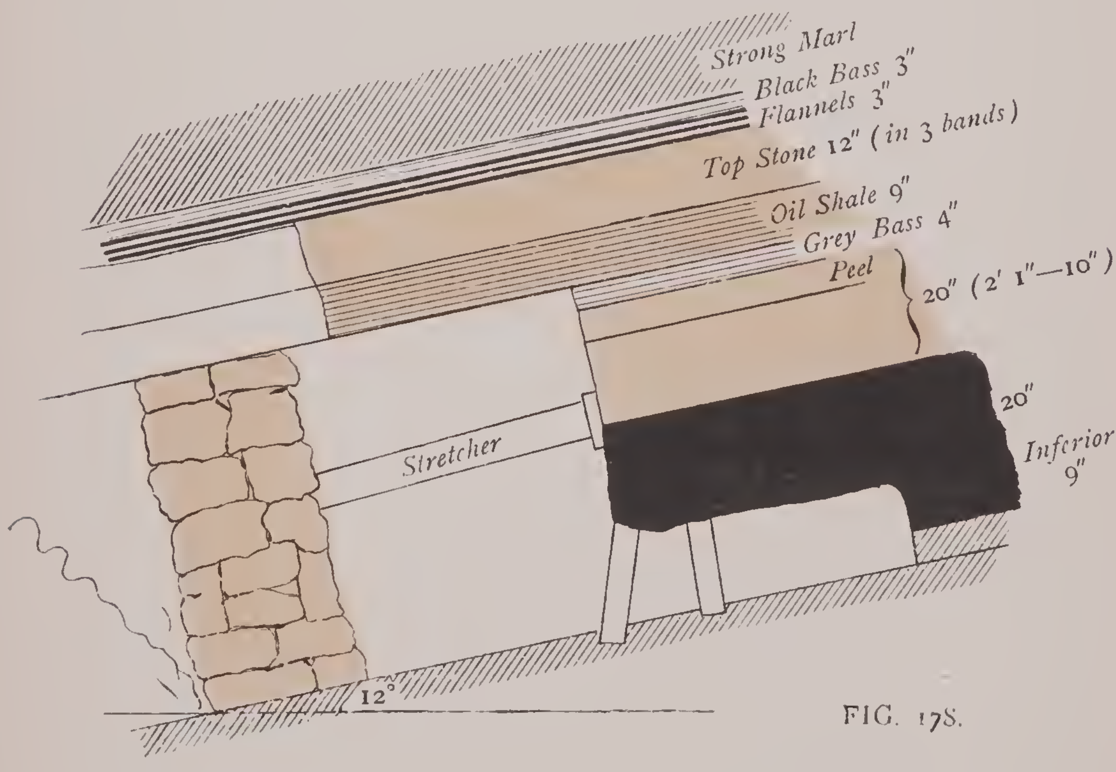


FIG. 178.

Fig. 178. Section further North and Centre. The oil shale and top stone are got down in the spaces between the stone cogs, which are from 3—4 yds. apart. The top stone and oil shale form a strong roof, but where they are removed the roof is bad. The oil shale is sent out.

Further W, the top stone of the last Section is represented by two bands of stone, each 6″ thick, separated by 4″ of bass. The oil shale is 2′ thick, is very good, and is usually got down behind the stone face. The stone below it consists of a peel about 9″ thick, top stone 2′—4′ 6″ thick, which varies greatly in thickness, and bottom stone 2″—12″, which is the best.

To the South, the Red Mine, called Gutter Stone, is very lean. It has been worked at the outcrop.

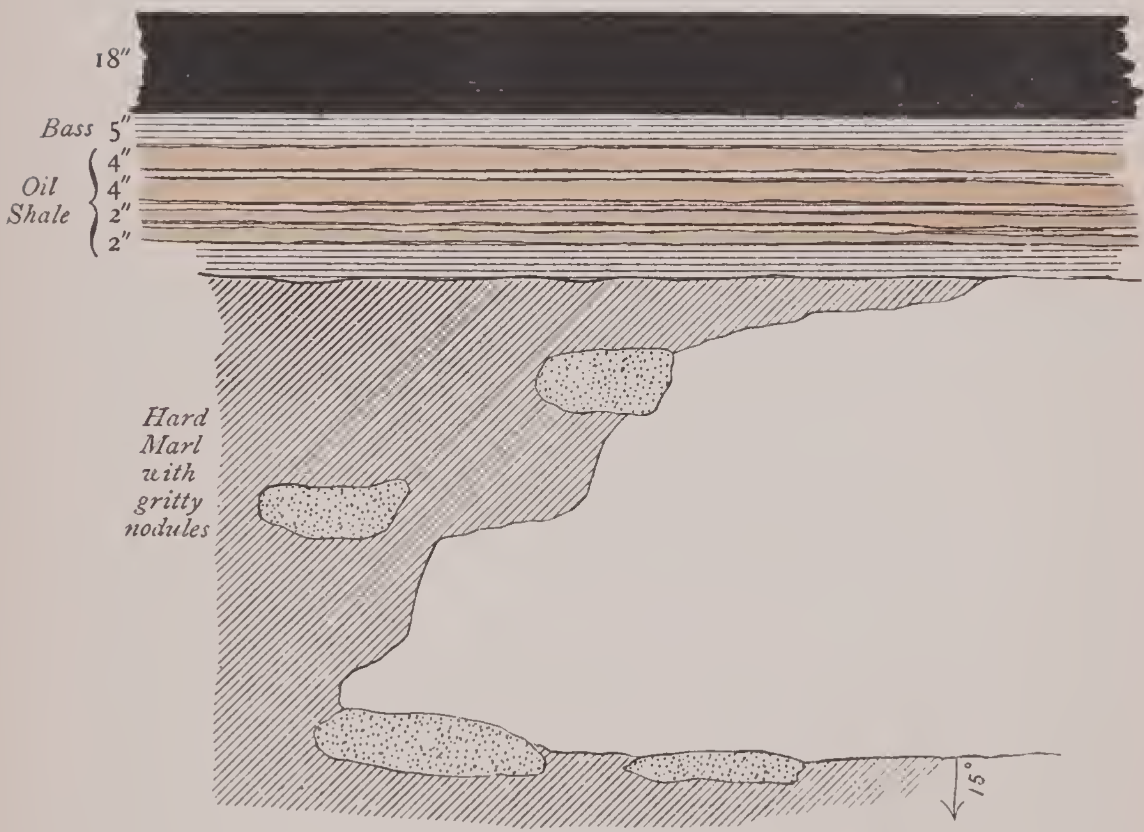


FIG. 179.

Fig. 179. Section of heading C. The stone and coal which are not worked at present form a good but jointy roof. The headings are from 6′—7′ wide. Little timber is required. The marl is very strong, and has to be blown down. About 4′ of it is sometimes left as a roof. It is used for making "saggars" and Queenware.

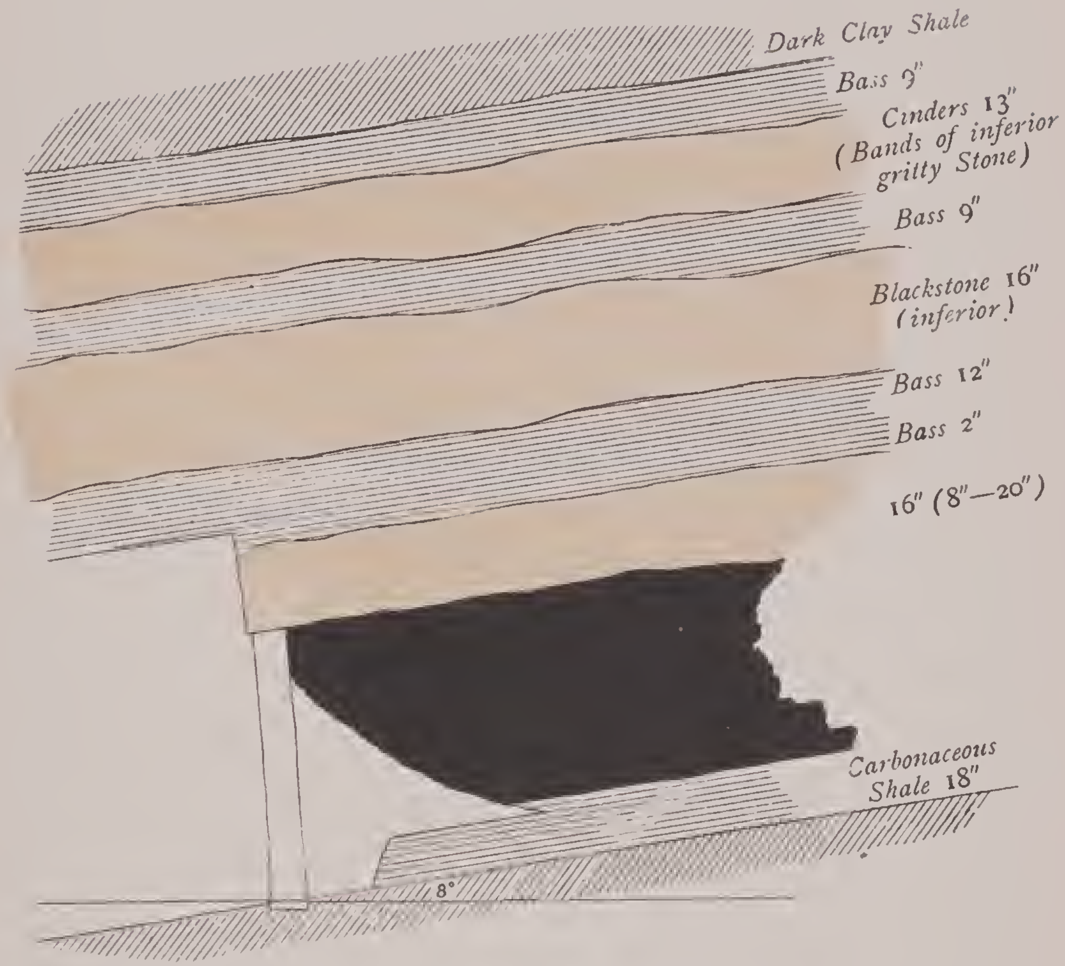


FIG. 180.

Fig. 180. Section S. The stone and coal vary much in thickness at short intervals. In some places the stone is 3′ 7″ thick. Where it is thin the coal thickens, and is of good quality, but where the stone is thick the coal thins and contains coalstones. Longwall, the gob being entirely packed, except where the stone is thick, when packs are formed. The roof is excellent, and requires little timber.

The main joints run very frequently and distinctly 23° NW, and parallel to the coal cleat. Cross joints occur 22° NE.

The following is a Section of the Bassey Mine NW:—

Strong good bass roof, with frequent straight joint .

Pinning Bass	9″		
Top Stone	2′ 2″		
Bottom Stone	11″		
Oil Cannel	4″	}	5 6″
Crozil Stone	8″		
Dirt	2″		
Coal	6″		

Fireclay (very plastic)

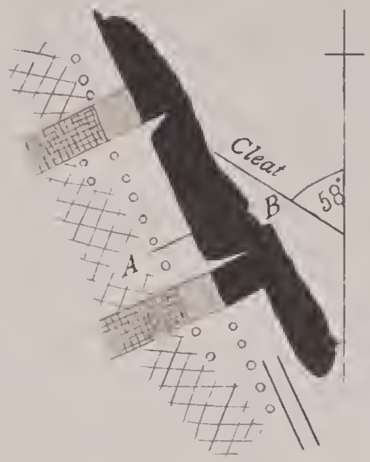


FIG. 181.

Figs. 181 and 182. Plan and Section NW. The roof is very heavy and breaks at the face at each dressing. 18″ of Top Coal is left over the packs to divide the walls, and to make the roof break separately in each. The roof is supported in the wastes by one row of posts closely set, and well stamped, generally nine in a 5 yds. wall. They are supplied with long lids, to catch loose pieces. The coal is soft, and the bottom sprags all require lids. There are also stretchers from every post. Cleat distinct, but very short. The corner stretchers in each wall have to be removed to cut the corners; before this is done top sprags are set. The Top Coal which is left over the packs forms a bridge at the face. Bridge posts are set to prevent the Top Coal falling before the walls are cut. Foreset posts are set whilst drawing the back timber. Corners of dips are chocked and the dips barred, levels are driven just wide enough for tubs to pass along, and even then they require stretchers.

Further N. the coal is 5′ thick. Longwall, with packs and wastes; there are four closely-set rows of posts in the wastes, behind which the roof breaks abruptly. The cleat is conchoidal and short, and appears in three directions.

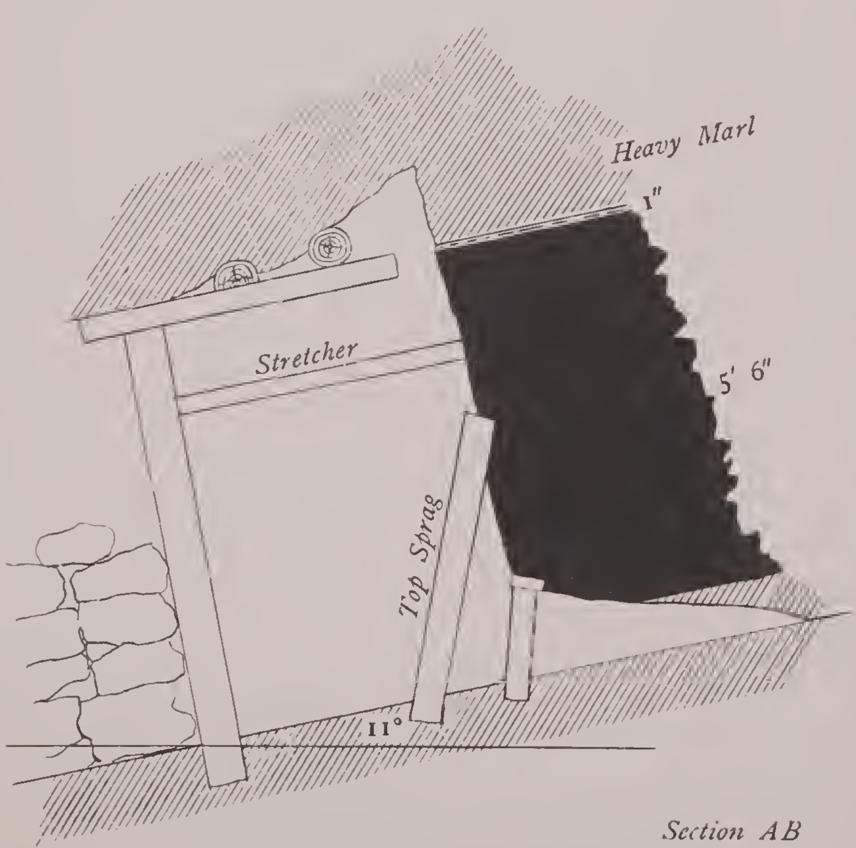


FIG. 182.

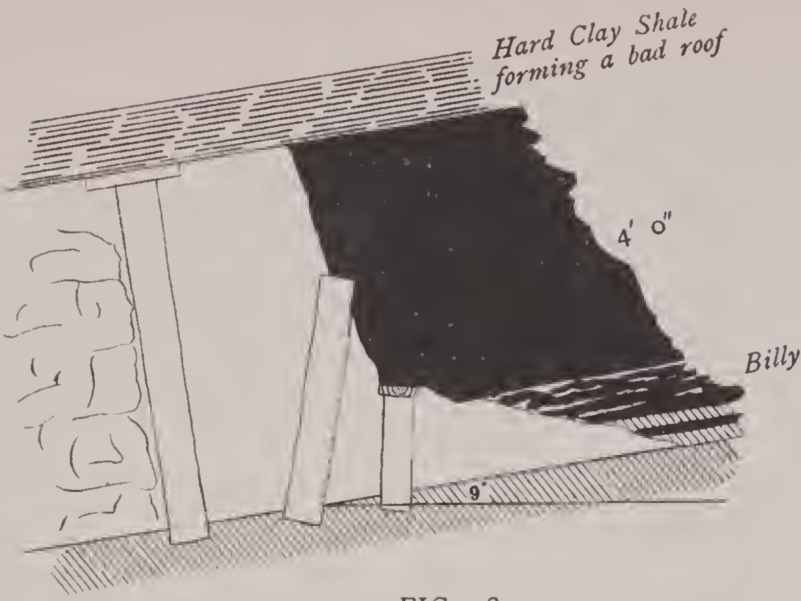


FIG. 183.

Fig. 183. Section W. Longwall, with 30—40 yds. drifts; 4 yds. packs and 4 yds. wastes. A row of posts is set on the gob side of the rails only, the posts being from 3′ to less apart. Most of these posts support bars at one end, which are let in the solid at the other end. As soon as holing recommences foreset posts are set under the bars. The coal is very brittle, and has to be supported by top as well as bottom sprags. Cleat indistinct, 42° NW.

GUBBIN IRONSTONE.

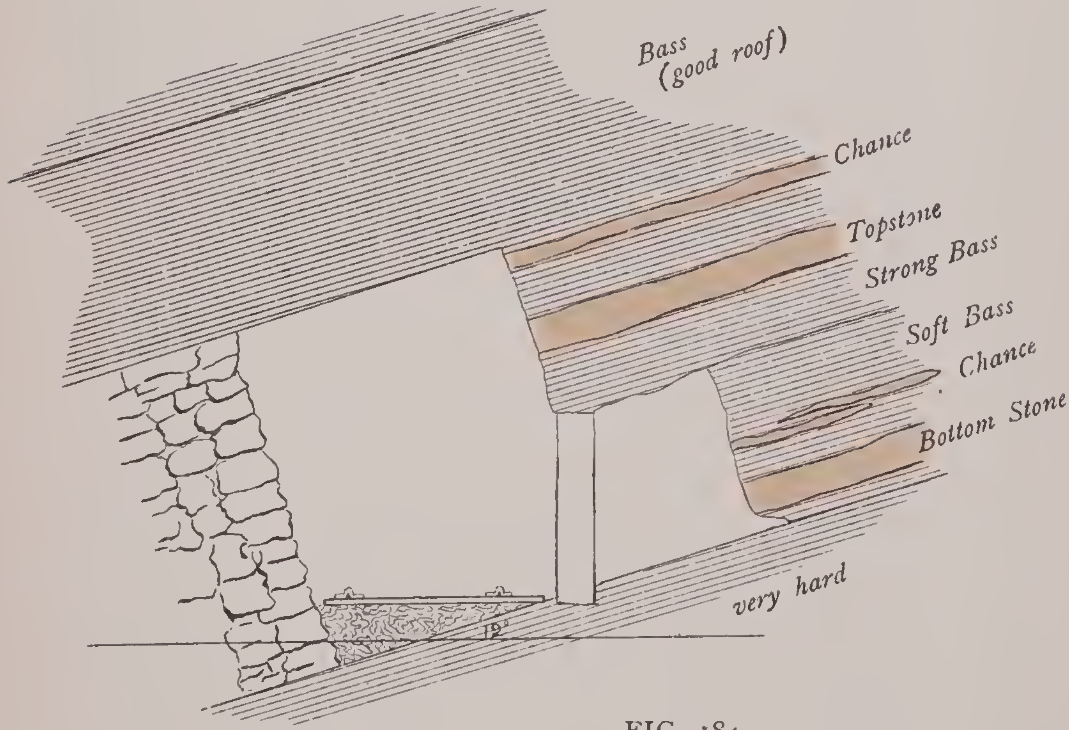
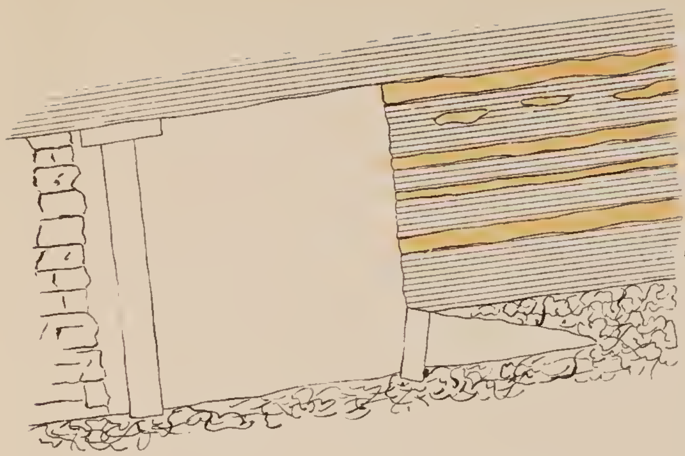


FIG. 184.

Fig. 184. Section S. The stone bands and chance bands are very irregular. Joints are very frequent and distinct in stone bands; they occur at greater intervals in the strong bass, and are absent in the soft bass below. Longwall outwards; gob entirely packed; a large amount of dirt having to be sent out for want of space. The roof stands well in drifts, in which little timber is used, The jigs and levels, however, require much timber. Holing is facilitated by water being thrown on to the soft bass. Sprags are usually 6″ in diameter and are strong; they last three dressings or two months.

GUBBIN IRONSTONE.



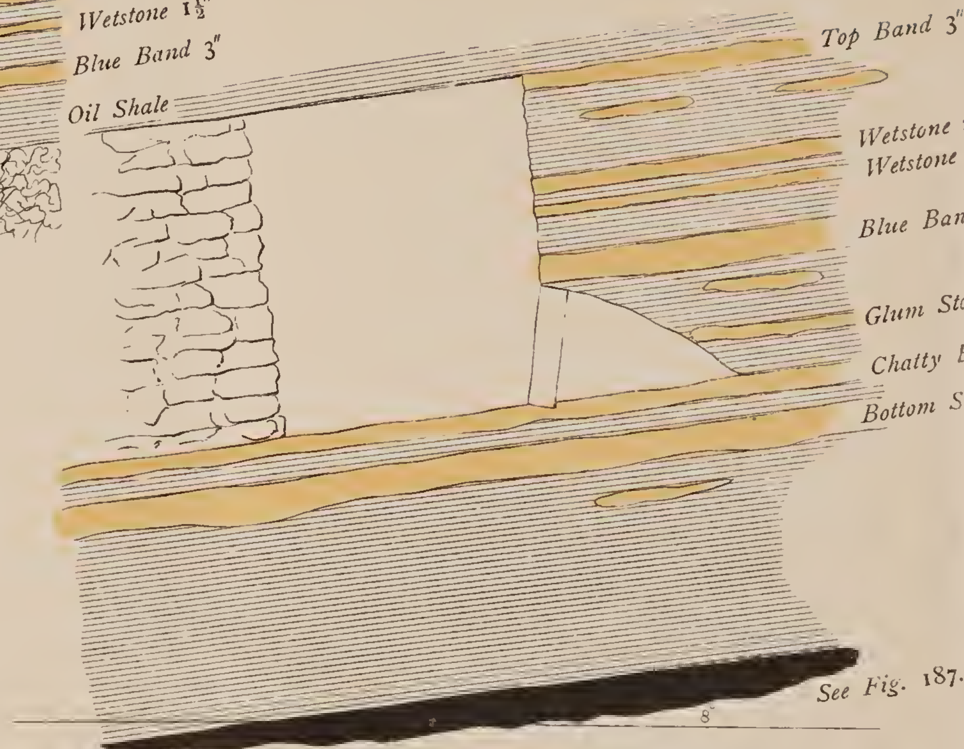


Fig. 185. Section NW. (called Cannel Mine) varies much. The bottom bands are worked 15—20 yds. in advance, and the gob is carefully packed. The two bottom bands are left in places, so as not to have too high a drift. The gob in the top work is also carefully packed, and little timber is required.

FIG. 185.

GREAT ROW COAL.

FIG. 186.

Fig. 186. Section S. Cleat pretty distinct 24° NE. Longwall; drifts 40 yds. on each side the jig. Packs are 4 yds. in width, and wastes from 4—5 yds. The Top Coal is cut down in the wastes, and is nearly all recovered, unless the roof breaks down with it, when the larger portion is buried. A row of posts is set at the face unless the coal projects too near the rail; another row is kept below the rails. Temporary posts are set under the tops whilst cutting, if necessary. The roof breaks down to a considerable height in the wastes, when the packing is not properly attended to. Holing at the top is found to improve the roof coal considerably. It is not shot shaken, as it would be if the coal were underholed and the shots placed at the top. The floor lifts, and by holing one day in advance the coal is loosened, and only half the number of shots are required.

To the West, 4″—6″ of shale intervene between the Tops and the Bottoms.

GREAT ROW COAL.

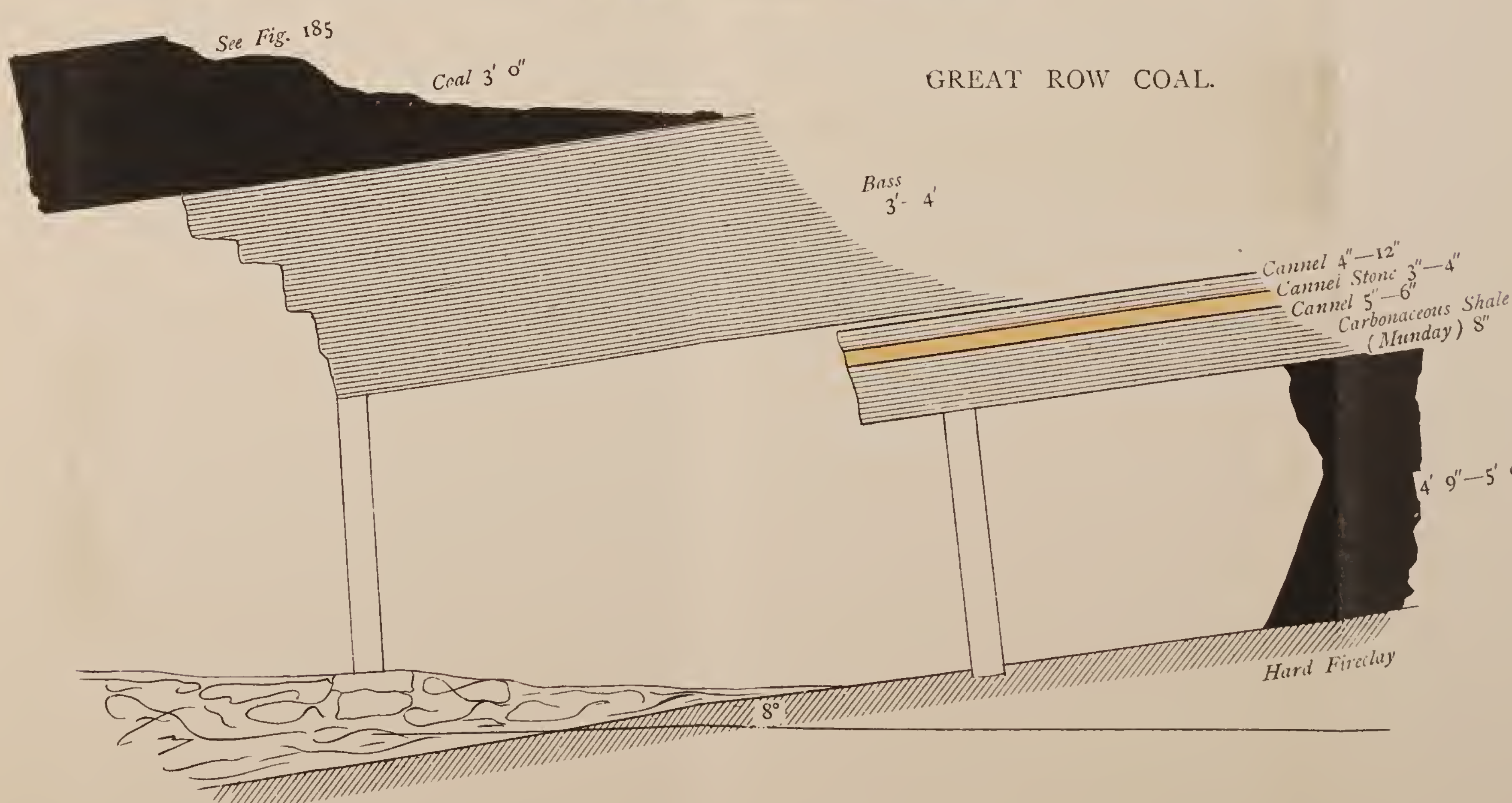


FIG. 187.

Fig. 187. Section NW. About 2′ 6″ of gas producing Cannel and 3′—4′ bass intervene between the Tops and Bottom Coal. The Top Coals and Cannels are got in the wastes; they all form a very good roof. The packs are kept about 4 yds. wide and the wastes 8 yds. Two distinct parallel sets of joints, about 4″—6″ apart, run through the Cannels. The face of the Top Coal is as much as 9 yds. behind that of the Bottom Coal. Posts are set without lids; the roof being so hard. They are set on hard pieces of stone in wastes. Slips run in the Bottom Coal 30° NW. and dip in opposite directions.

Figs. 188 and 189. Plan and Section S. Cleat irregular in places. The Cannel Ironstone forms an exceptionally good roof. The drifts are often opened 30 yds. before the roof weights sufficiently to afford builders. Until then, when starting a drift walls and cross walls are built with the Cannel, about 18″ thick, and the intervening space is filled with holing dirt and slack. 10 yds. pi lars are left on each side the jig.

FIG. 188.

Southwards the Cannel Ironstone becomes thinner and the Cannel of better quality. The Cannel is used for calcining, as it contains much bitumen; and the Cannel Ironstone is also used when it can be got out, and placed at the bottom of the ironstone rucks, as one ton of it will produce about 5 cwts. of calcined stone.

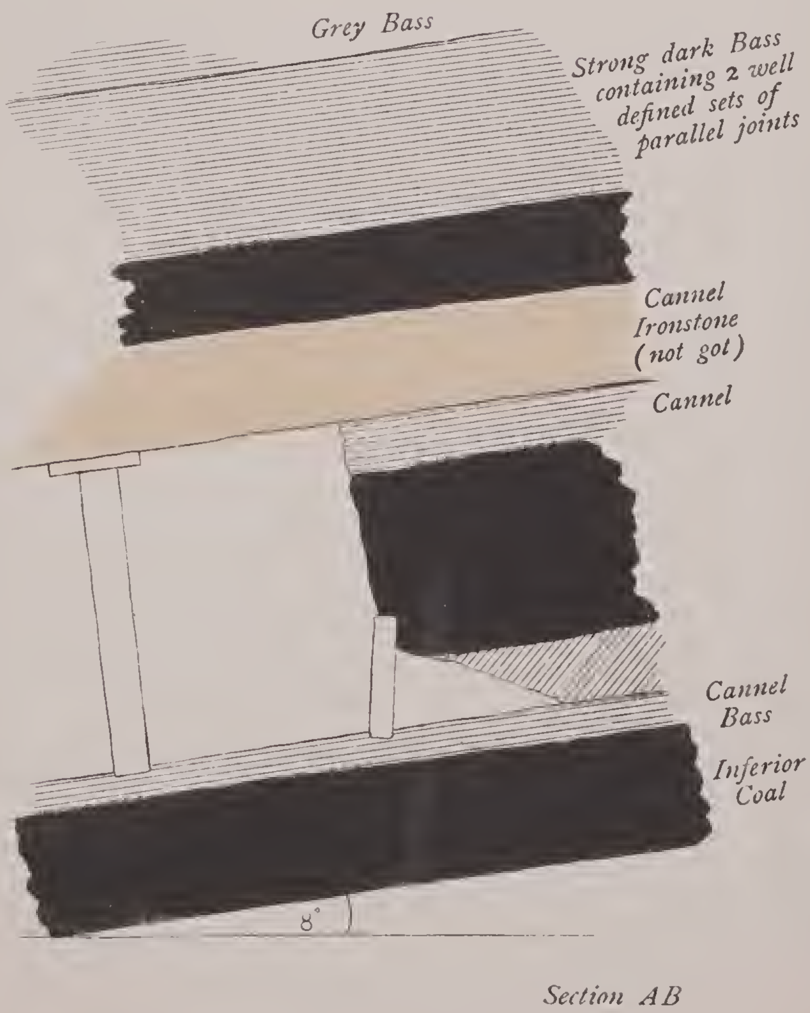


FIG. 189.

CANNEL ROW IRONSTONE AND COAL.

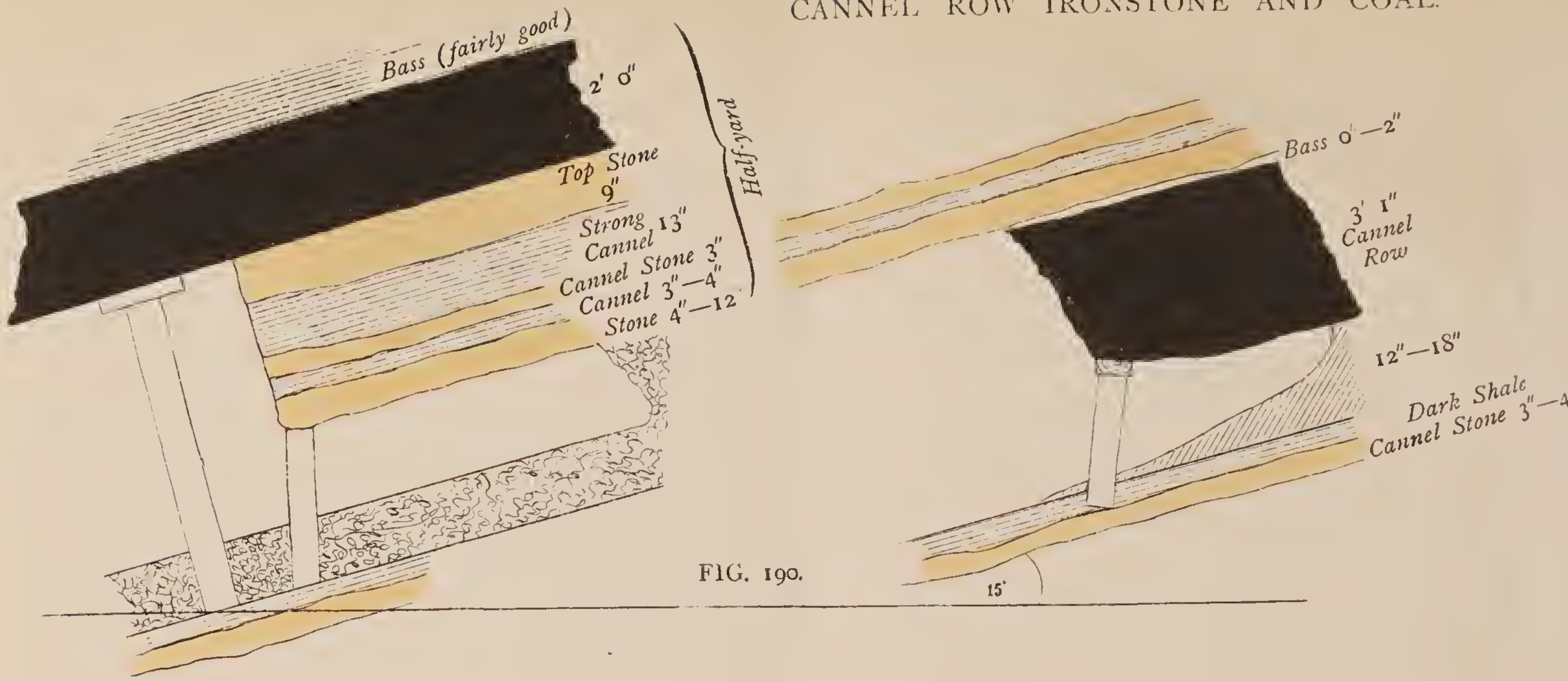


FIG. 190.

Fig. 190. Section NW. The stone called Half-yards and the Cannel Row Coal are worked separately; the former about two years after the latter. They are both worked in 40 yds. drifts. The stone forms a very good roof in the Cannel Row workings. No packs are formed, the gob being almost completely filled. The roof seldom breaks. Only one row of posts is set, and that on the gob side of the rails. If the roof begins to cut at the face posts are set on the high side. The coal is brittle, and lids are placed on the sprags.

The roof coal in the Half-yards work is cut down in the wastes; its face is $1\frac{1}{2}$ dressings behind the stone face. Packs are formed 2 yds. wide by Riflemen being placed at short intervals, and the intervening space filled in. The wastes are 4 yds. wide. Holing is done in part of the old gobbed up dirt of the Cannel Row Coal workings, which, having been compressed, forms easy holing. The Cannels and the Cannel stone are oil producing.

PENNYSTONE IRONSTONE.

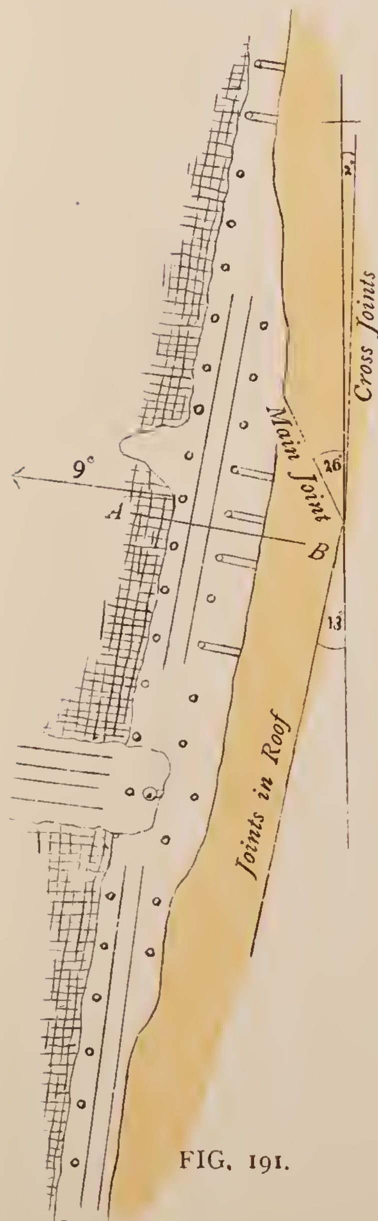


FIG. 191.

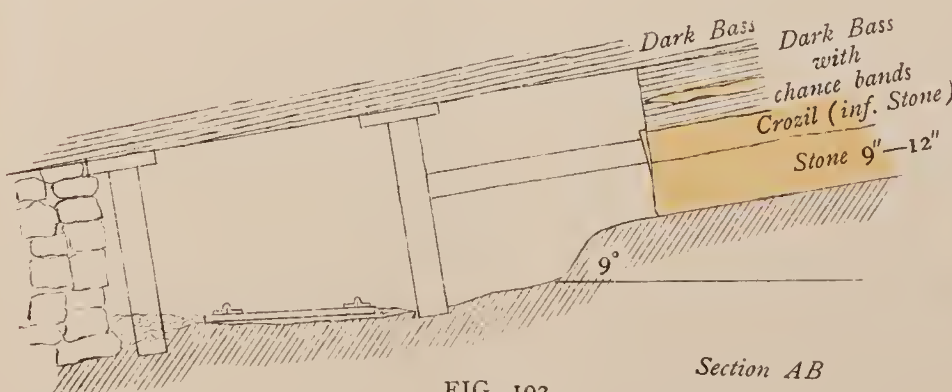


FIG. 192.

Figs. 191 and 192. Plan and Section S. The main joints run from 12"—18" apart; a few pass into the crozil, with a slight set off. Joints in bass frequent. Worked by 40 yds. longwall drifts on each side the jig. 2'—3' of floor are taken up in levels and jigs, in which larger tubs are used than at the face; the stone being tipped at the top of the jig and reloaded. The gob is entirely packed, except where the holing dirt is thin. Whilst the buttock is being pushed forward the stone is rated off the side where it works off easily. Little holing or blasting is needed.

NEW CHALKY IRONSTONE.

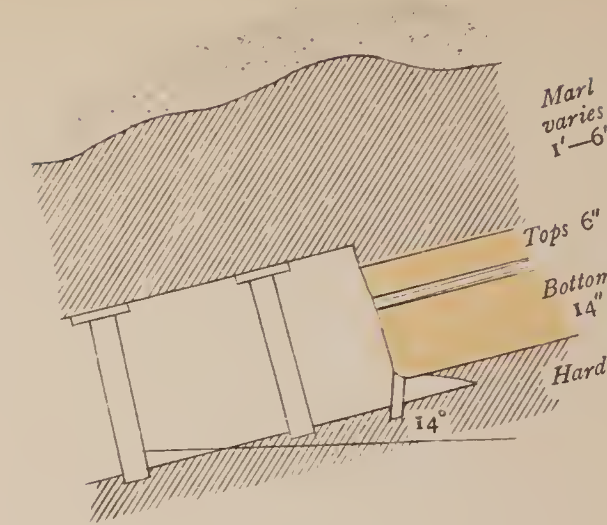


FIG. 193.

Fig. 193. Section W. Worked in 5 yds. walls.

LADY AND WINGHAY COAL.

Fig. 194. Section Centre. Worked together. First the Winghay, in 80 yds. longwall faces, with 3 yds. packs and 4 yds. wastes. The Lady Coal is worked about 8 yds. behind over the packs and in the wastes, the fireclay being first dropped in the latter. About 8" of coal are left as a roof in the Winghay drifts, owing to the clay strata above forming a very bad roof; little of it is recovered. The cleat is indistinct in the Winghay, but pretty distinct 23° NW. in the Lady Coal.

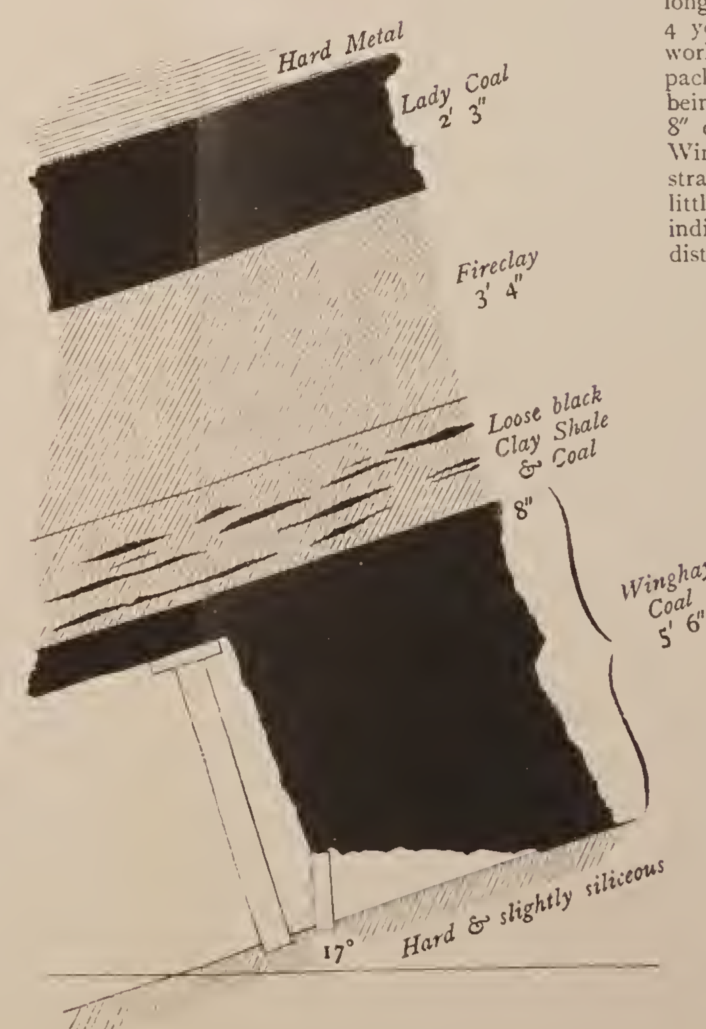


FIG. 194.

Northwards the Winghay Coal is worked alone; it is 6' thick. 1' of coal is left to form the roof, part of which is recovered. As the coal is removed a row of posts is set 3' from the former row, which is then removed. The posts in each row are 1' apart; the roof breaks up to them, and stones from the gob are packed behind them. See Fig. 281.

Further East it is worked by post and thurl, pillars having to be left, owing to its proximity to the surface (30 yds.)

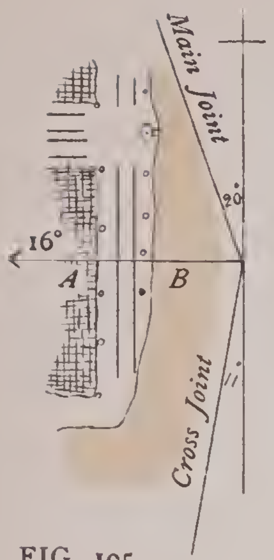


FIG. 195.

Figs. 195 and 196. Plan and Section NW. Joints run very regularly from 12″—18″ apart. Worked by short longwall faces.

A fatal accident occurred in a level 5′ wide, with a pack on one side, owing to a deficient post (stoop) which supported a bar being loosened at the foot, without a foreset post being first set under the bar. The roof, which was considerably loosened by water, fell, though it was barred and planked.

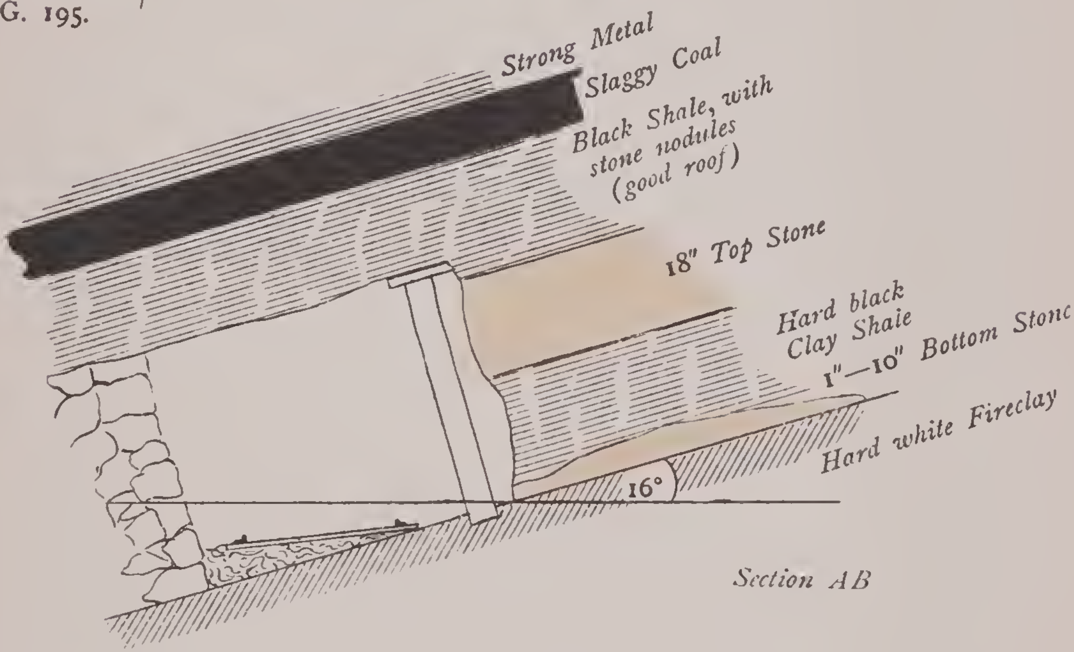


FIG. 196.

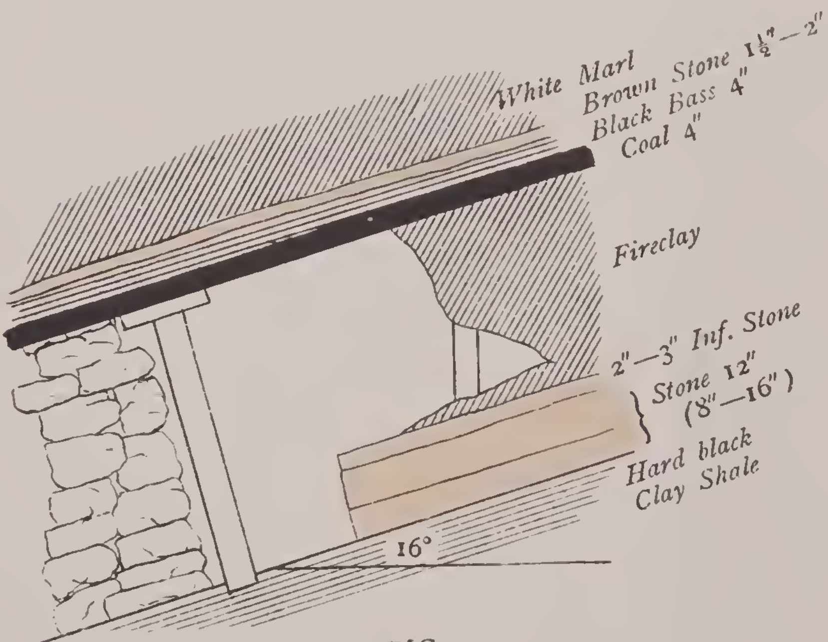


FIG. 197.

Fig. 197. Section E. of Fig. 196. The coal forms a good roof. The gob is all packed, and one tub of dirt is sent out to four of stone. Longwall drifts, with one row of posts on gob side of rails.

BIG MINE COAL.

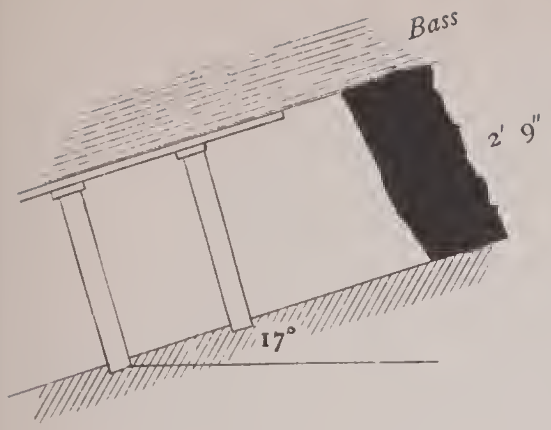


FIG. 198.

Fig. 198. Section of thurling in course of being driven. N.W. The roof, which is usually good, is extremely loose here, from the proximity of the working to the surface, and has to be slabbed, even in thurlings. Cleat 40° NW., good.

CHANCE BAND IRONSTONE.

Fig. 199. Section NW Levels driven every 10 yds. and drifted back in 4½ yd. slices, thereby exposing as little of the roof as possible. The gob is entirely packed with bass and marl. This band thins Southwards.

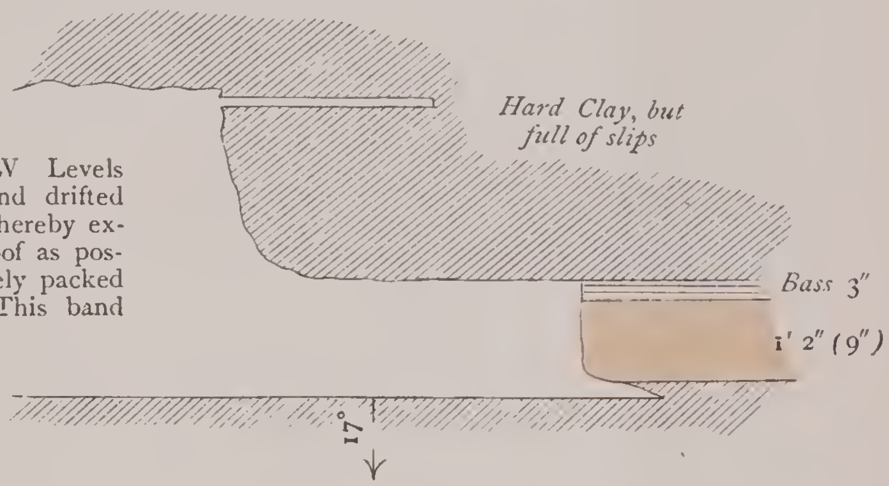


FIG. 199.

BROWN MINE IRONSTONE.

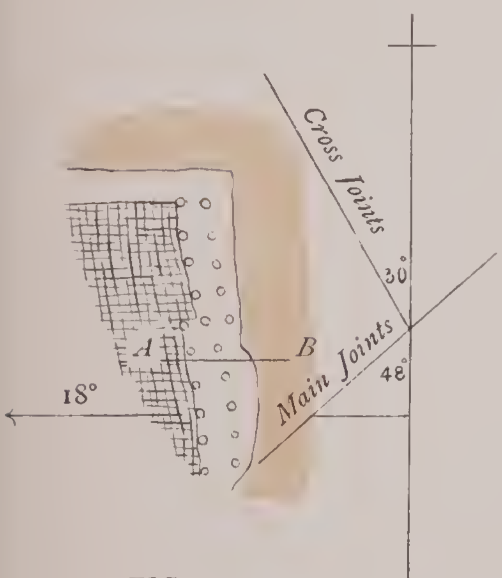


FIG. 200.

Figs. 200 and 201. Plan and Section NW. Joints very frequent and distinct. The roof is very jointy and bad. Worked in short longwall faces.

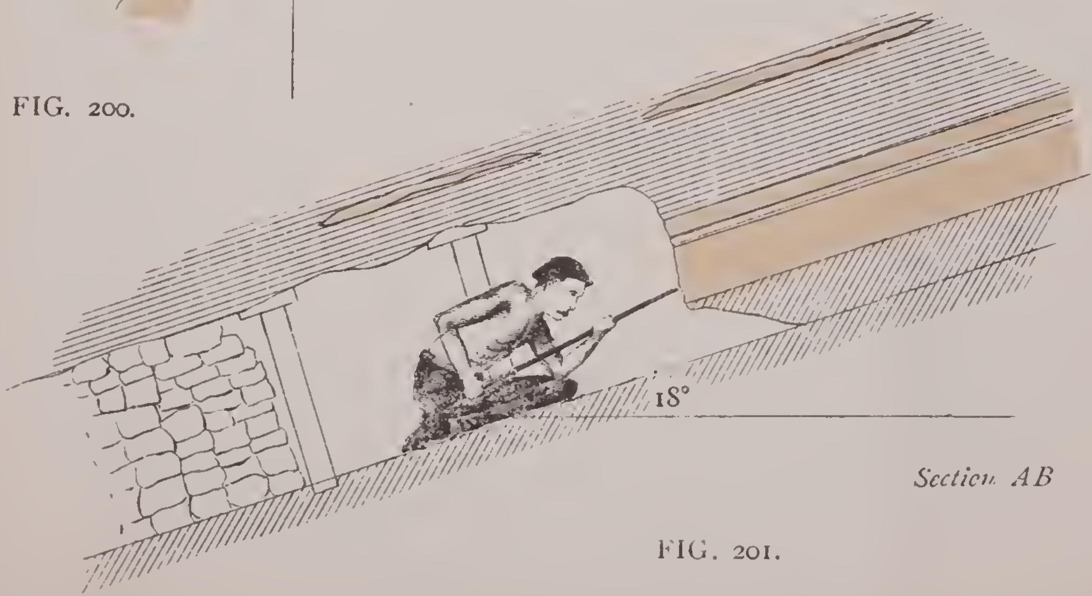


FIG. 201.

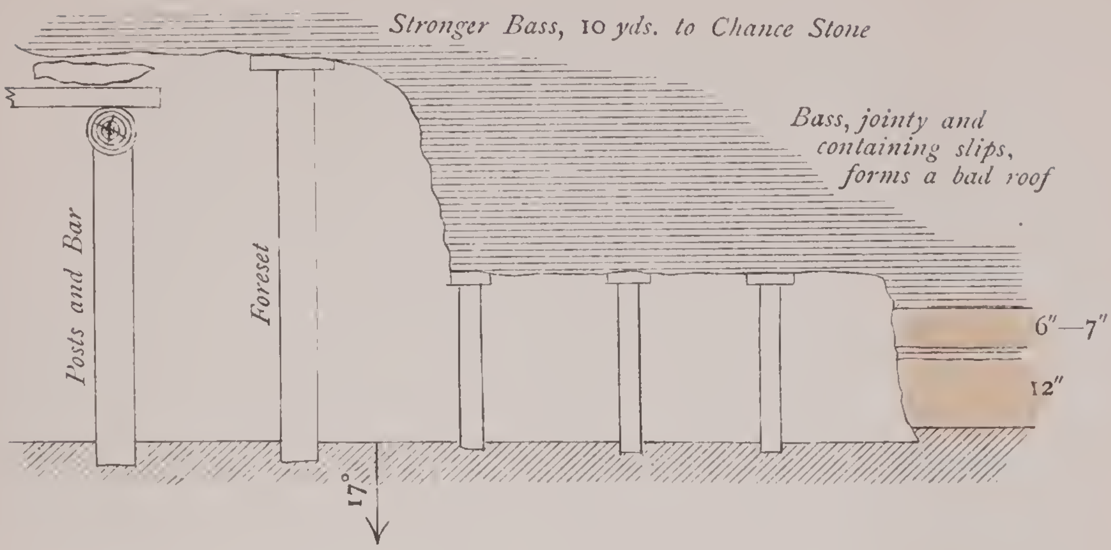


FIG. 202.

Fig. 202. Section further North. Heads are driven 10 yds. apart, and intervening pillars drifted back. Section represents a principal heading in the solid, 5′ wide. The roof, which is usually good, is bad at this point, from its proximity to the surface, and has to be well timbered in strait work. Joints as above.

RIDER COAL.

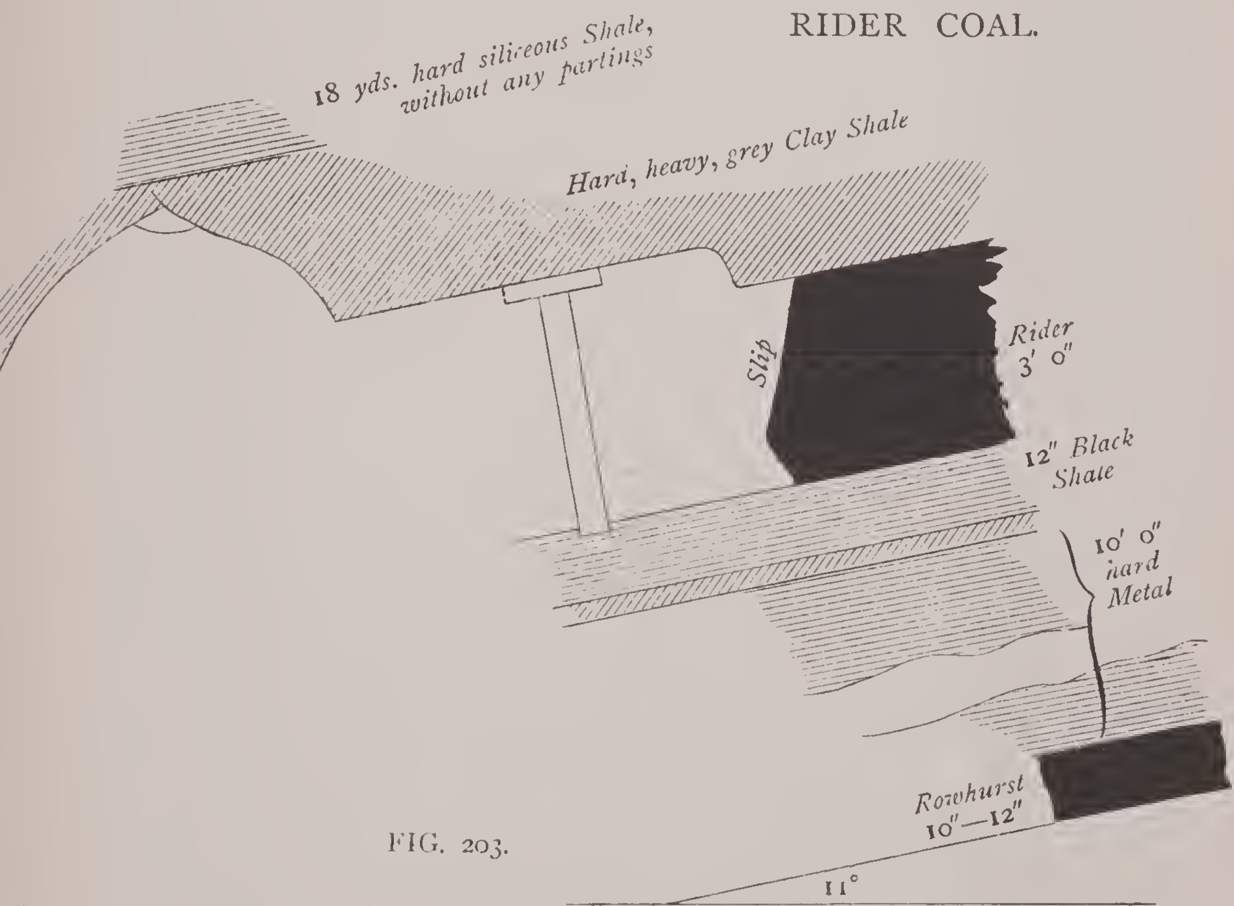


FIG. 203.

Fig. 203. Section N. Worked in 18—20 yds. longwall faces. The coal contains slips, which run 30° NW, from 2′ 6″—3′ 6″ apart, along the whole length of the drift, which facilitate the getting, as there is no holing done. The slips do not run into the roof. The clay shale breaks in places in curved surfaces, but forms a good roof until a weight of the shale above occurs, when neither posts, chocks, or even packs are able to resist it, and the drift comes in. It gives ample warning, and rails are taken up and everything removed. It often takes a week to settle, and a new drift is then re-opened.

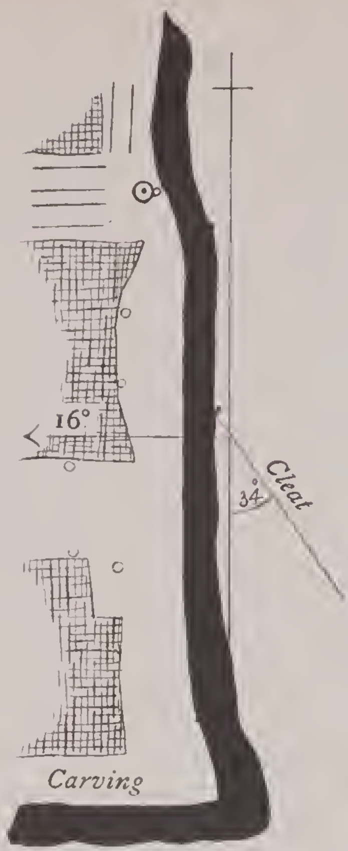


FIG. 204.

Figs. 204 and 205. Plan and Section further South. Cleat very distinct. The coal is tender and rates off and requires little holing. The roof is very good and little timber is set.

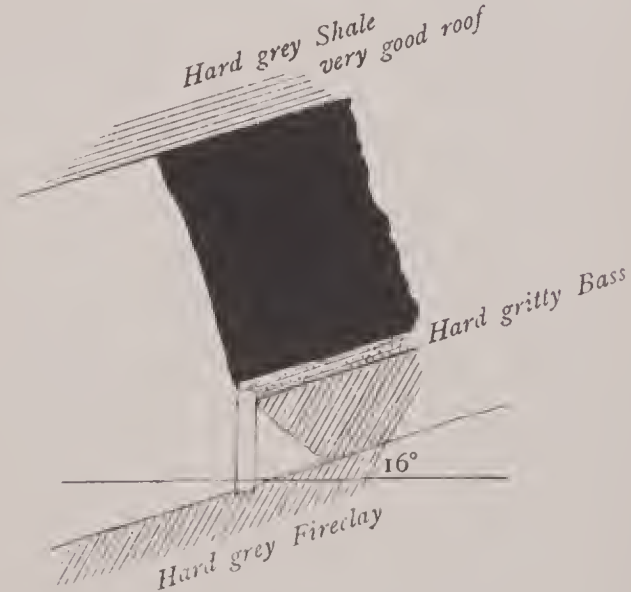


FIG. 205.

At the extreme North the roof, which is heavy clay shale, contains joints, which run in the same direction as the cleat and slips in the coal, 47° NW; the dip of the mine being 61° SW. Drifts are kept as small as with Fig. 203, for the same reason that although the roof is good, when once it weights it breaks all before it, and a new drift has to be started. The drifts extend 12 yards on each side the jig; one waste is formed with 6′ pinning on each side. The posts are not stamped; they rest on 3″ slagg. The underlying floor is so soft that were they once through into it they would be pressed in. Boards are placed under them where the slagg is absent.

Figs. 206 and 207. Plan and Section S. Cleat indistinct. Slips run very frequently, but independently, in top and bottom coal. Longwall drifts and breasting; as "stret work" in opening out injures the roof, necessitating much timber. The drifts extend 30—35 yds. on each side the jig. A post is sometimes left in the wastes, to prevent a pot hole being formed, as it would immediately fill with gas. The wastes are often open for a distance of 15—20 yds., the roof and floor bending towards each other, and closing the cavities.

FIG. 206.

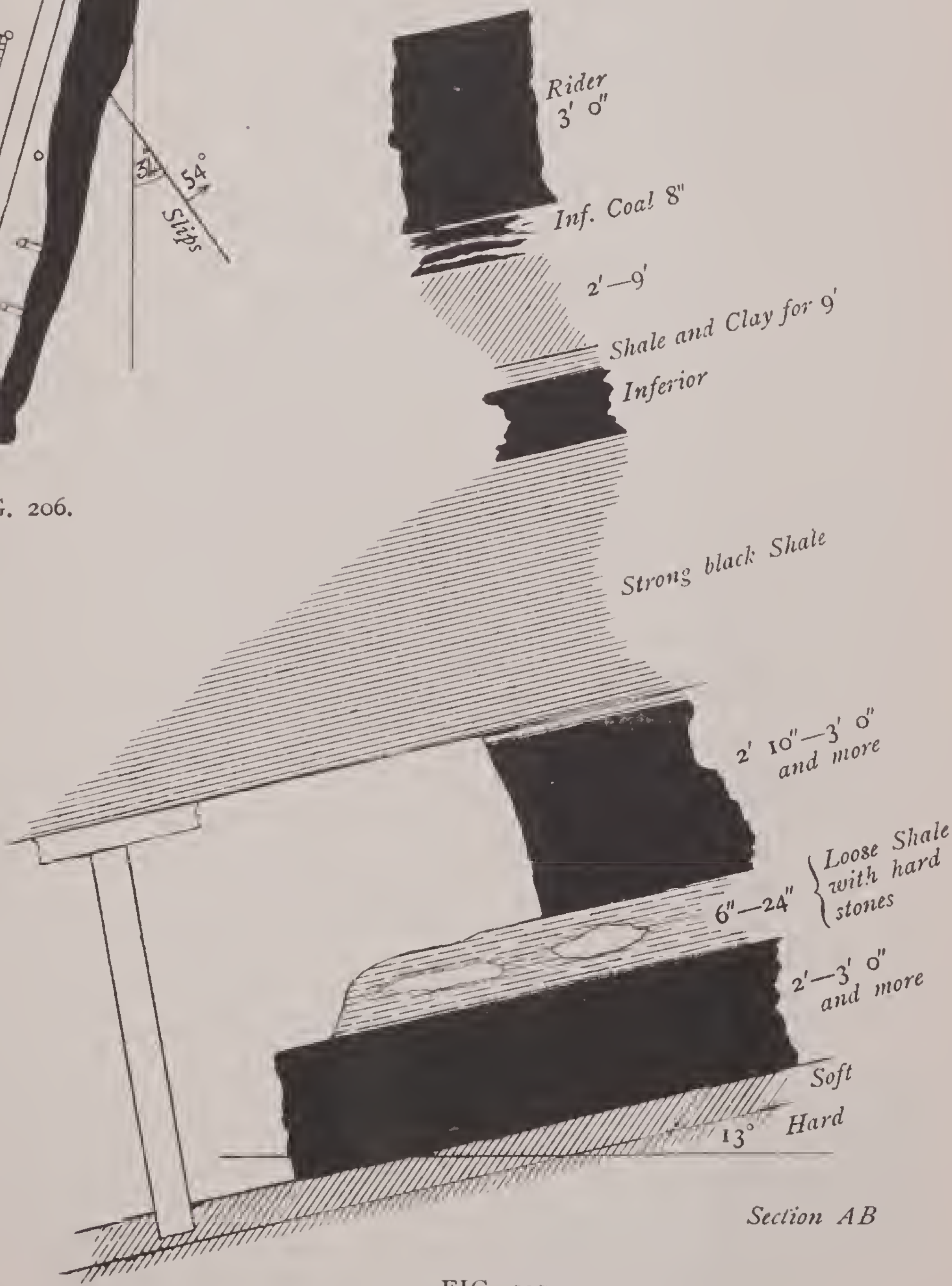


FIG. 207.

Figs. 210 and 211. Plan and Section C. The stone and the coal are close together. Cleat is distinct. Joints in stone and roof are not regular. Regular slips occur in the coal at intervals; they run through the stone, and sometimes into the roof. The roof is very jointy and loose, and requires specially large lids. Broken posts are used for the purpose. The drifts extend 25 yds. on each side the jig. After the coal is dressed the rails are laid to the far end, there being a row of posts on each side of them. As the coal is dropped another row of posts is set next the face, and the rails are taken up, the bottom row is then drawn and the packs are built. In this way the men are not under the fresh roof whilst breaking up the coal, and are at once protected. The coal is fallen against the posts in such a way as not to injure them.

FIG. 210.

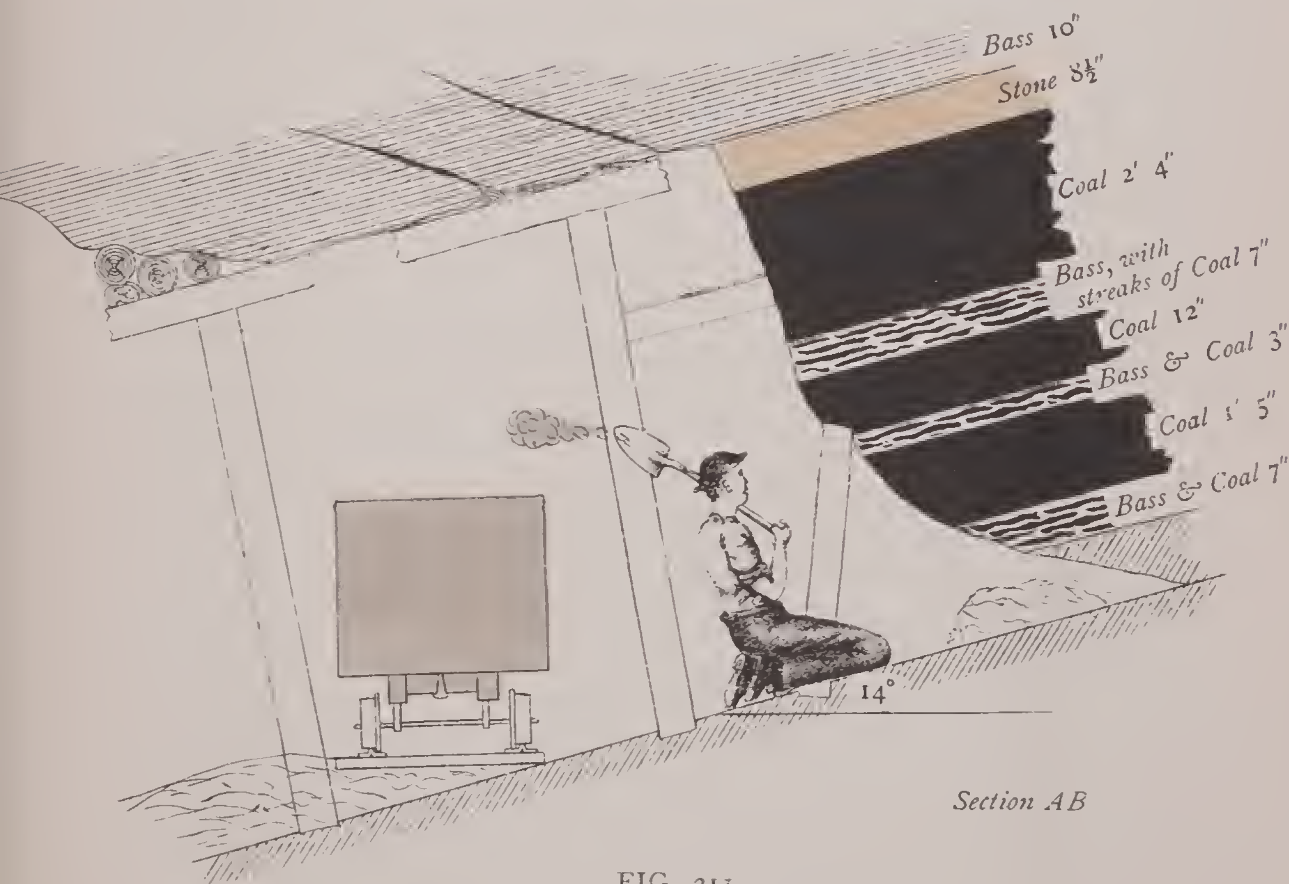


FIG. 211.

Northward 4′—4′ 6″ of bass or grey metal separate the coal from the stone, which is much thicker.

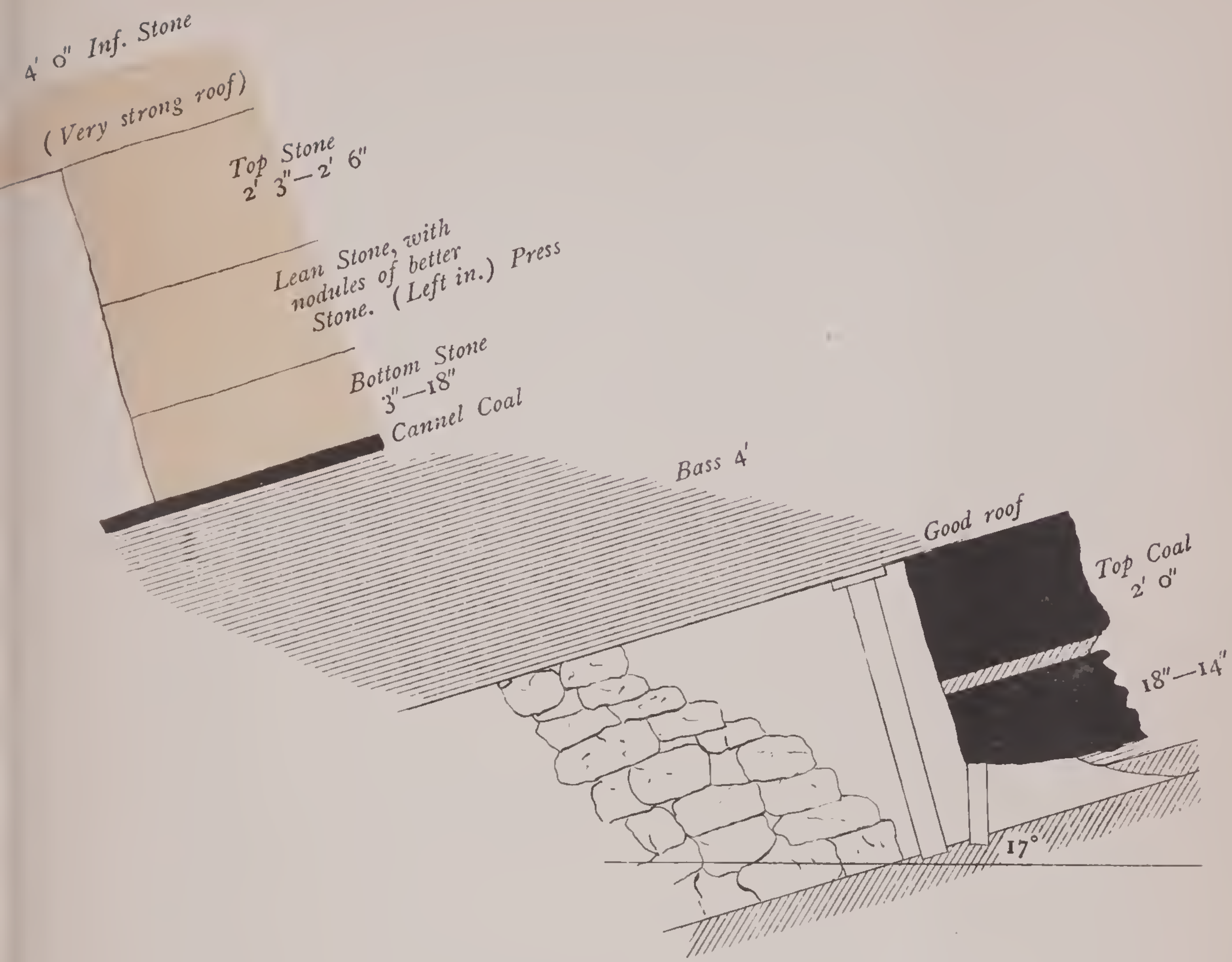


FIG. 212.

Fig. 212. Section NW. Cleat distinct 47° NW, and slips occasionally 34° NW. The joints in the Top Stone are distinct from those in the Bottom Stone; both are very irregular: Top Stone, 47°—59° NW; Bottom Stone, 28°—35° NW and 115° NW. The coal and stone are both worked by longwall faces, the latter about 8 yds. behind the former. The stone work equires very little timber.

Further North, about 8″ of hard shale, with streaks of coal run above the Top Coal. The latter varies much in thickness and quality, but the Bottom Coal remains constant. Cleat indistinct; slips occasionally in the coal 55° NW. Both coal and stone seams are worked by longwall, the latter about 15 yds. behind the former. If the stone is worked any considerable length of time after the coal, the floor heaves, and the stone which has been loosened by the subsidence of the bass sets fast again, and costs more to get. Both gobs are fully packed; the lean stone is used for that purpose in the stone work. A band of lean stone, 18″—2′, which forms the roof, is left. In the coal work the drifts are about 30 yds. on each side the jig. A row of posts is set close by the coal face, *before the holing is commenced*, and the back row drawn.

FIG 213.

Figs. 213 and 214. Plan and Section N. Worked by 30—50 yds. drifts, with the rails below the buttock which necessitates two rows of posts on the high side of the rails. Small wooden wedges (gluts) are driven into open joints in the roof. The joints in stone are regular and frequent through all the bands.

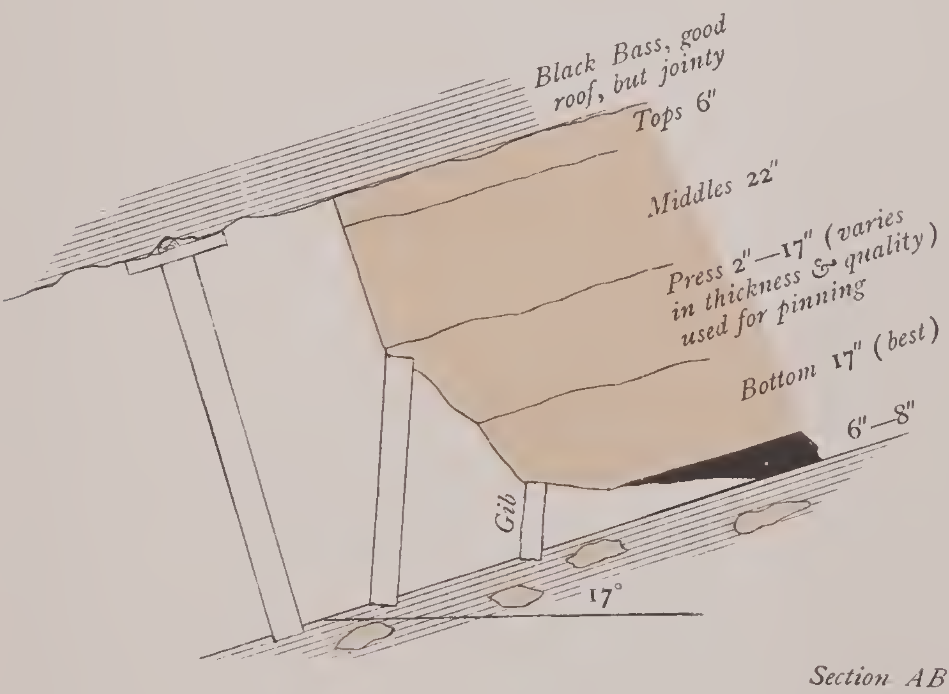


FIG. 214.

At the extreme North, where the section and dip are almost identical, the rails are placed in the usual way, next the face and in front of the buttock; posts are then placed between the rails and face where there is room. It is considered a better and safer method, as the workmen are under a smaller area of roof, and the pinnings can be kept closer.

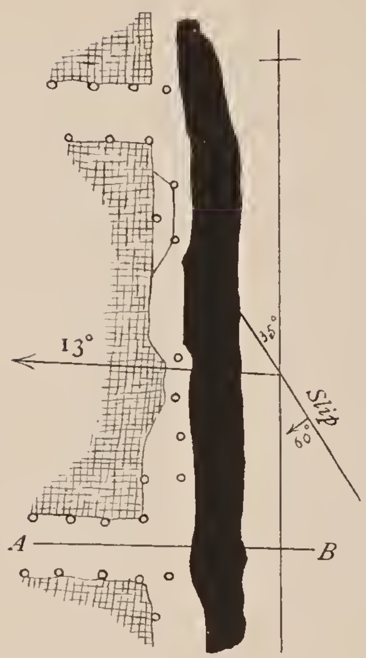


FIG. 215.

Figs. 215 and 216. Plan and Section N. Cleat indistinct. Slips every 3′ or 4′. They are deflected on passing into top and bottom layers, and sometimes pass into the roof. Longwall, without much holing, except occasionally in top or bottom.

Further South the cleat, which runs 34° NW., is more distinct, and slips not so frequent.

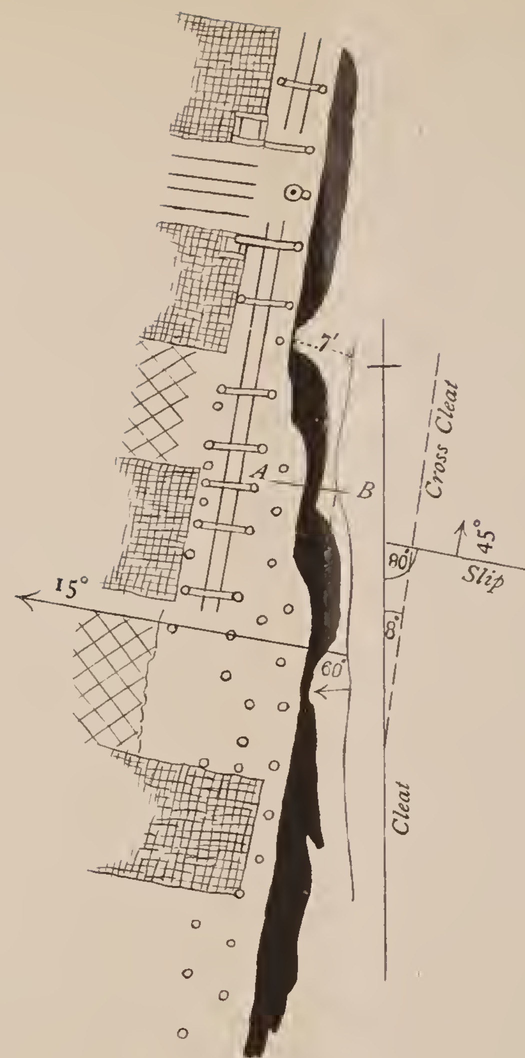


FIG. 217.

Figs. 217 and 218. Plan and Section S. Cleat due N and S, pretty distinct, and cross cleat in places. Coal short grained and hard. Pig backs, or elevations of the floor without any corresponding elevation of the roof, are frequent. They are accompanied by wavy slips in the coal. Longwall; a backfall 7′ in width is taken homewards. Slips occur in the roof.

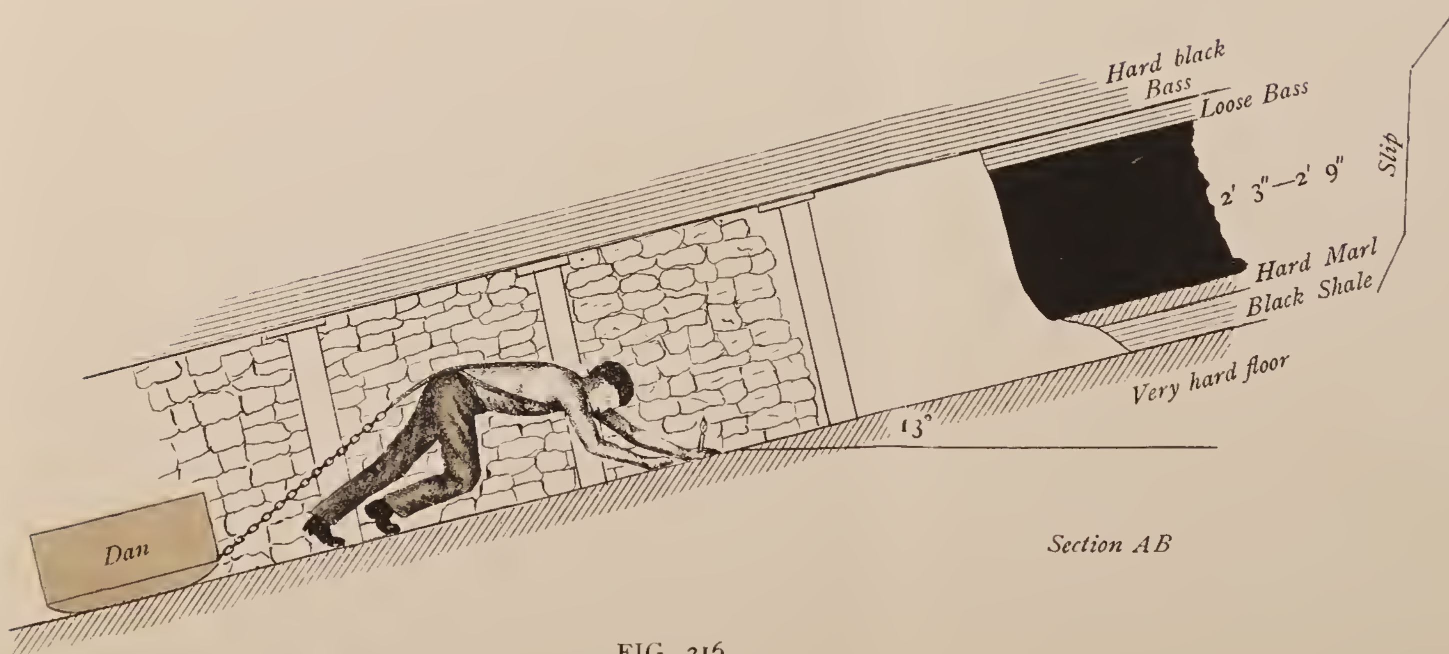


FIG. 216.

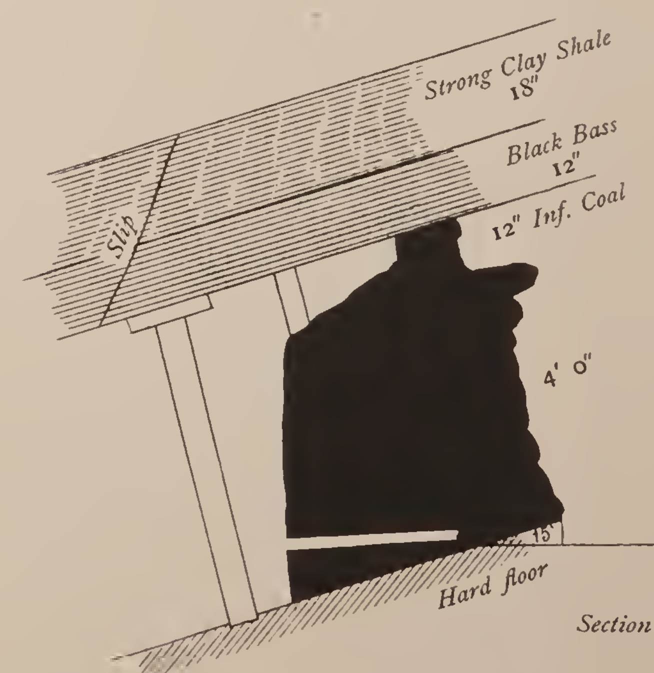


FIG. 218.

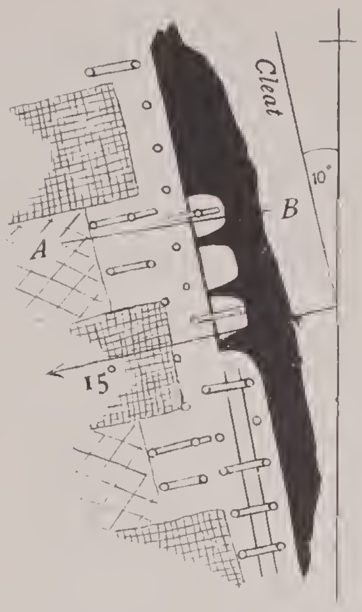


FIG. 219.

Figs. 219 and 220. Plan and Section further North. Cleat indistinct. Coal breaks in curly or round lumps. The holing is done at the top, owing to the coal sticking to the floor, which is very hard. The roof is so short and brittle in places that holing can only be done at intervals, separated by small unholed distances forming coal supports (bunches). These little intervals are called panes. A slab (slab-bar) has to be placed against the end of the holing after the pane is holed, and supported at first by a short post on the coal, and eventually by a long post at one end. The roof breaks abruptly behind the timber in the wastes up to a hard bass. Much timber is required, of which 75°/o is lost. The wastes soon fill up. Where the roof is a little stronger the bass and 7″ of shale are taken down with the holing.

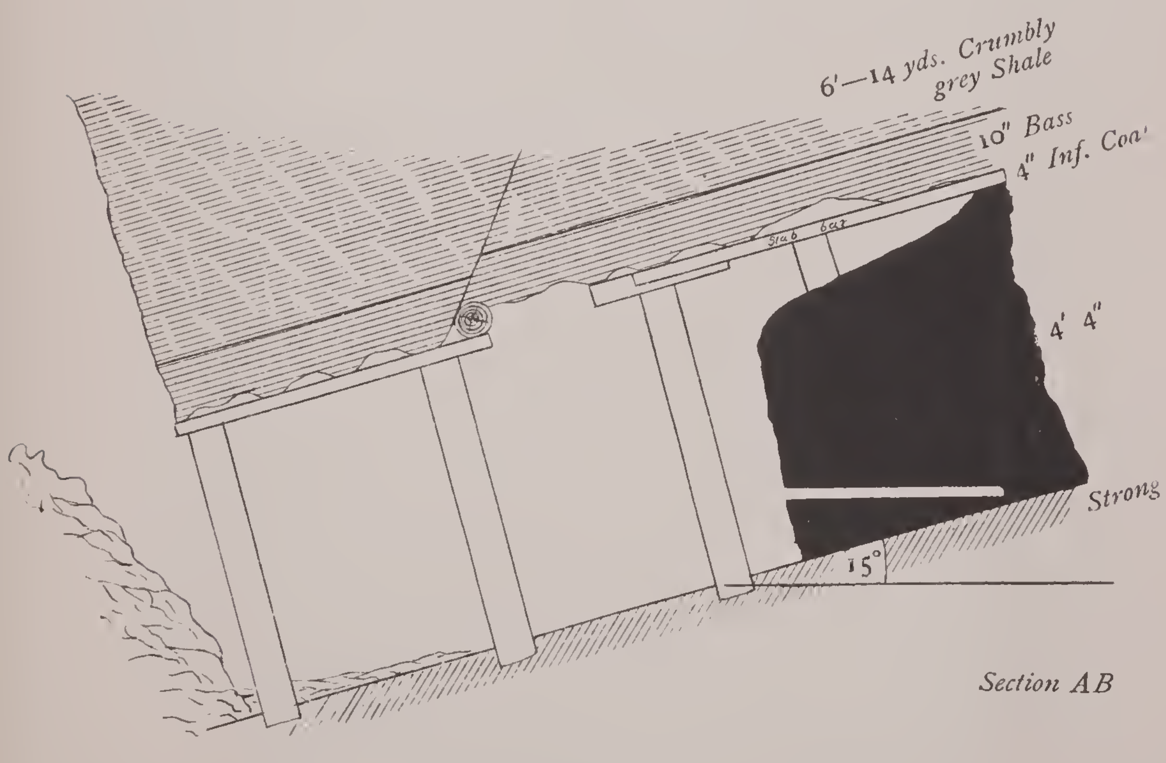


FIG. 220.

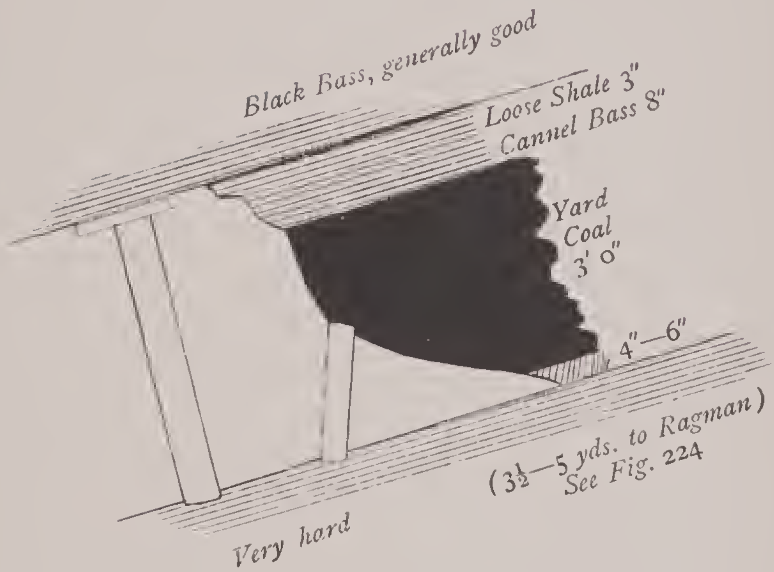


FIG. 221.

Fig. 221. Section S. Longwall ; 30 yds. drifts on each side the jig ; the gob is almost entirely packed. Cleat, 6° NW, distinct. Two rows of timber are set, one on the gob side of the rails and one next the face, until the rails are taken up and the holing completed, when the former is removed. A large weight occurs about every 40 yds., when the roof drops 5″ at the face.

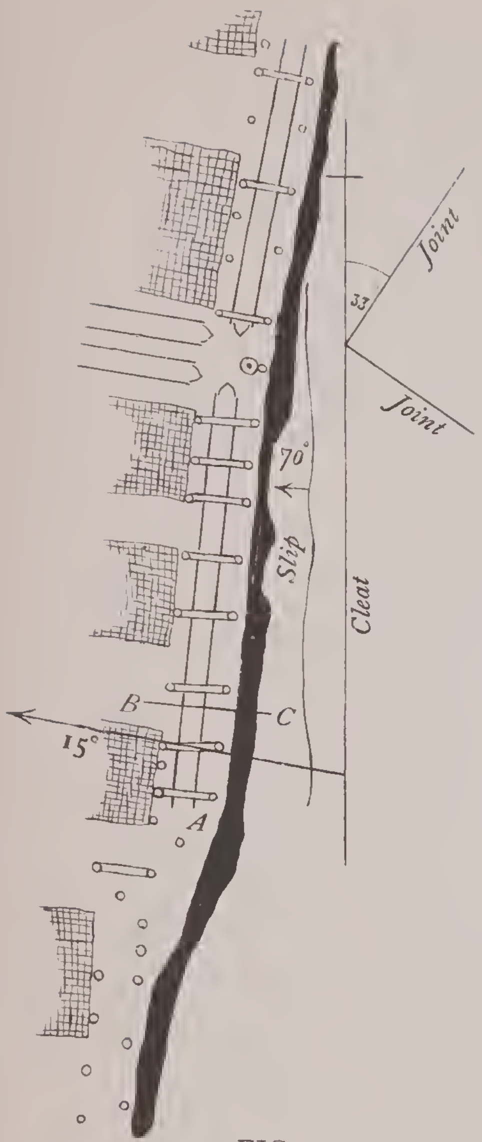
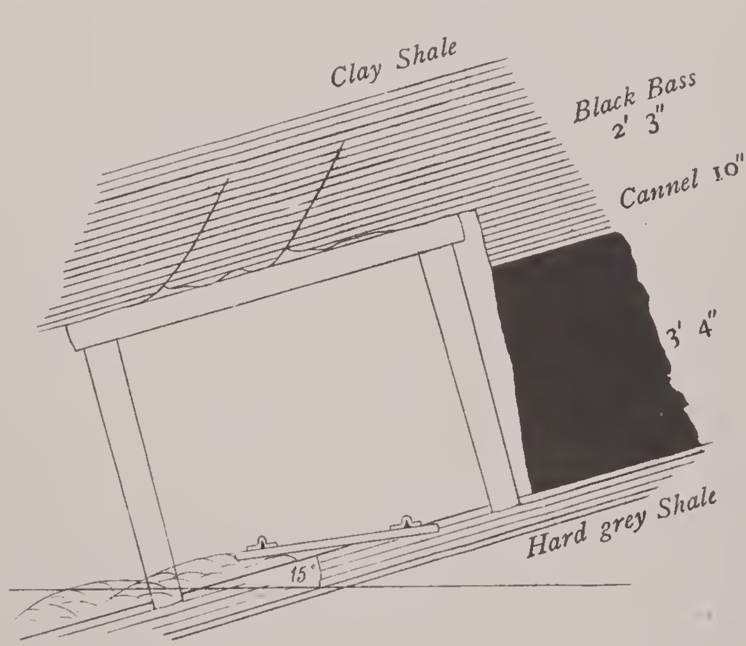


FIG. 222.

Figs. 222 and 223. Plan and Section further North. Cleat: due N and S, very distinct but short. Slips: in coal and cannel due N and S but wavy, about every 3′; in roof frequent. Joints: distinct in two directions in black bass, 3° NE, and ½″ and more apart in Cannel. The coal is not holed; it is "rated" down, so that a large portion of roof is exposed before the proper timbering can be set. It is important under a roof such as this, therefore, to set a temporary post *A* (Fig. 222) whilst "rating," as the posts and bars or high side posts cannot be set until the place is "squared up." Several fatal accidents have occurred from neglecting this necessary precaution.



Section BC

FIG. 223.

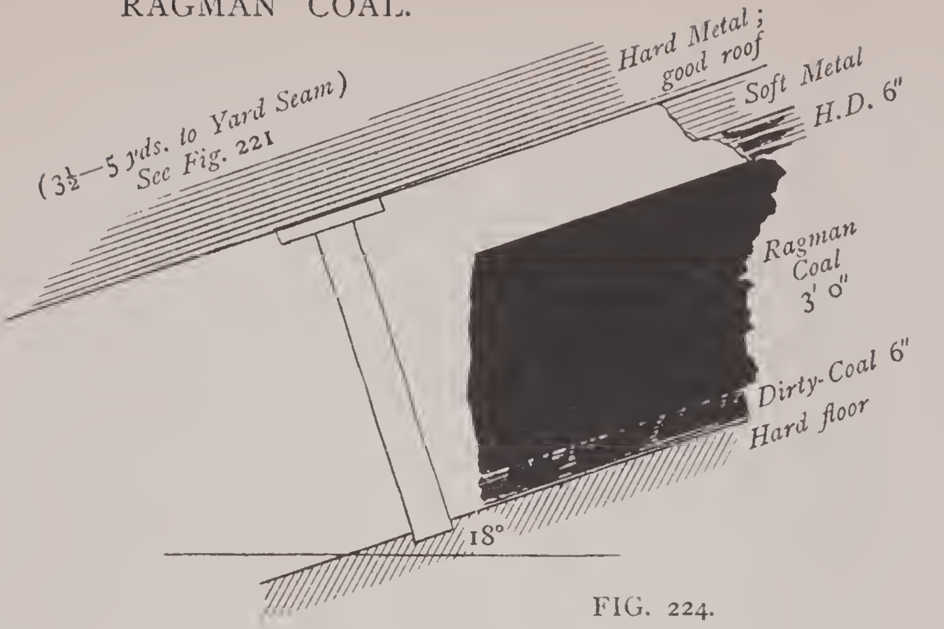


FIG. 224.

Fig. 224. Section SE. Worked the same as the Yard Coal (Fig. 221), but in 40 yds. drifts, the roof being stronger. Packs are formed 3 yds. wide and are 3 yds. apart. Weight and timbering as in Yard. Cleat indefinite, but predominating 5° NE.

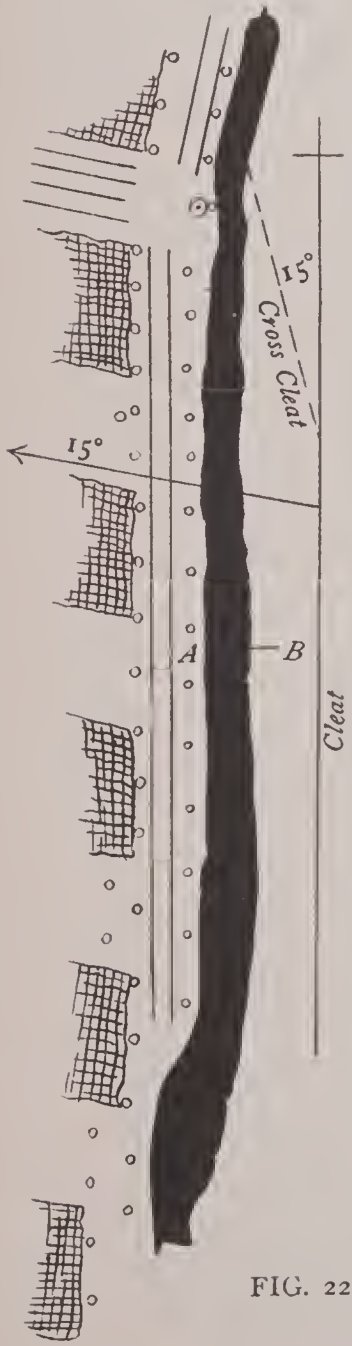
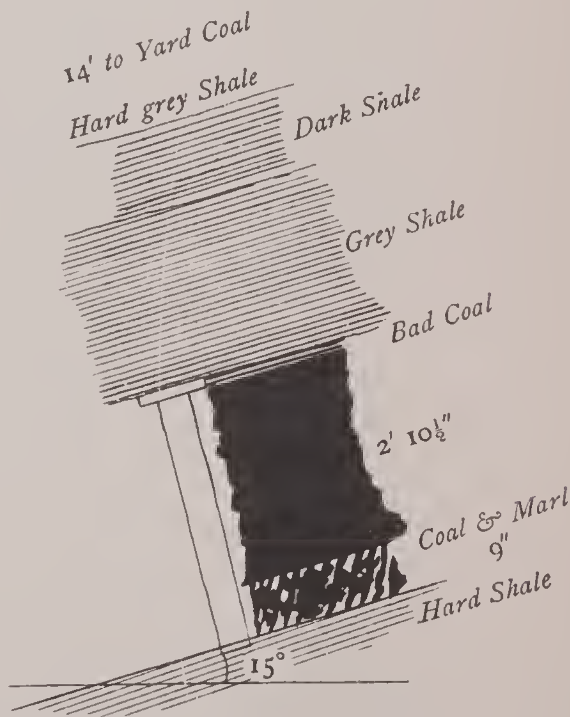


FIG. 225.

Figs. 225 and 226. Plan and Section S. Cleat: due N and S, very distinct, but short. Cross cleat: short and in patches, but frequent. Coal: soft and short-grained, but harder in this instance from Yard Coal (Fig. 223) having been worked. The roof, which is very strong, and contains no slips, is not thereby affected.



Section AB

FIG. 226.

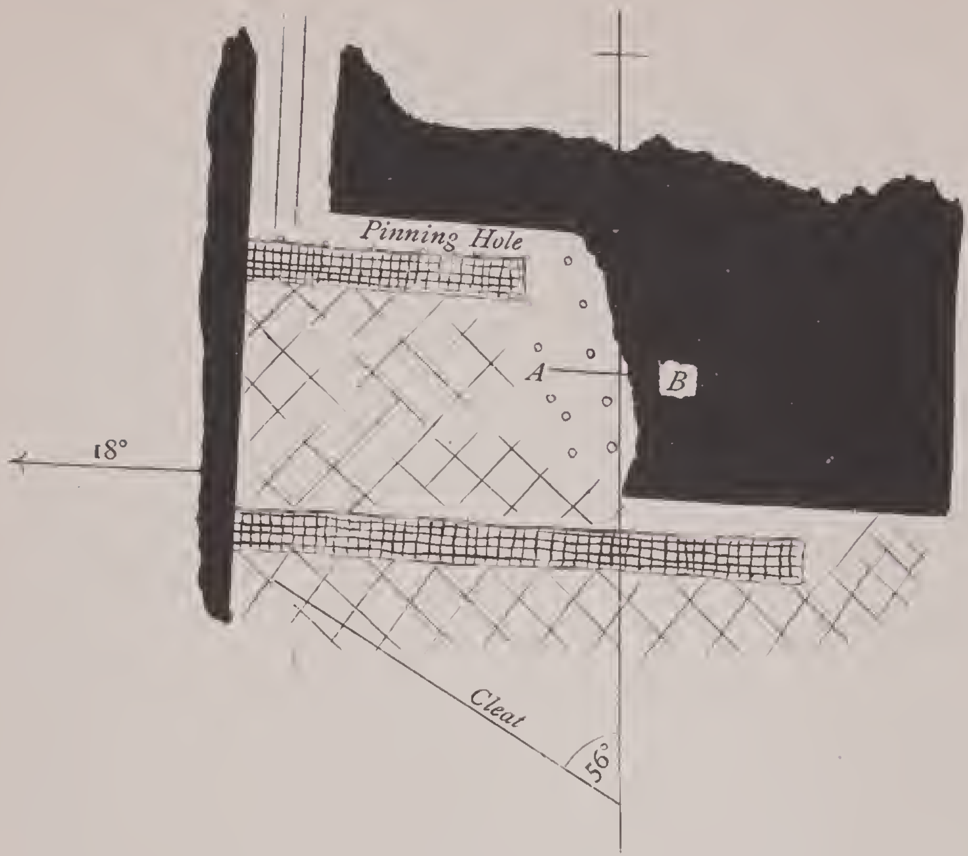


FIG. 227.

Fig. 227 and 228. Plan and Section N. The cleat is short. Lancashire method: headings 20 yds. apart; 8 yds. slices taken off. There are always two rows of posts at the face.

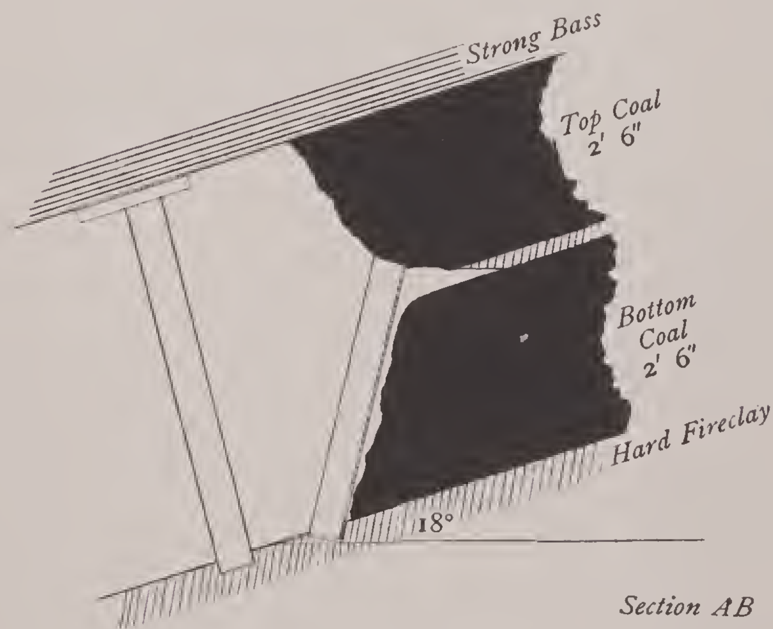


FIG. 228.

NE. the Bottom Coal thickens to 3′ 9″, and the roof is so much softer that the Top Coal is left up in the drifts. It is dropped, and all recovered in the wastes. There are always two standing rows of posts at the face, and one either being set or drawn. Worked as Fig. 229.

STONEY EIGHT FEET COAL.

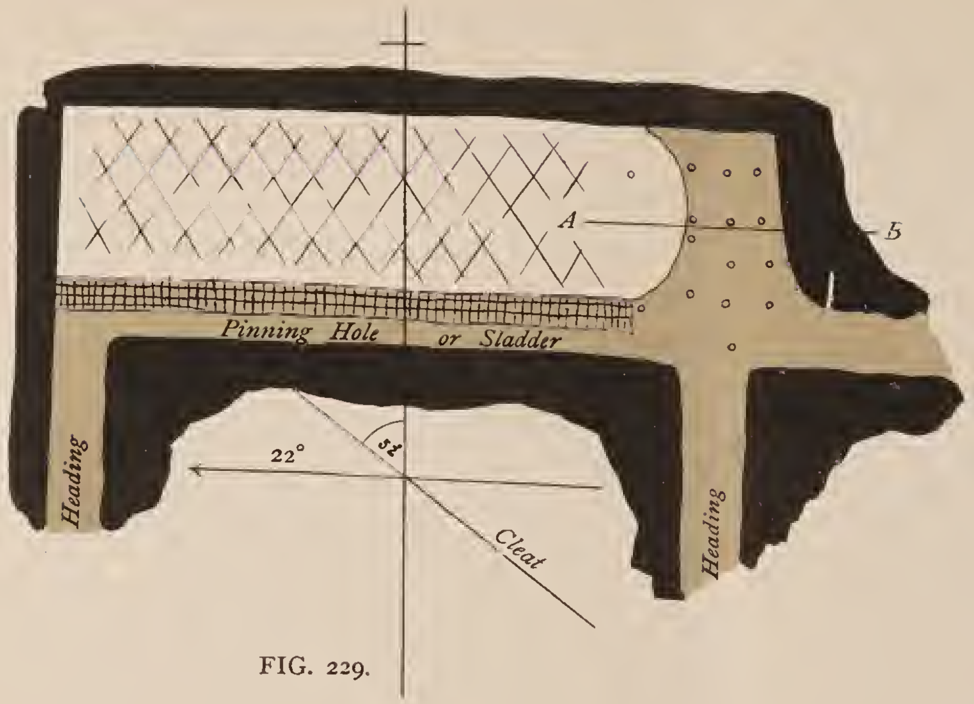


FIG. 229.

Figs. 229 and 230. Plan and Section N. Coal very hard and cleat short. Lancashire method: headings 20 yds. apart; 7—8 yds. slices taken off. Top Coal got in wastes. Post C set to prevent roof from falling with Top Coal. The pinning, which is 3′ at its base and 18″ at the top, is built of pieces of the sandstone band. It is built up to the Top Coal.

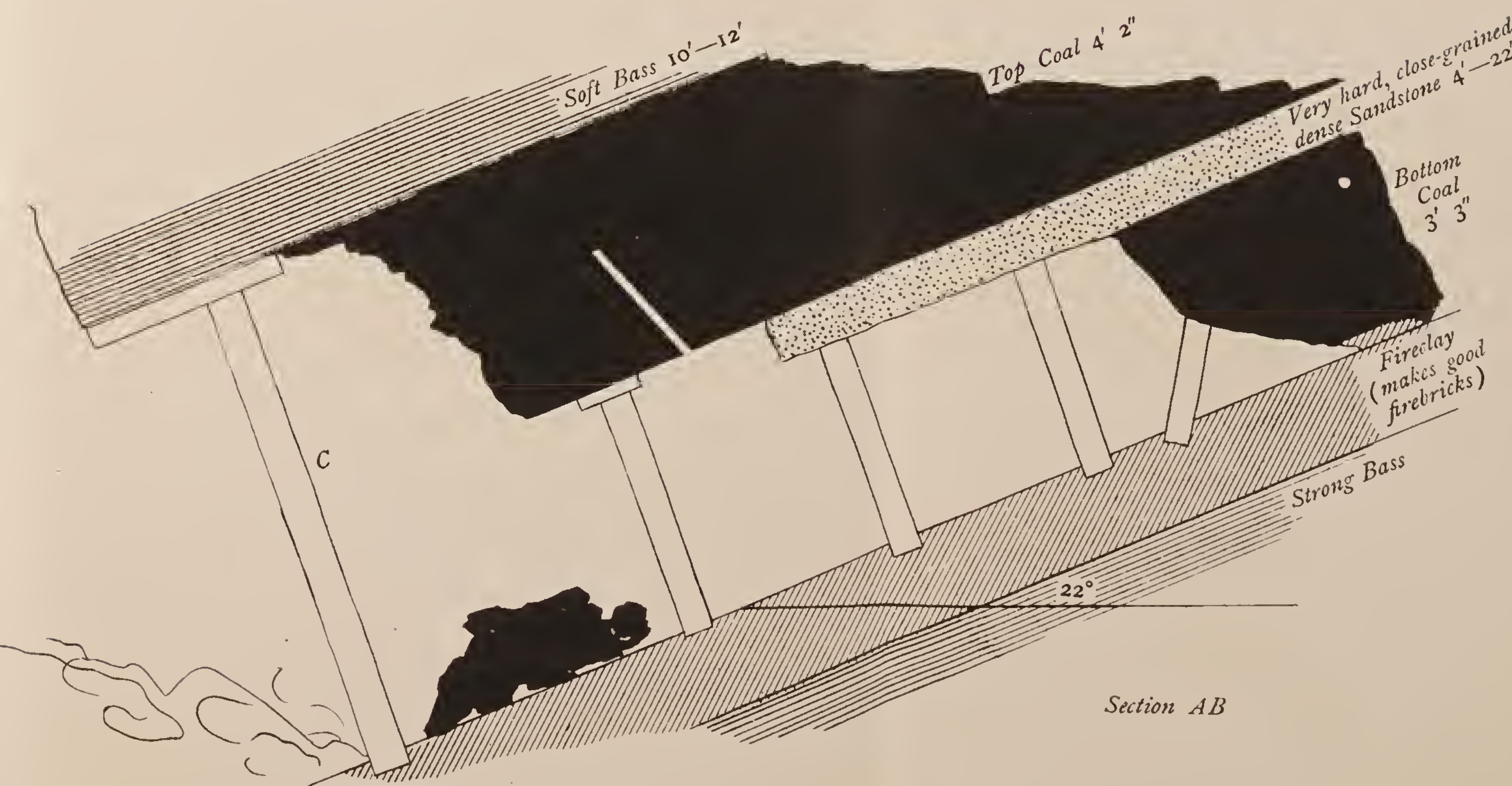


FIG. 230.

TEN FEET COAL.

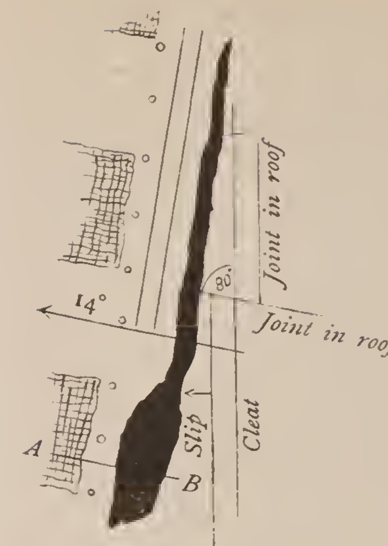


FIG. 231.

Figs. 231 and 232 S. Cleat due NS, very distinct. Cleat planes coated with carbonate of lime. Coal: long-grained.

Slips in coal N and S, from 18″—4′ apart. The Top Coal is left to form a better roof; it is inferior. The Middles stick to it and project over, preventing a row of posts from being set next the face.

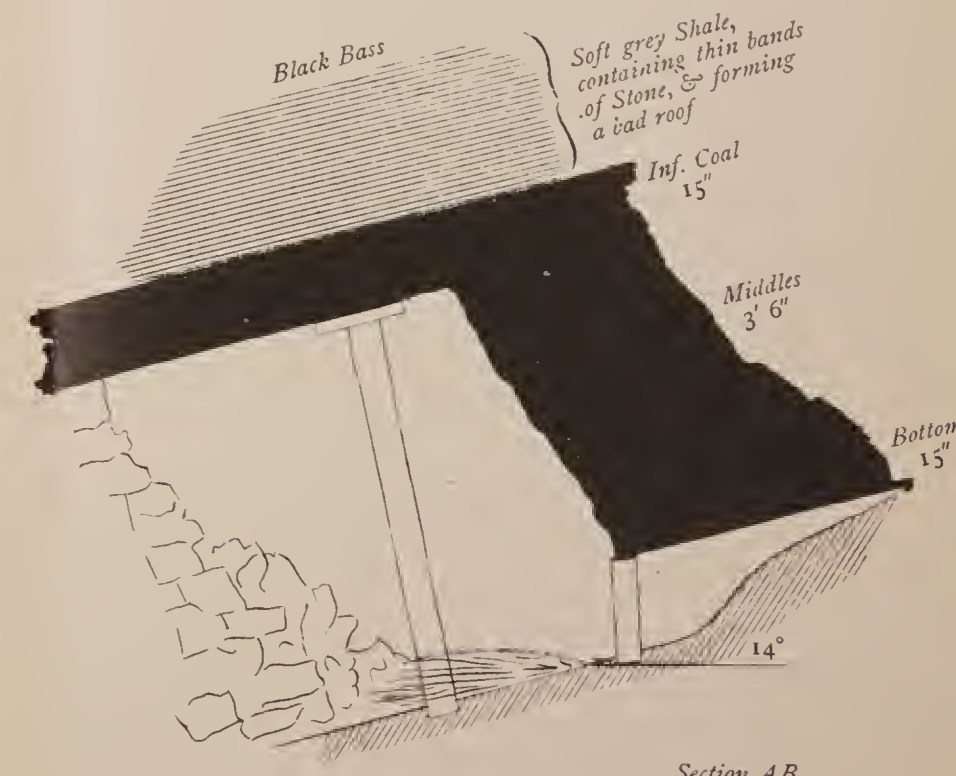


FIG. 232.

Northwards. The Tops, which are the best coal, are 5′ 8″ thick; the Middles, which are inferior, are 1′ 6″, and the Bottoms 1′ 0″. They are divided by ½″ dirt partings.

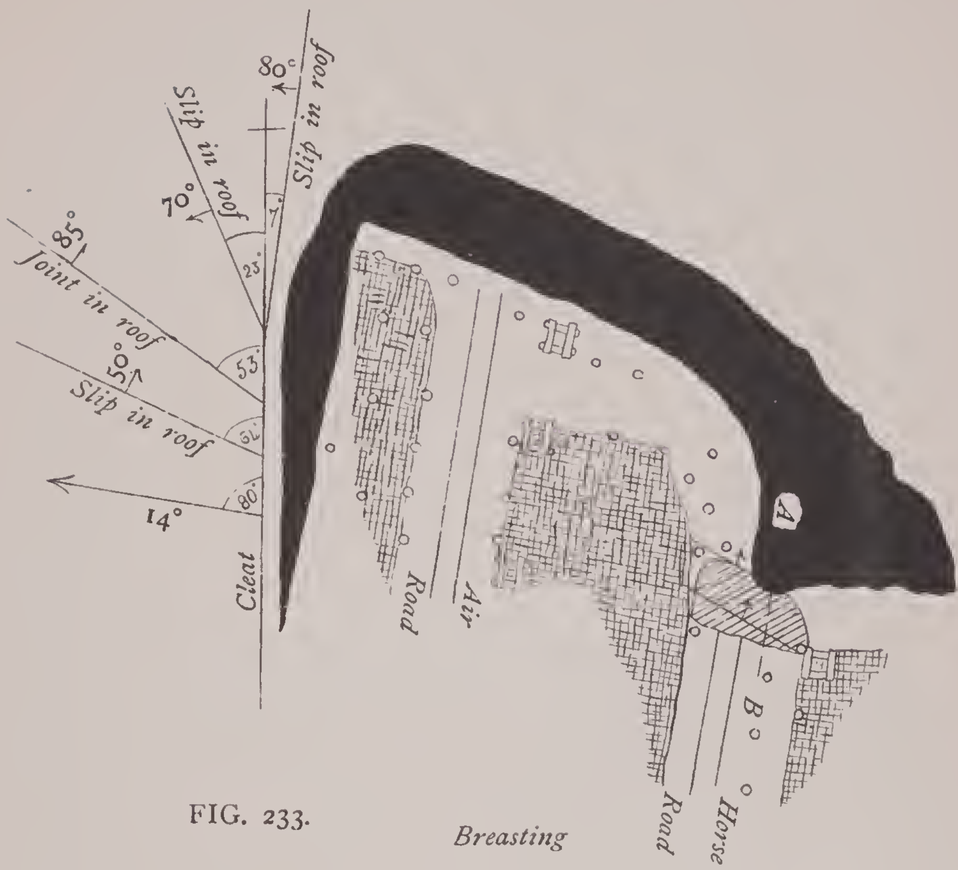


FIG. 233.

Figs. 233 and 234. Plan and Section S, illustrating a fatal accident in a breasting. The collier fired a shot, which did not take effect, and instead of first protecting himself by timbering the overhanging roof, through which it was reasonable to expect slips to run, he started to pull the coal down, when the roof, which had been shaken by the shot, broke off two slips and killed him. The levels are breasted out; the longwall drifts start immediately from them. Cleat very distinct, due N and S. Slips in roof in three well defined directions. 2′ 3″ of shale is taken down in horse roads behind the coal face. The roof is good, and contains two thin bands of stone. Abrupt corners, like the place of this accident, try the very best roofs.

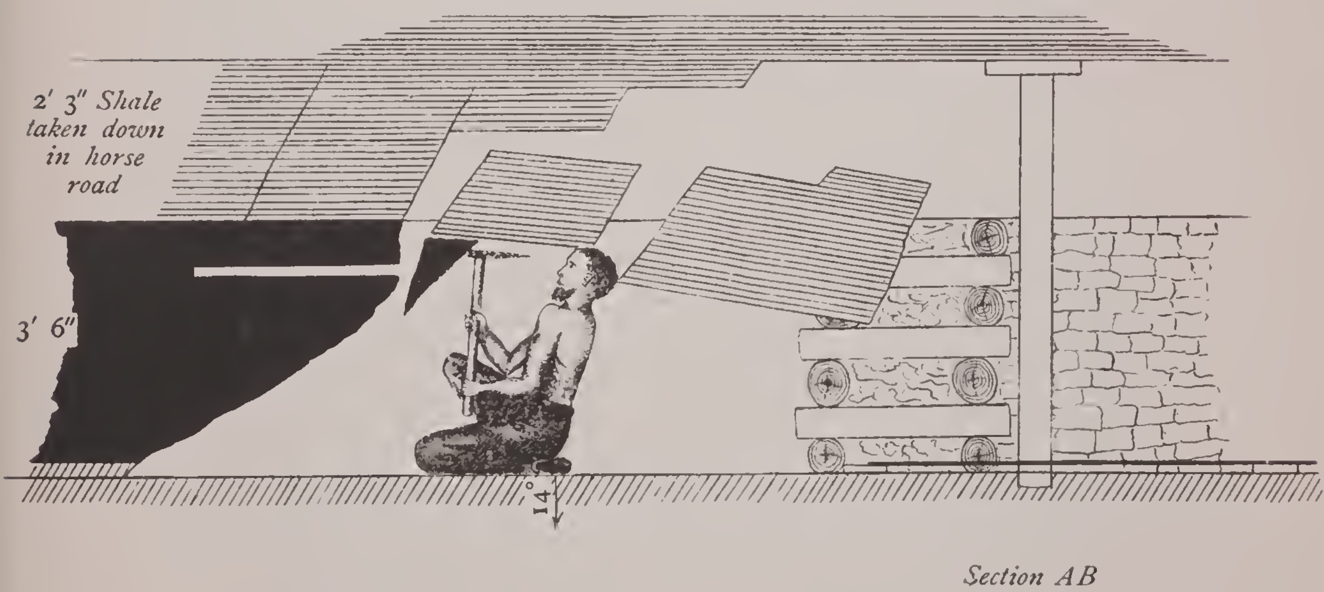


FIG. 234.

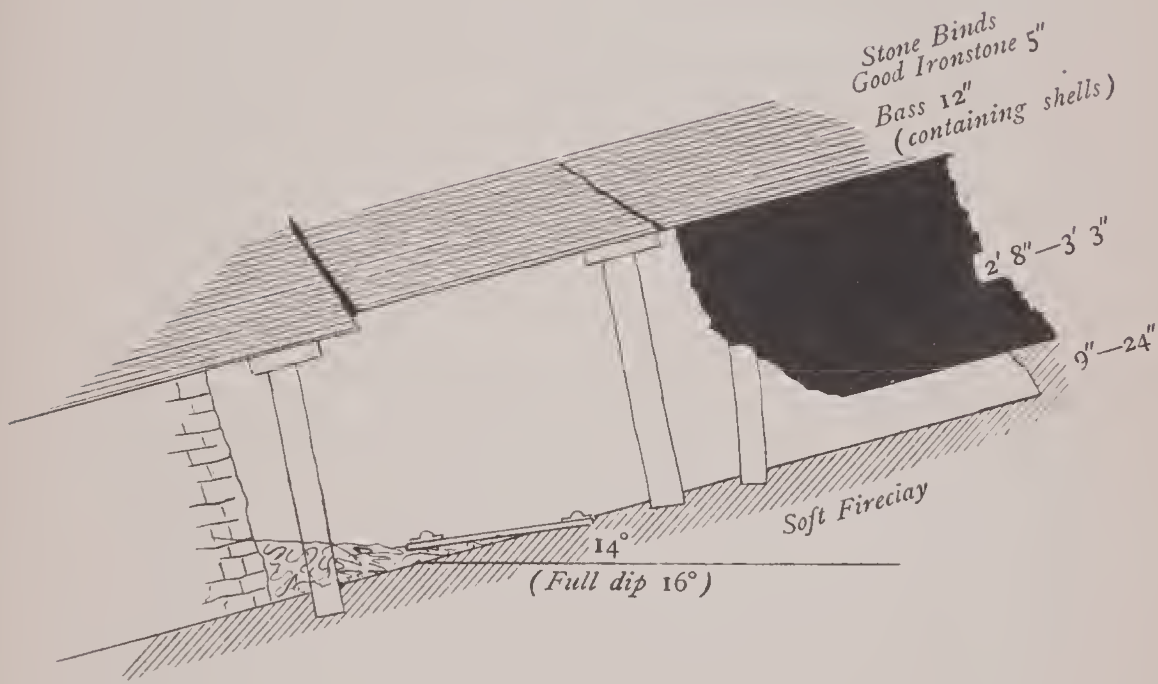


FIG. 235.

Fig. 235. Section N. Worked by pure longwall, with as long faces as possible, either straight or along the arc of a large circle. The jigs are from 80—90 yds. apart. The coal is holed 4′ 6″—6′ 0″ under, and the men are under a fresh roof every three days. It is best worked on end, enabling it to be holed deeper and easier. Regular packs are built at intervals when the gob is not completely filled. Timbering as in Fig. 241. Cleat distinct 43° NW.

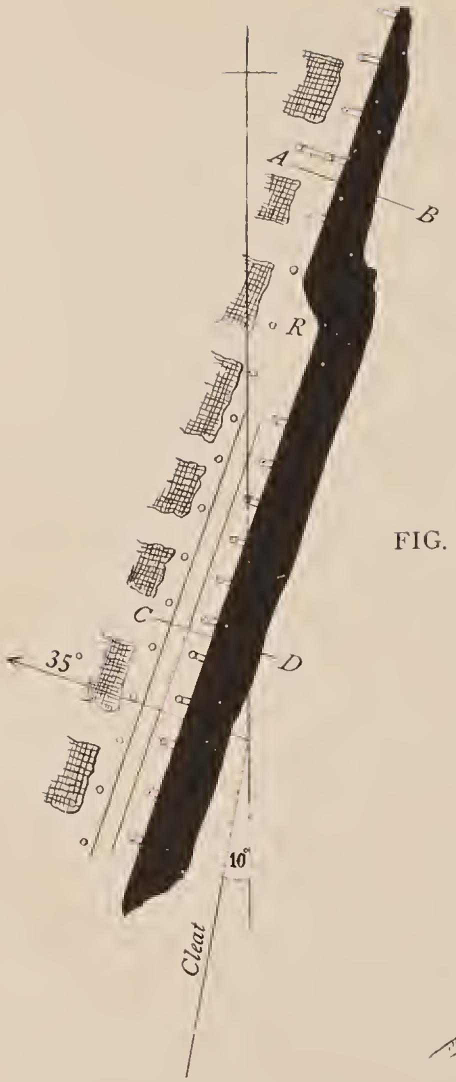


FIG. 236.

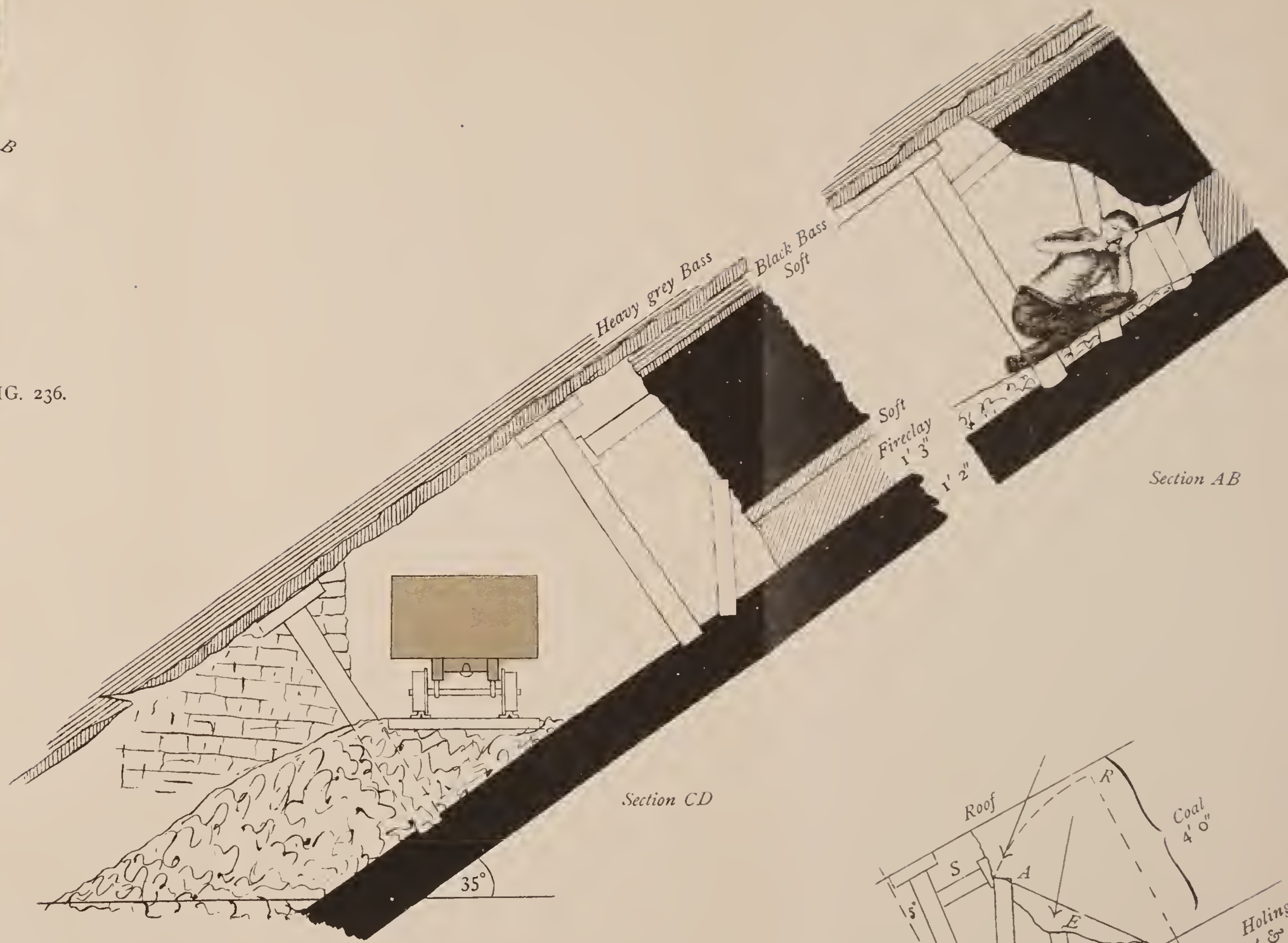


FIG. 237.

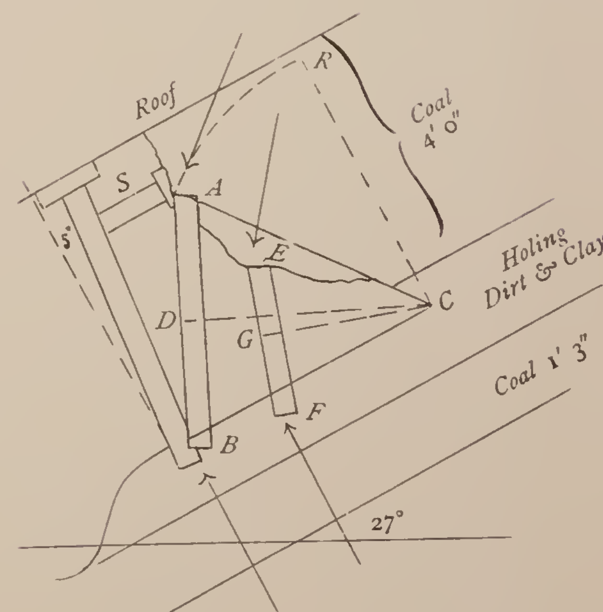


FIG. 238.

Figs. 236—238. Plan and Sections SE. Longwall drifts, 40 yards on each side the jig; 34 out of 40 yards are packed. The roof subsides without breaking; it peels off in long pieces parallel to the cleat. The holers are about seven yards in advance of the buttocker, who falls the coals at *R* (Fig. 232). This is done with a view of having as little roof unsupported as possible. The coal gets very easily, and the loaders are fully occupied. The cleat is very distinct. Several accidents having occurred from sprags giving way and coal falling on to the colliers, the following rule has been established: "In addition to ordinary sprags, stretchers must be set against holed or unsafe coal, at intervals of not less than 6', and oftener if necessary." No accidents have been recorded since.

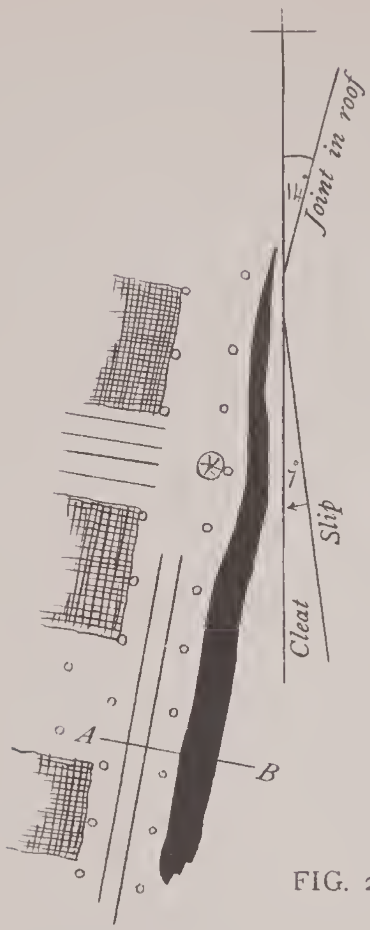


FIG. 239.

Figs. 239 and 240. Plan and Section S. Longwall. Cleat very distinct due N and S ; the cleat planes contain calcic carbonate in abundance. The coal is long-grained. Slips in coal frequent. Joints in roof ½″ and more apart. The roof is very strong ; it does not break in the wastes, the floor heaves up to it. Floor is taken up to form builders. Large weights, which break off at the face, occur frequently.

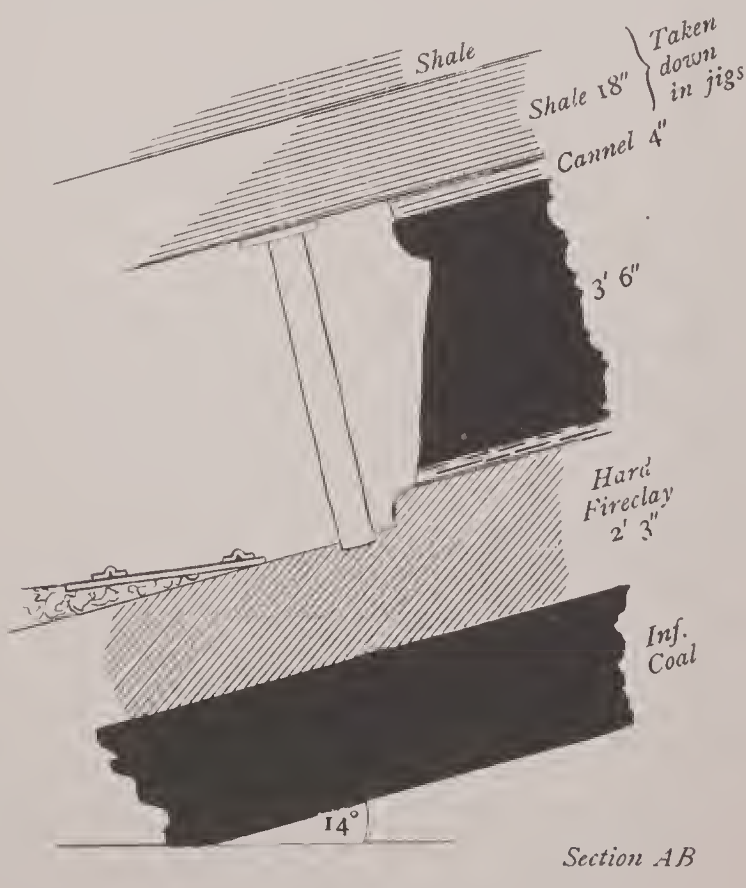


FIG. 240.

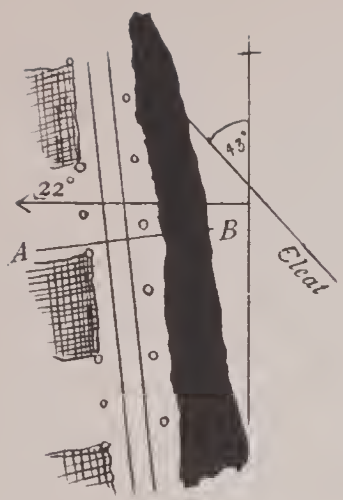


FIG. 241.

Figs. 241 and 242 Plan and Section NE. Worked as in Fig. 235. The sandstone roof breaks mostly in leaning faces, as in Section. Cleat very distinct. The coal is holed 6′ under. A fatal accident occurred in a dip from the driftman getting coal off the side against orders. and without setting posts. A slip was visible, which passed from the coal to the roof, and some of the roof had previously fallen.

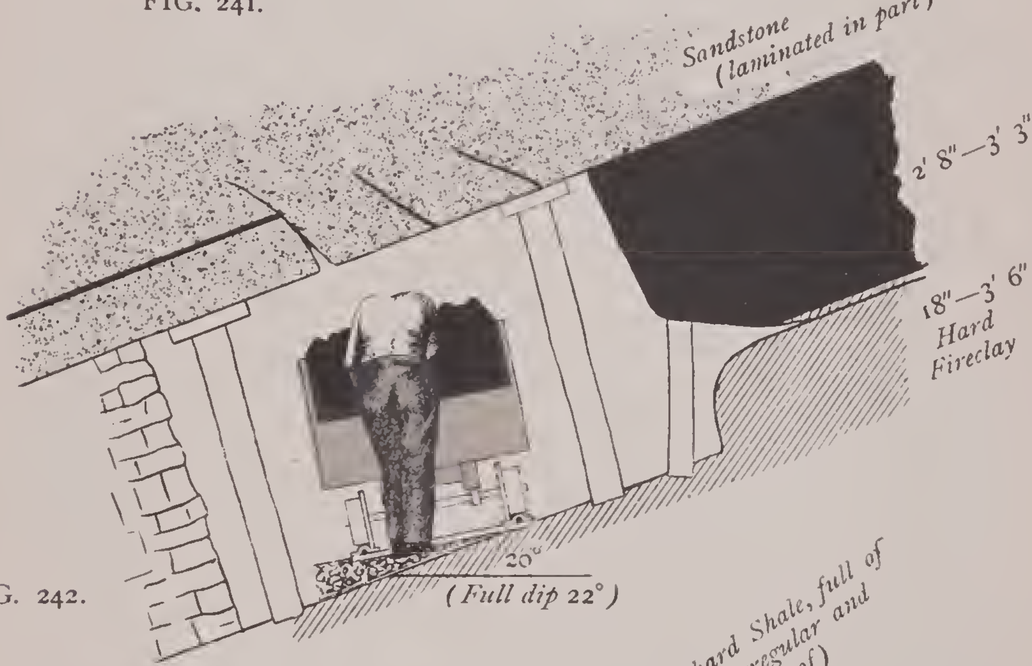


FIG. 242.

Section AB

HARD MINE COAL.

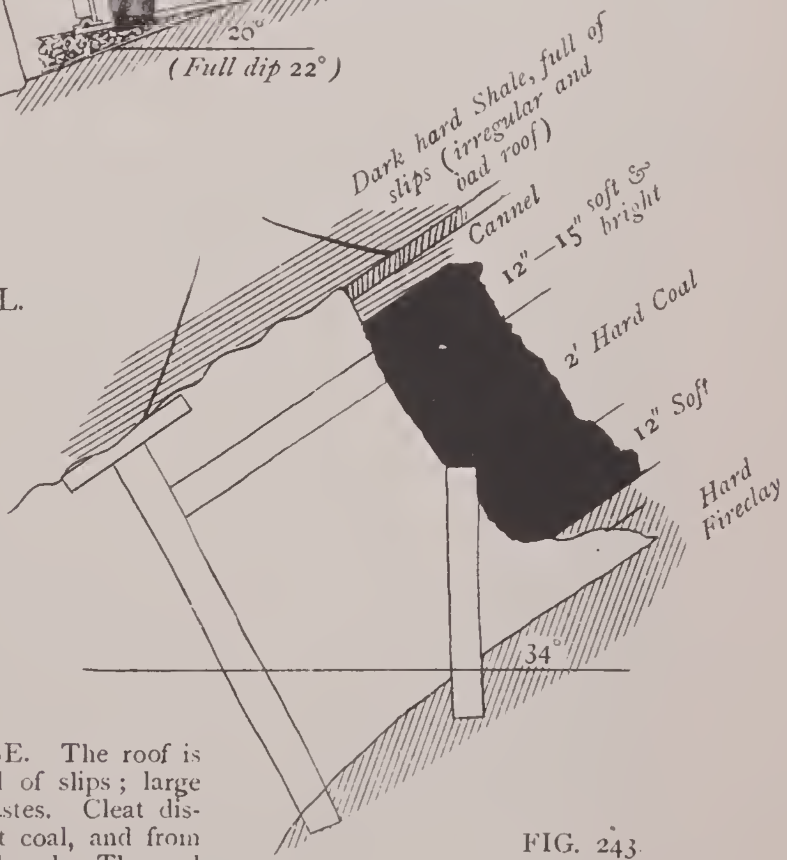


FIG. 243.

Fig. 243. Section SE. The roof is very irregular, and full of slips; large pieces fall out in the wastes. Cleat distinct 10° NW in the soft coal, and from 8°—20° NW in the hard coal. The coal had set very hard, from the Holly Lane, which is 30 yds. above, having been worked first. It is worked like the Holly Lane (Fig. 236), and the same precautions are adopted as to timbering.

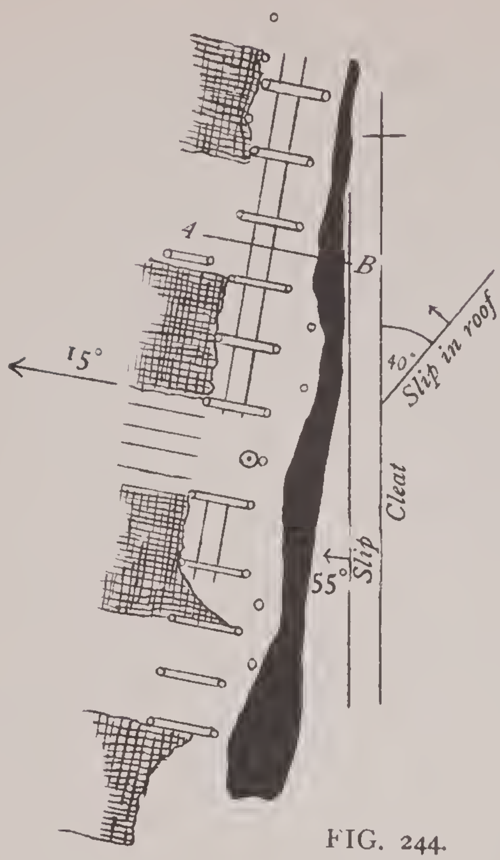


FIG. 244.

Figs. 244 and 245. Plan and Section S. Plan shews temporary posts set near jig wheel whilst making room to move it up. Cleat due N and S, very distinct. Slips, N and S, very frequent ; their surfaces are coated with fine dust. Coal exceptionally long-grained. Joints in Cannel N and S, at short intervals. The roof is jointy, and contains slips with very smooth surfaces. The clayshale forms a very bad roof, and requires to be well supported ; it weights after each dressing.

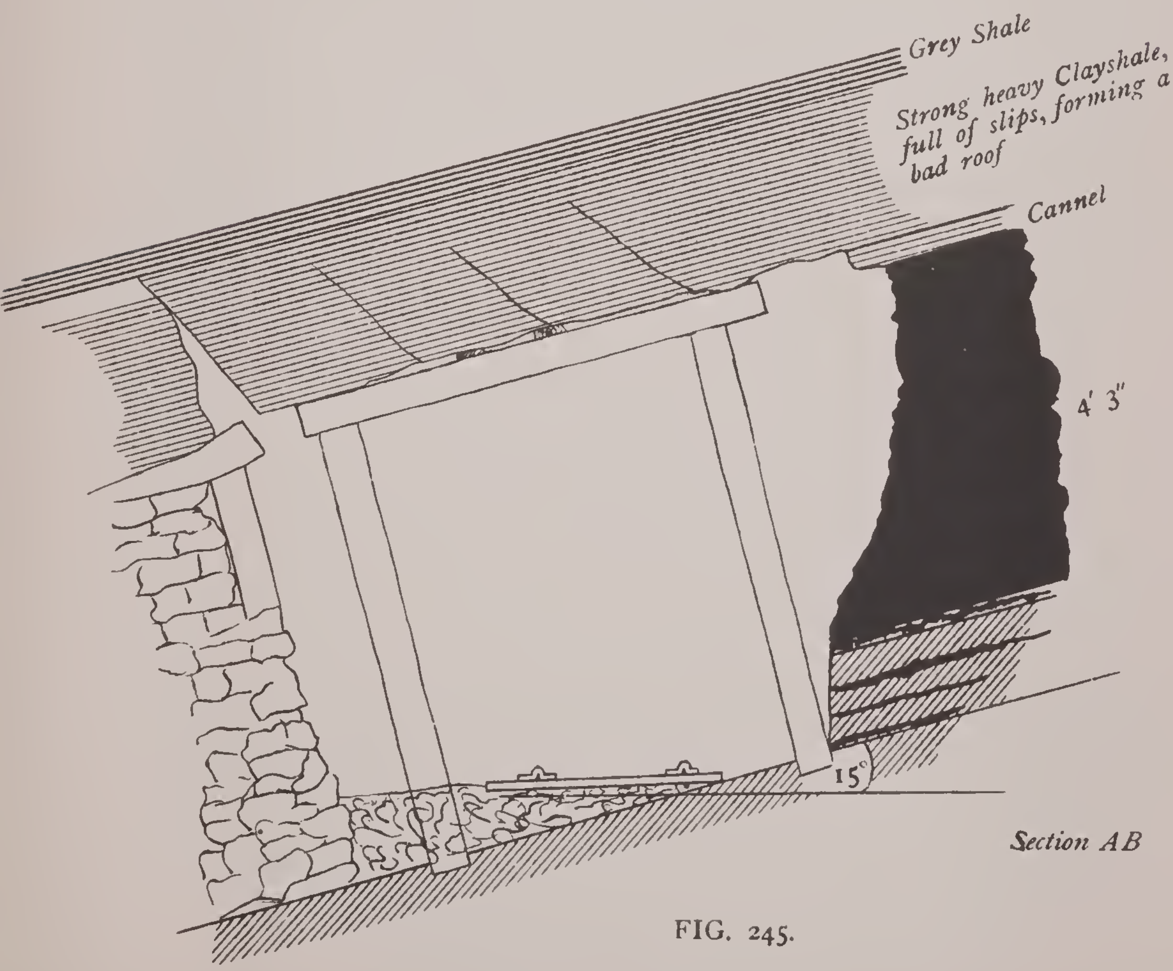


FIG. 245.

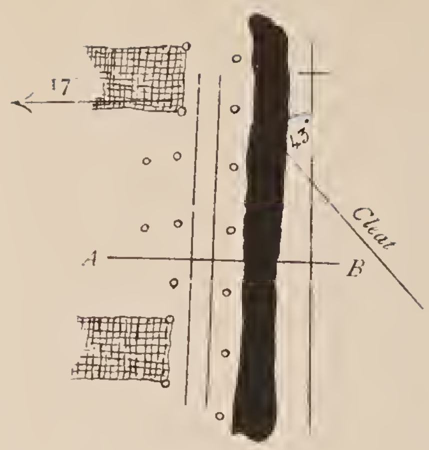


FIG. 246.

Figs. 246 and 247 Plan and Section NE. Worked as in Fig. 235. Cleat very distinct; there are one or two hard coal bands in which the cleat planes are far apart. Owing to the hardness of the floor, the posts are not stamped. The coal is holed 4′ 6″ under; where the holing dirt is thin the coal requires to be slotted, and a certain amount of slack is produced. Jigs are 50–60 yds. apart.

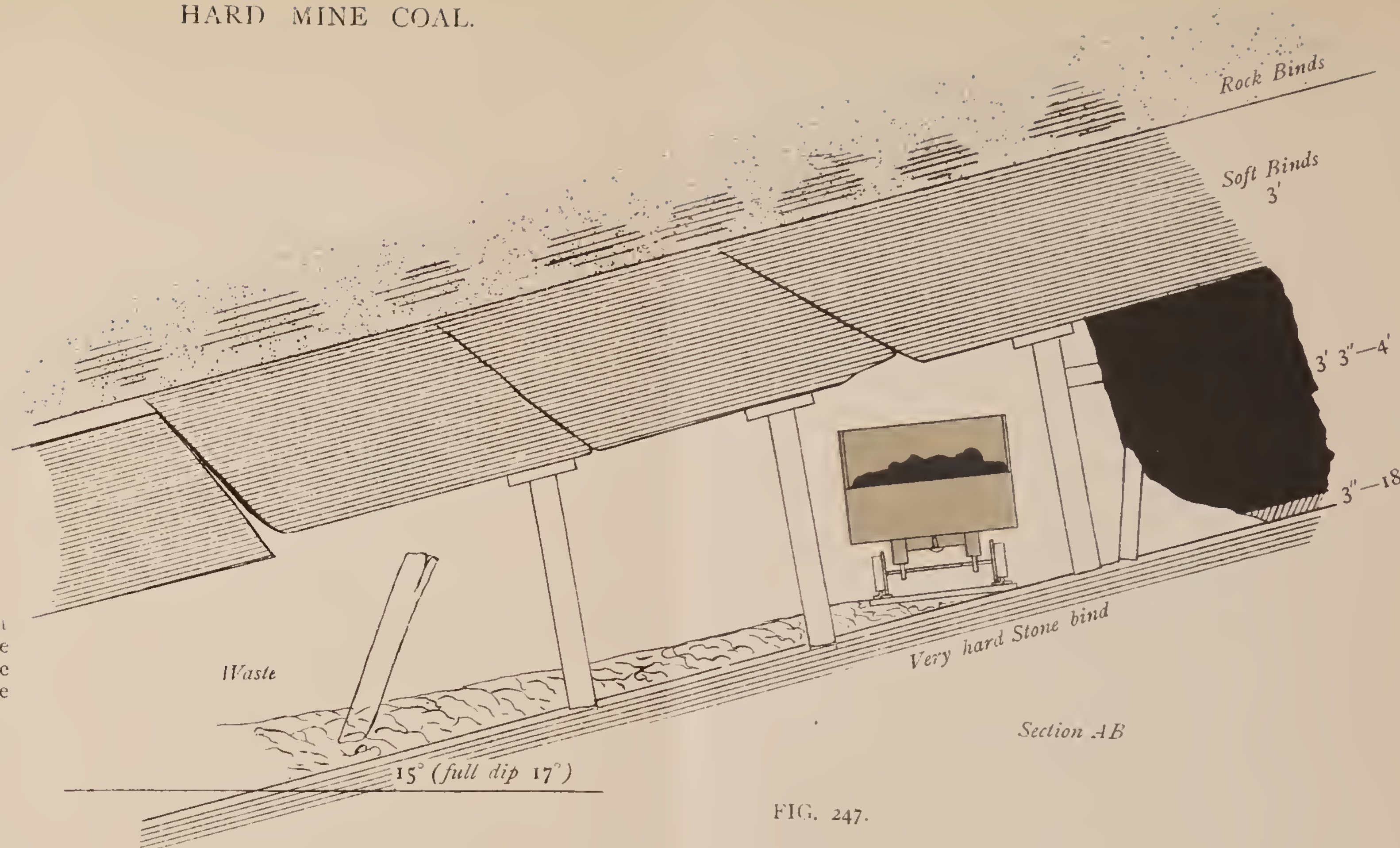


FIG. 247.

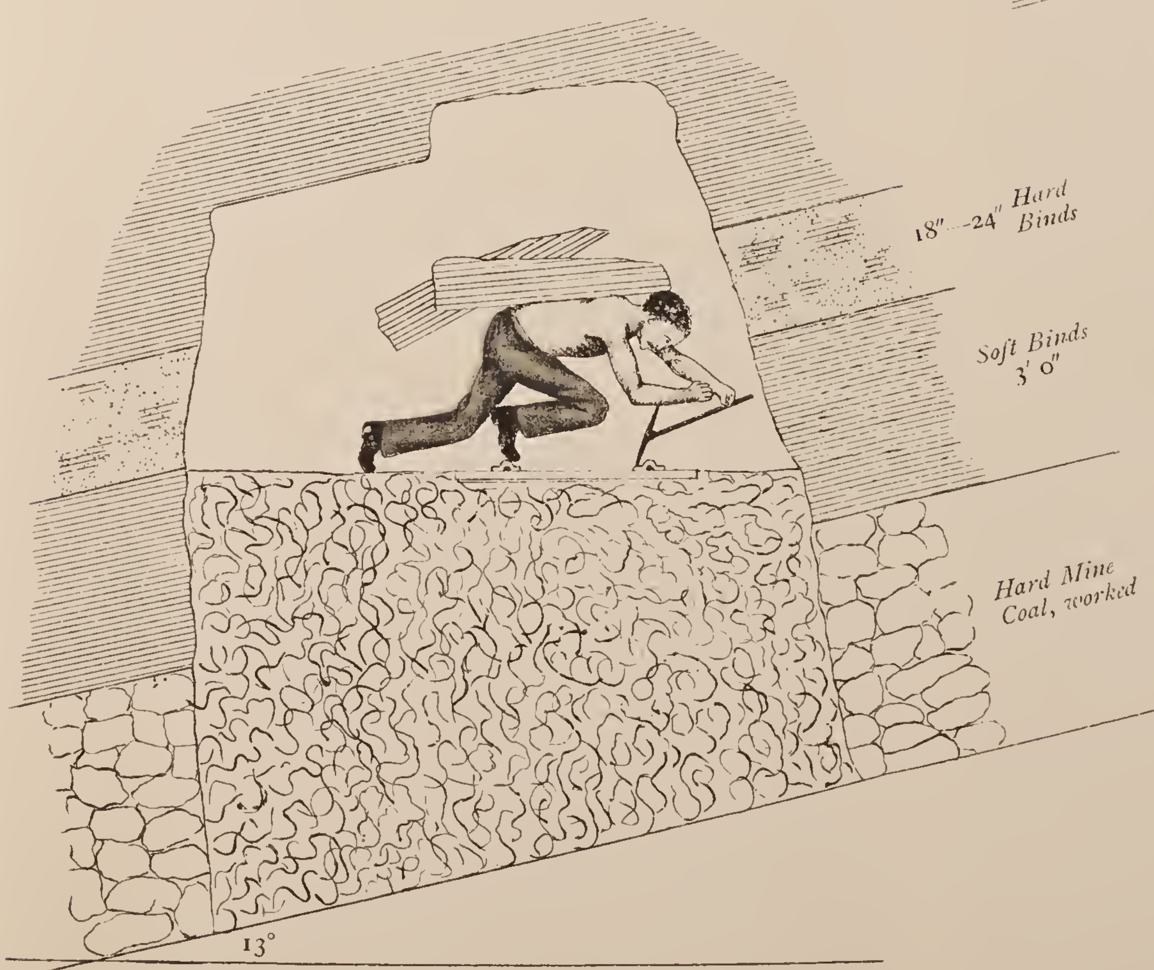


FIG. 247B. *Section AB*

Figs. 247A and 247B. Plan and Section NE, illustrating a fatal accident in a level. Two datallers were told off to set four bars or stretchers under a slightly defective part of the roof in a level. Whilst one of them was holing out the hole to receive the first bar, a large piece of roof, weighing about 2½ tons, fell, killing him instantly. He had knocked at the roof before starting to work, and thought it safe. Had he set a temporary post, as is usually done before beginning to disturb the roof the accident would not have occurred. Temporary posts should always be set whenever timbering is to be done in main roads; this should not be left to the discretion of the timberers. The disturbance and appearance of breaks in the roof was due to the approach of the Holly Lane workings over the Hard Mine level.

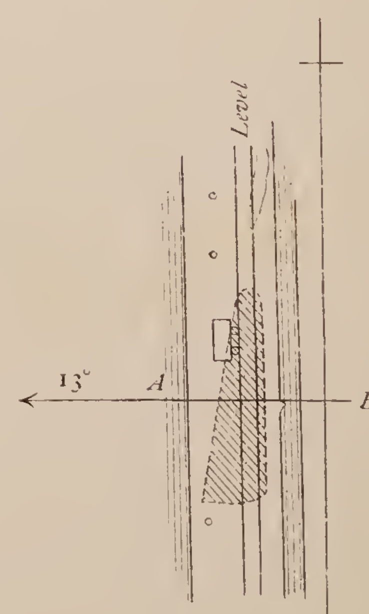


FIG. 247A.

Further South a fatal accident occurred at the face of a new level which was being driven alongside an old one which had fallen in. The roof was consequently worse than usual. It was also wet. The collier took out a post which he thought was too near the rails, *without previously setting another one*, and three tons of roof fell and killed him.

At the extreme N. the coal is about 6′ thick, and the seam is worked by the Lancashire method.

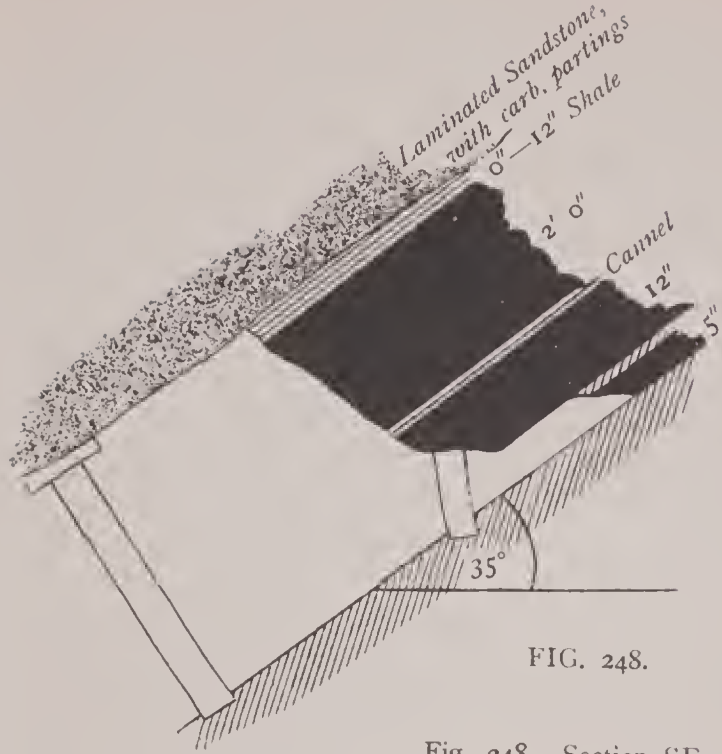


FIG. 248.

Fig. 248. Section SE. Worked by longwall, 40 yds. drifts on each side the jig. The floor lifts and closes the gob. The coal grows to the sandstone when in contact with it.

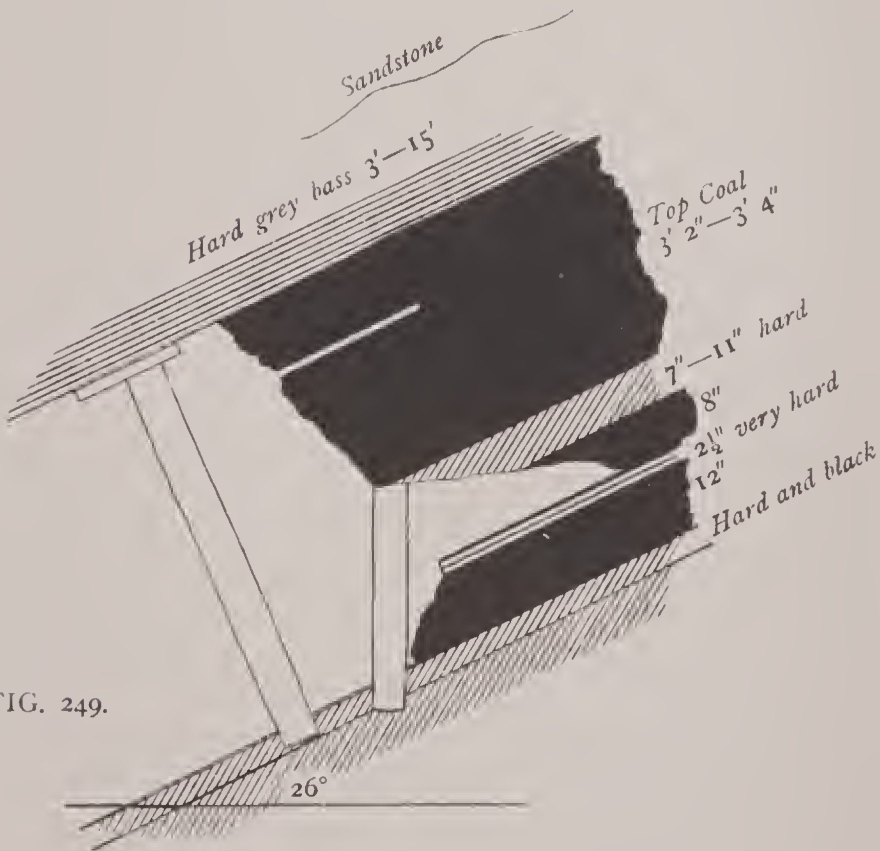


FIG. 249.

Fig. 249. Section extreme N. Cleat 38° NW, very distinct. Worked by bank and pillar, much the same as in Fig. 251. The rails are shifted every 9 yds. The walls are 12 yds. wide. Regular rows of posts are set; each horizontal row from 4′—5′ apart, and the posts in each row about 3′ 6″ apart. Two rows are kept standing below the rails. The roof is very good. About one post out of six is lost.

COCKSHEAD COAL.

Figs. 251 and 252. Plan and Section E. Worked by bank and pillar method. The bank or drift is 80 yds. wide, and is worked in four walls, two on each side. The wall furthest in is completed and the timber drawn before the near one is fairly started. The rails are shifted every 5—6 yds. The roof is very good, it peals off in patches from small slips, and from breaks which shew themselves in the centre of the walls. About 1′ 6″ of Top Coal is left in all levels and dips, and forms a good roof. Part of the coal punches left in the gob are recovered. The posts are set from 4′—5′ apart, and are strong, some measuring 12″ in diameter. When the timber is drawn extra posts are set along the topmost row.

An attempt has been made Northwards, where the dip is less, to work this seam by pure longwall, as described Fig. 235, so far with success.

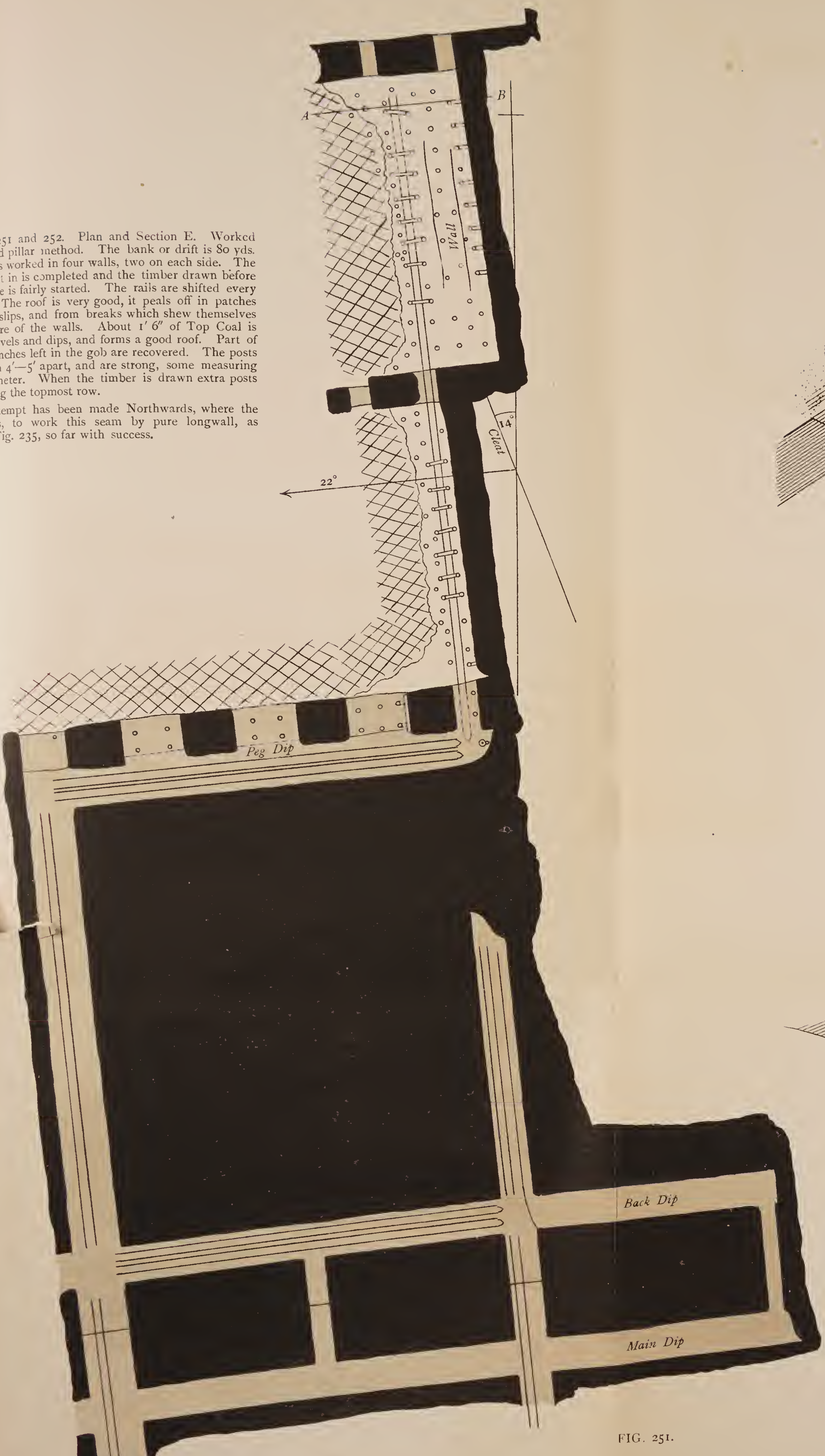


FIG. 251.

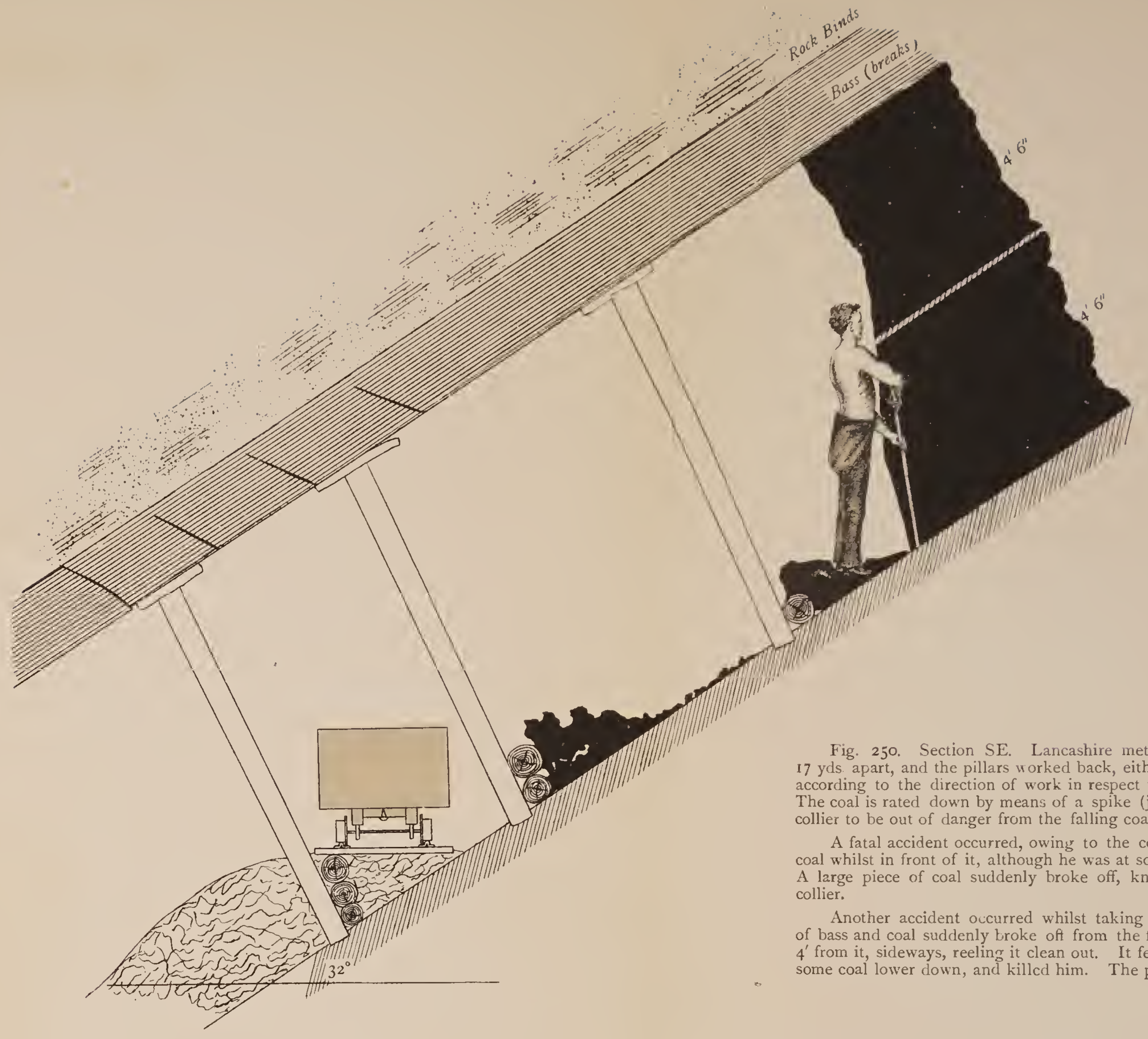


Fig. 250. Section SE. Lancashire method. Headings are driven about 17 yds apart, and the pillars worked back, either with a fast end or continuously, according to the direction of work in respect to the cleat, which is very distinct. The coal is rated down by means of a spike (jobber) 9′ long, which enables the collier to be out of danger from the falling coal.

A fatal accident occurred, owing to the collier improperly pulling at the top coal whilst in front of it, although he was at some distance from it behind a post. A large piece of coal suddenly broke off, knocked the post out and killed the collier.

Another accident occurred whilst taking up a 5 yds. wall. About 7 cwts. of bass and coal suddenly broke off from the face, and struck a post, which was 4′ from it, sideways, reeling it clean out. It fell on to a collier who was ridding some coal lower down, and killed him. The post had only recently been set.

FIG. 250.

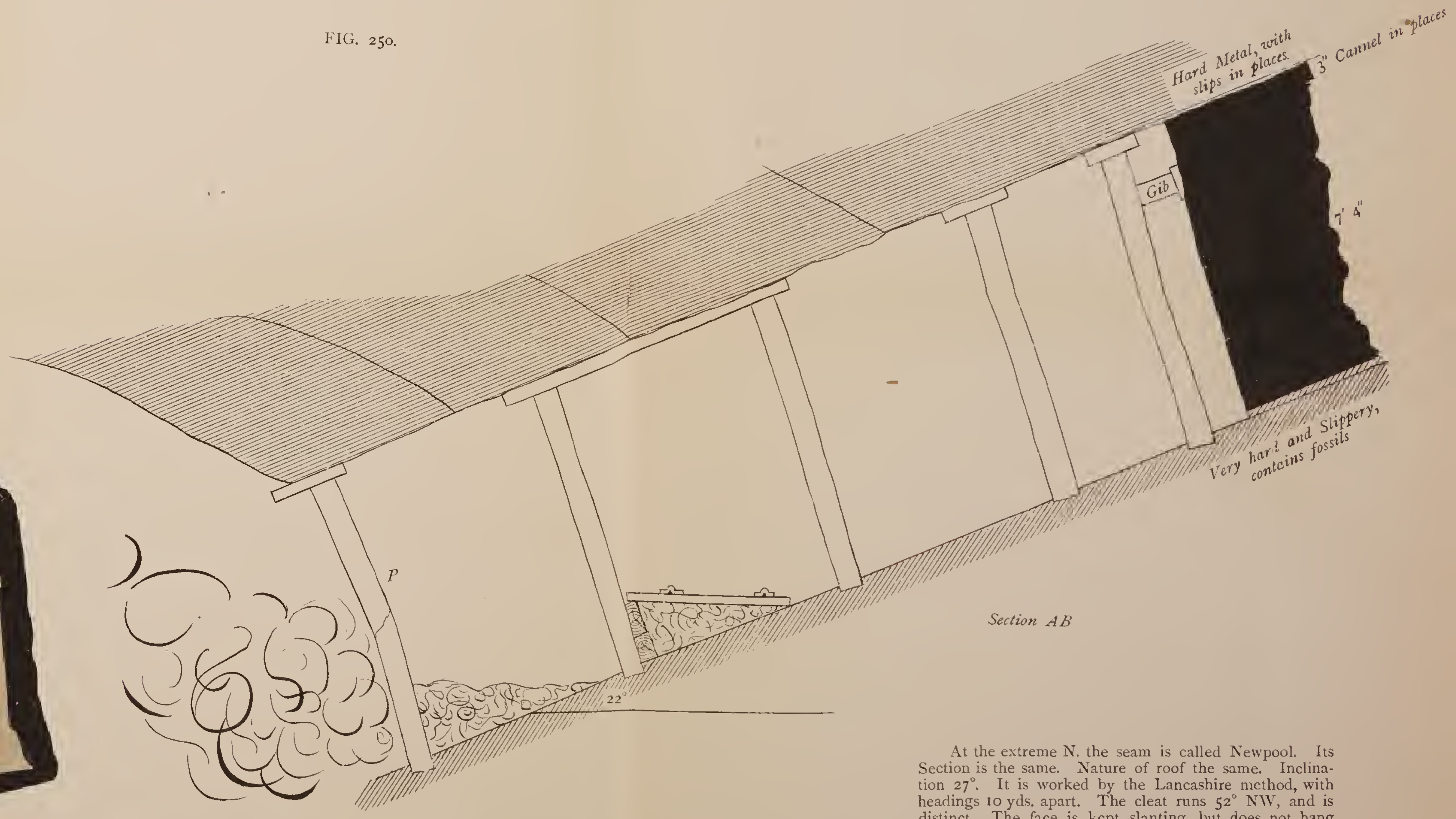


FIG. 252.

At the extreme N. the seam is called Newpool. Its Section is the same. Nature of roof the same. Inclination 27°. It is worked by the Lancashire method, with headings 10 yds. apart. The cleat runs 52° NW, and is distinct. The face is kept slanting, but does not hang over with the cleat. The coal is holed about 4′, forming 4′ shoulders. Horizontal rows of posts are set about 5′ apart; the posts in each row being 3′—3′ 6″ apart. Much less timber is lost by this method than by the method described Fig. 251; about one post in nine.

KIDSGROVE DISTRICT.

FIGS. 253—278.

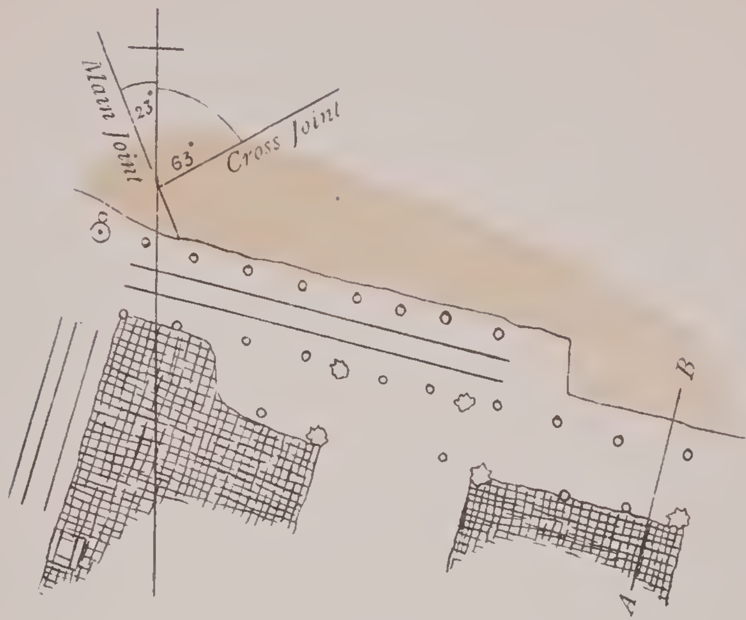


FIG. 253.

Figs. 253 and 254. Plan and Section S. The joints run irregularly, owing to proximity to faults and to change of dip. The roof is jointy, but good, and does not break down in the wastes. Riflemen, *C*, are erected in places. The stone is thicker than on the Norton side. The Bottom Stone varies greatly in thickness, reaching as much as 5′ in places. The seam is worked outwards by extended longwall faces. Whilst working out an old pillar, which was surrounded by gob on three sides, two men were killed by a fall of roof at the face within 6′ from posts. The men had begun to hole after completing their dressing without first setting a post. No accidents have occurred along the longwall face.

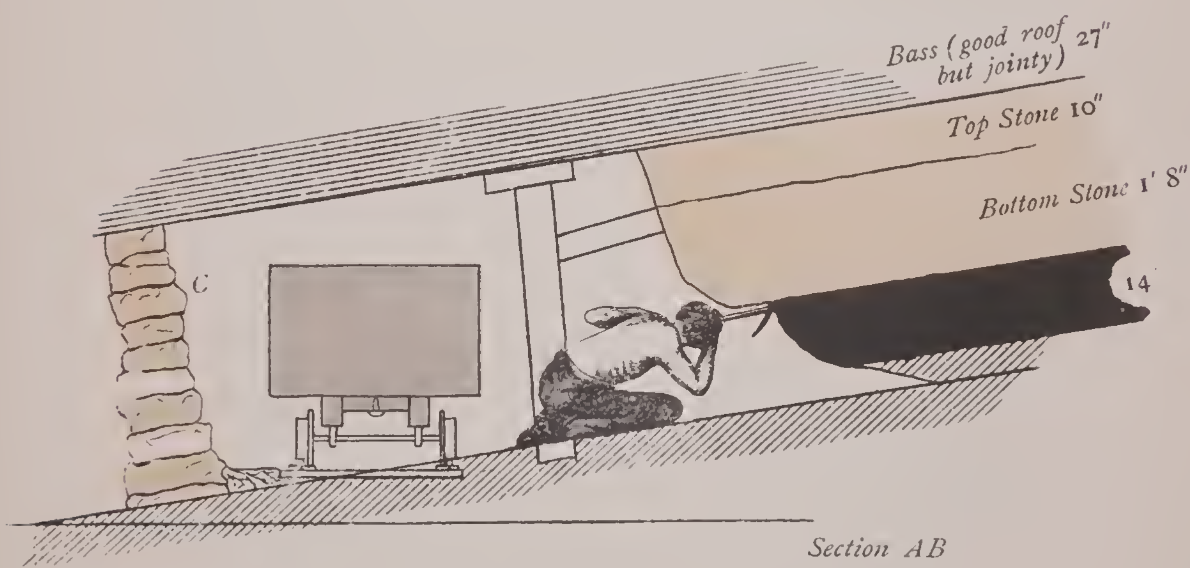


FIG. 254.

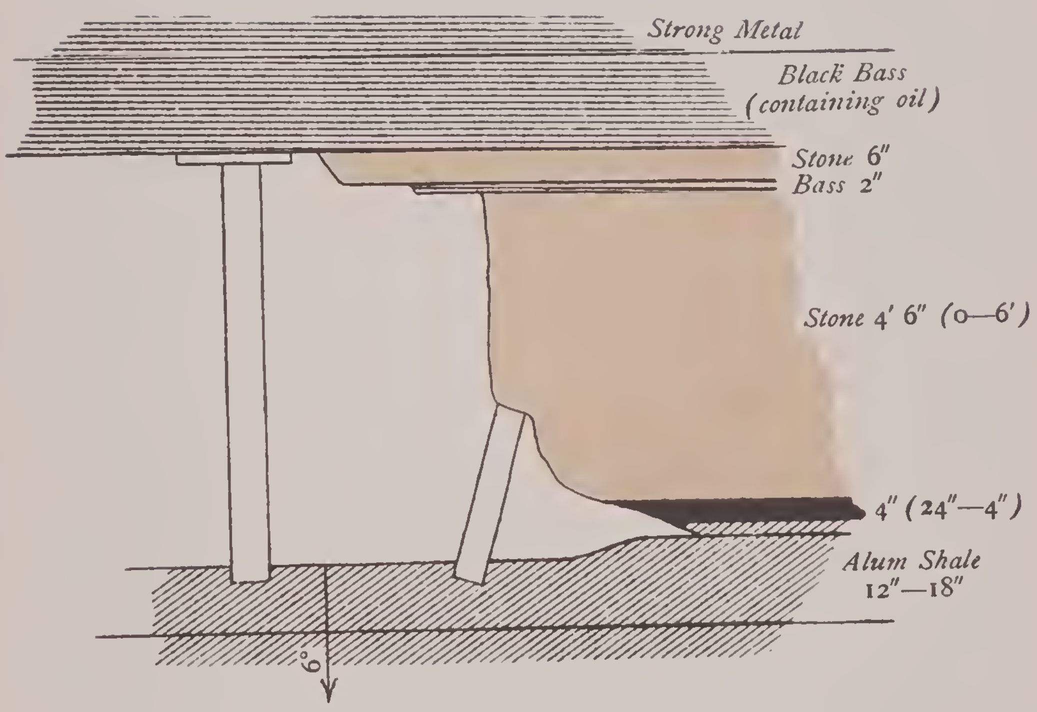


FIG. 255.

Fig. 255. Section further North. Worked by longwall homewards, with roads in solid, in direction of level. Packs from 3—4 yds.; wastes 5—6 yds. Two and sometimes three rows of posts. The Bottom Stone runs quite out Northwards, and the seam cannot be worked to profit. As the stone thins the underlying coal thickens, and *vice versa*.

NOTE.—To the South, however much the Half-Yards, Red Shagg and Red Mine Ironstone seams may vary in thickness individually, they invariably make up an equal total thickness of stone at all points.

FIG. 256.

Figs. 256 and 257. Plan and Section S, illustrating a fatal accident. The clod which forms the roof contains many slips in irregular directions, some of which form bell mouths. The clod in this instance fell over an area of 60 square feet. It lay between two slips which were seen and another at the face, which was invisible. These slips leaned towards each other, forming a bell mouth. There was a chock 9′ from the face; this effectually supported the clod roof, which was found to be detached from the coal above. The clod in the waste behind the chock had fallen easily. The mass being detached from the surrounding clod by the slips, and also from the coal above, rested almost entirely on three posts, which were not under its centre. One side must have given way first, and the lump having once started to move, the posts were immediately uncrowned and knocked out.

This accident shews the importance of chocks being built close to the *face* under such a bad roof.

The clod formed a worse roof here than usual, owing to the drift being nearly completed, and from its proximity to a large fault, near which slips are much more frequent, and also from the nearness of a seam of coal, from which the clod was detached. This seam of coal is, as a rule, 10 yds. above the stone, and is thinner.

Northwards it lies from 5′—6′ above the stone, and is from 2′ to 8″ thick. Rails are used instead of bars where the floor heaves and reduces the height, as they take up less room.

At the Southern extremity the Red Shagg resembles Fig. 174.

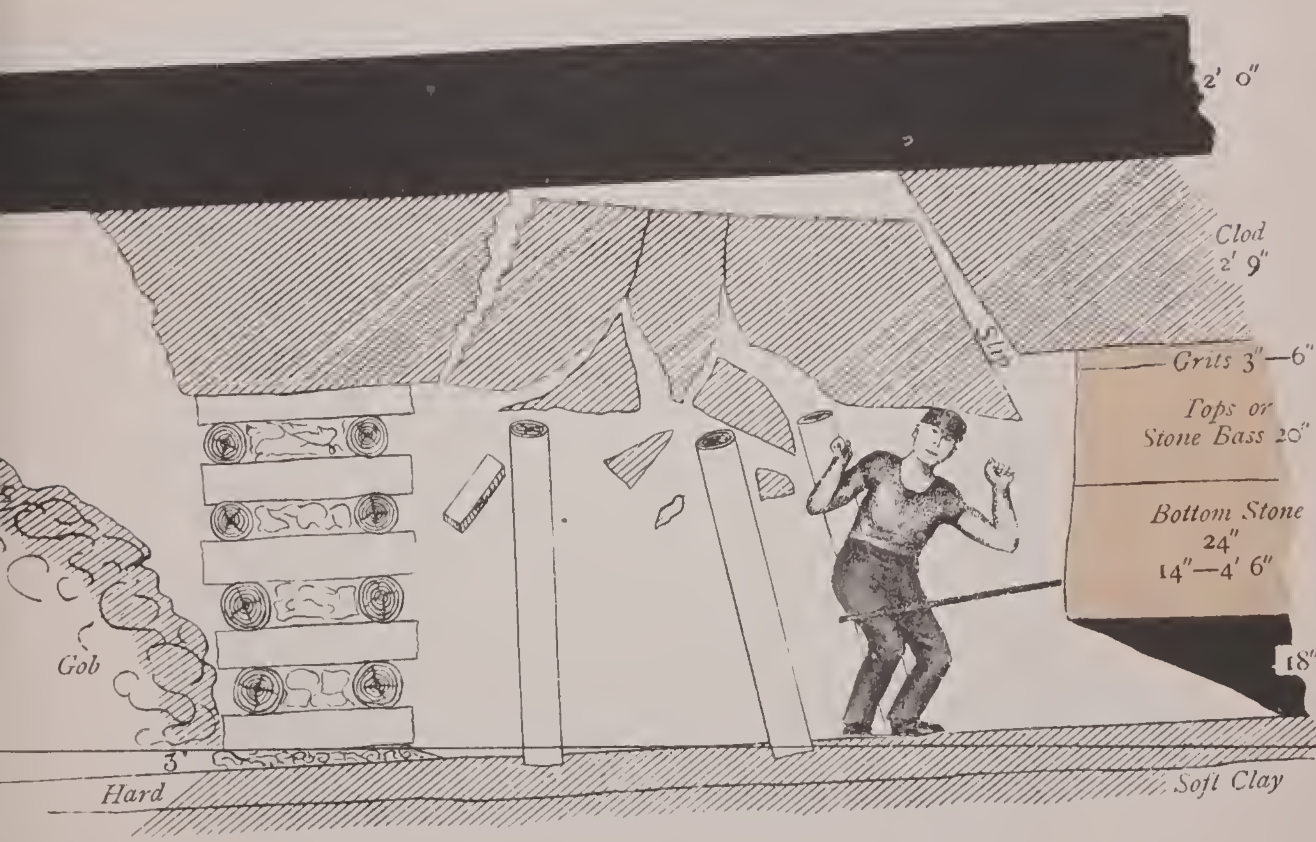


FIG. 257 *Section AB*

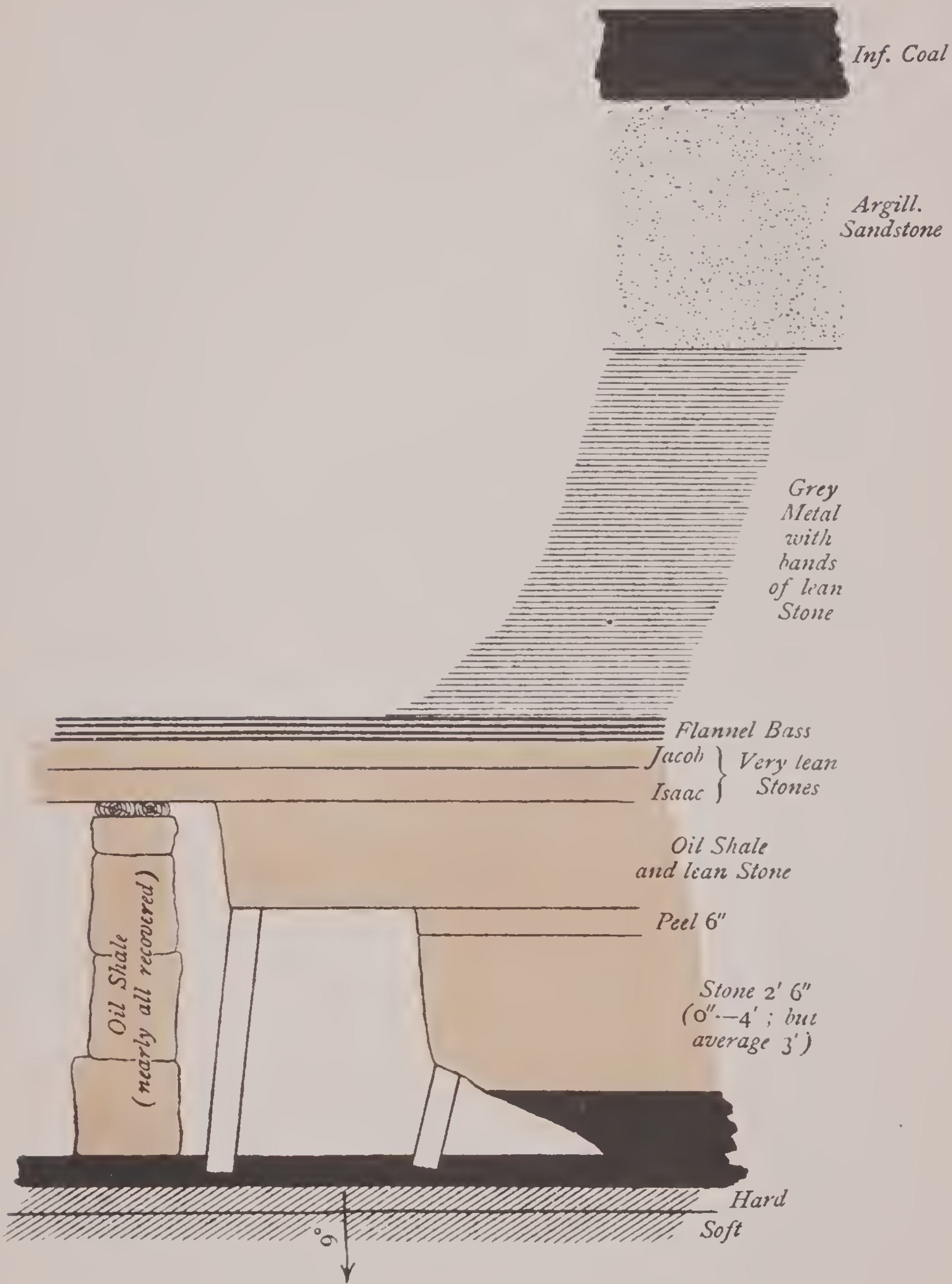


FIG. 258.

Fig. 258. Section S. Sometimes worked by longwall outwards, with gob roads from the main road pillars, and at other times by longwall backwards, the roads having been driven to the boundary in the solid. The latter method is preferred. Packs and wastes are formed ; the roof is supported mostly by "riflemen ;" posts only occasionally set. There are two rows next the face, and the packs are kept close up to them. The face or main joints run regularly 13° NE., from 12″—18″ apart. There are also cross joints. The roof is very strong.

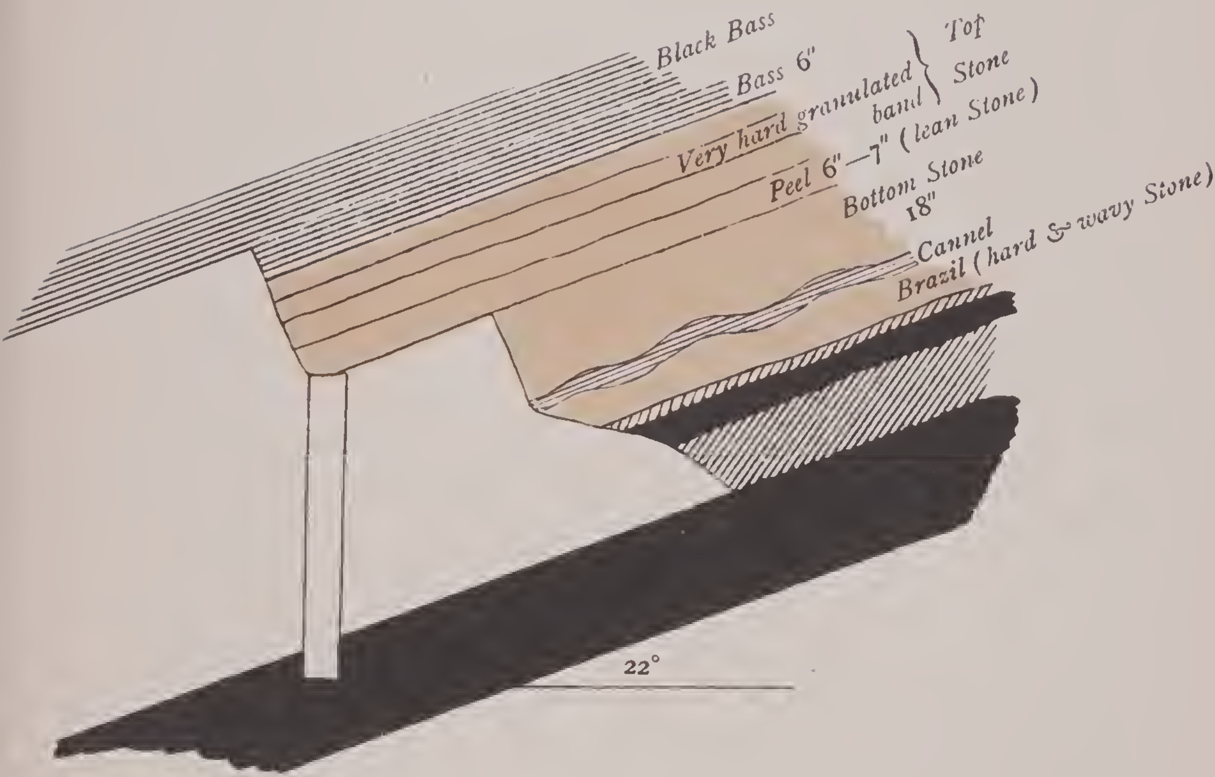


FIG. 259.

Fig. 259. Section W. Longwall, with 20 yds. drifts on each side the jig. The cogs are 8′ wide and 3—4 yds. apart. They are set out by building riflemen (topped with wood), and filling up the intermediate space as the builders (6″ bass) come to hand. The roof is jointy, but very strong. No timber is set in strait roads, but small wooden wedges are driven into the joints of the roof whenever it sounds heavy. Although no danger is anticipated it makes the roof knock hard, and is considered a safeguard. On becoming moist the wedges expand and tighten any loose blocks. Water is used to facilitate the holing. It is efficient if thrown on the last thing at night, and given time to act.

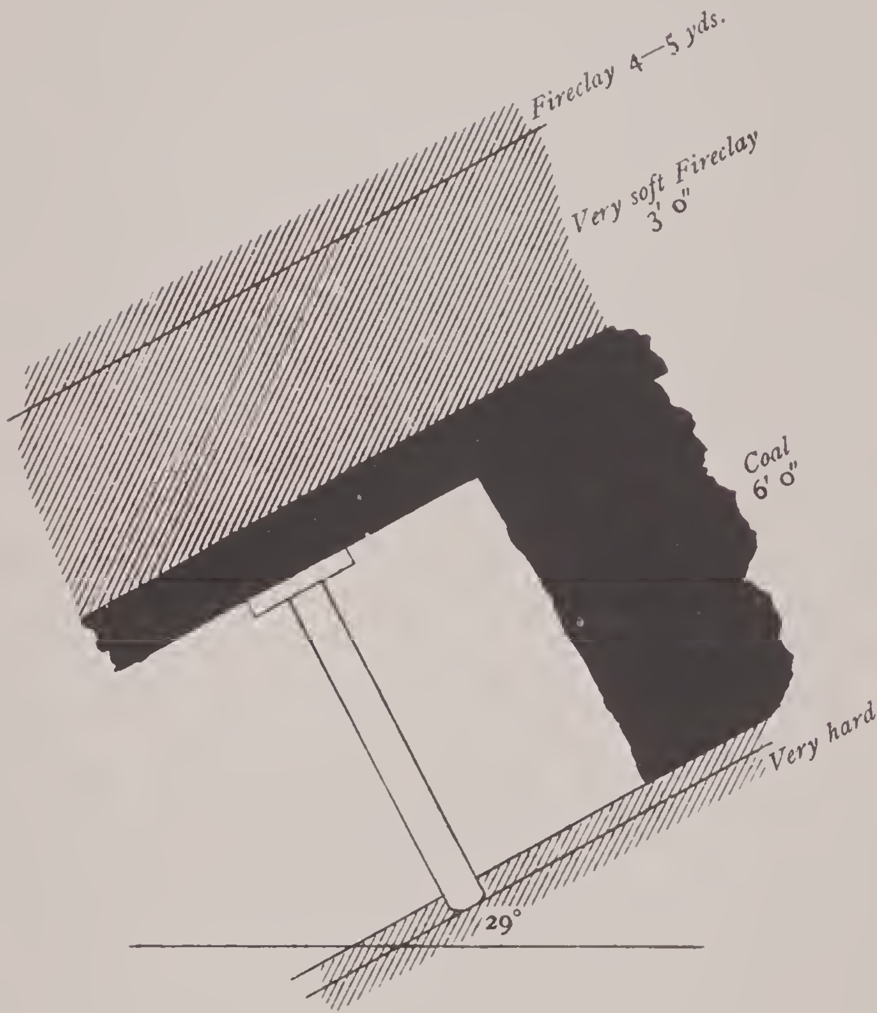


FIG. 260.

Fig. 260. Section E. The coal contains nodules of pyrites; it is best and hardest at the top. About 1′ of coal is left up against the roof, which is so bad that it could otherwise not be kept up. Westwards, a seam of coal 2′ 0″ thick (which lies 5—6 yds. above the Winghay Eastwards) is only 9″ above the Winghay Coal, and it is posted to. Worked by headings 7 yds. apart and drifted back. There is a good long grain 5° NW. The posts are kept in rows 3′ from each other; the rows being about 4′ apart. Half are lost. Slips are frequent in places 10° NE.

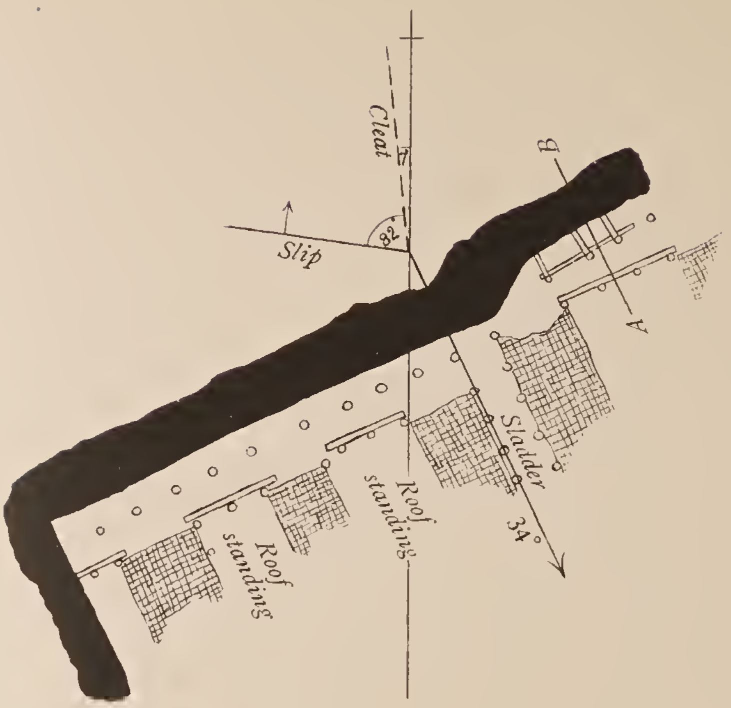


FIG. 261.

Figs. 261 and 262. Plan and Section E. The coal is short and close-grained. Cleat indistinct. Slips in coal pretty frequent. The roof is good and strong, but contains smooth slips, from which scales drop off in places. Worked by longwall drifts, as shewn. Scaffolds are put up across the wastes, to prevent the coal from falling into them and to collect the holing dirt for the packs. Holing is done in the fir clay, of which 6″—15″ are taken up.

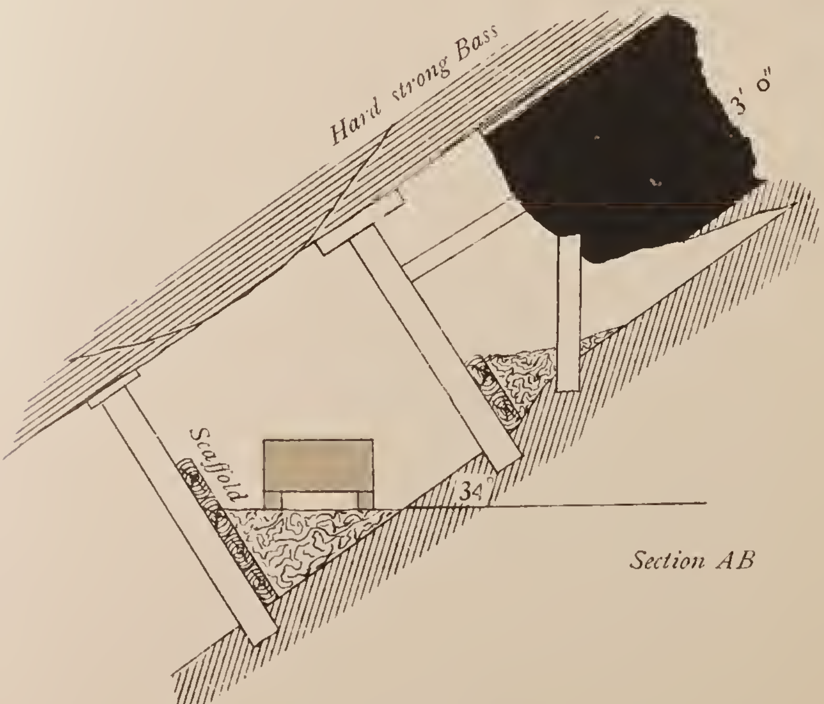


FIG. 262

NEW MINE IRONSTONE.

ROUGH SEVEN FEET COAL.

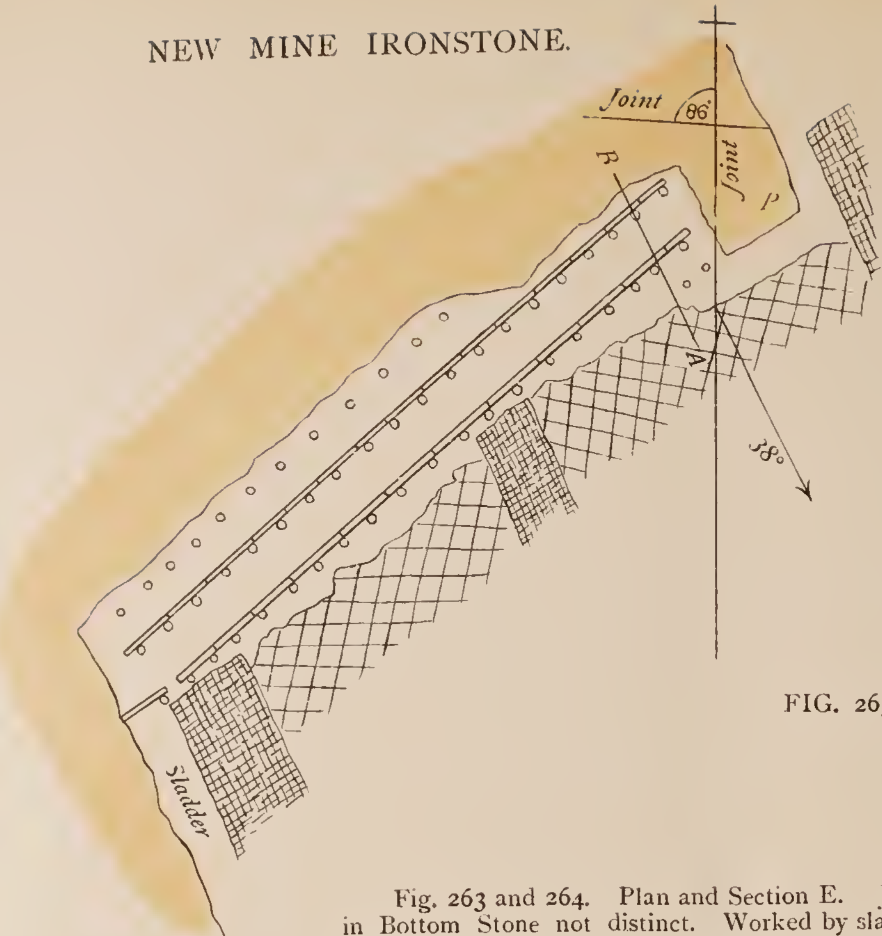


FIG. 263.

Fig. 263 and 264. Plan and Section E. Joints in Bottom Stone not distinct. Worked by slanting longwall drifts; a pillar (*P*) being left occasionally to regain the roof.

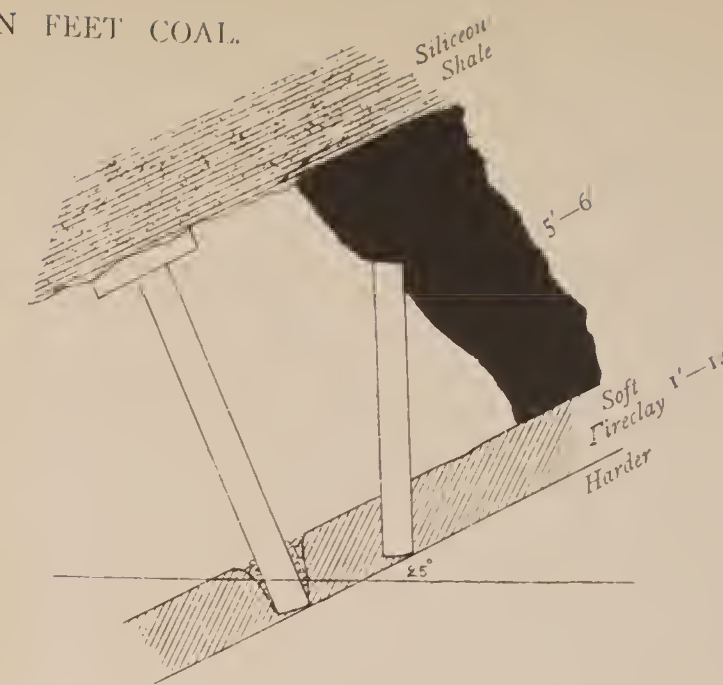


FIG. 265.

Fig. 265. Section in Centre. Flakes drop off the roof, and it contains a few slips. Lancashire method, with headings 9 yds. apart. Cleat indistinct.

Eastwards the roof becomes less siliceous.

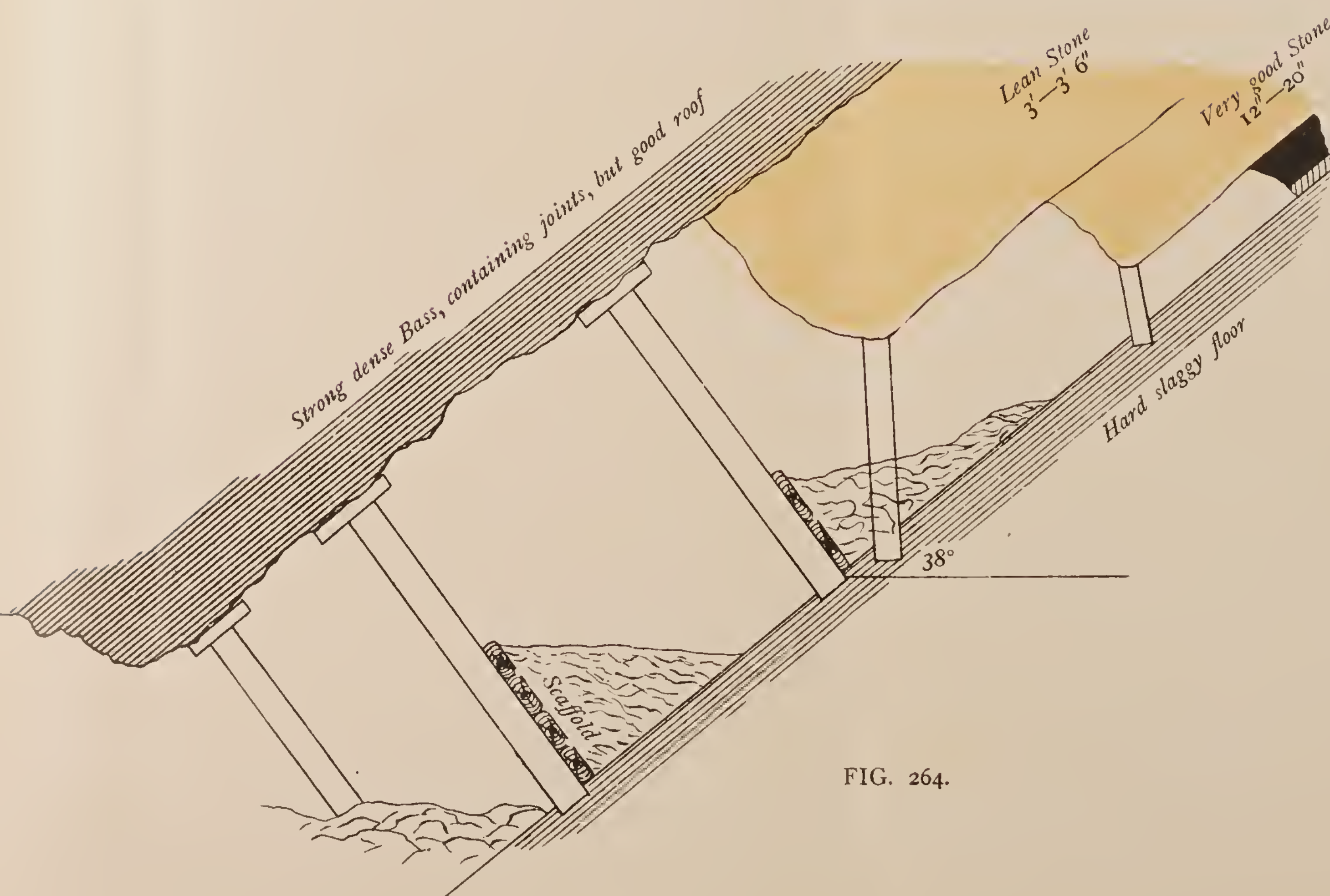


FIG. 264.

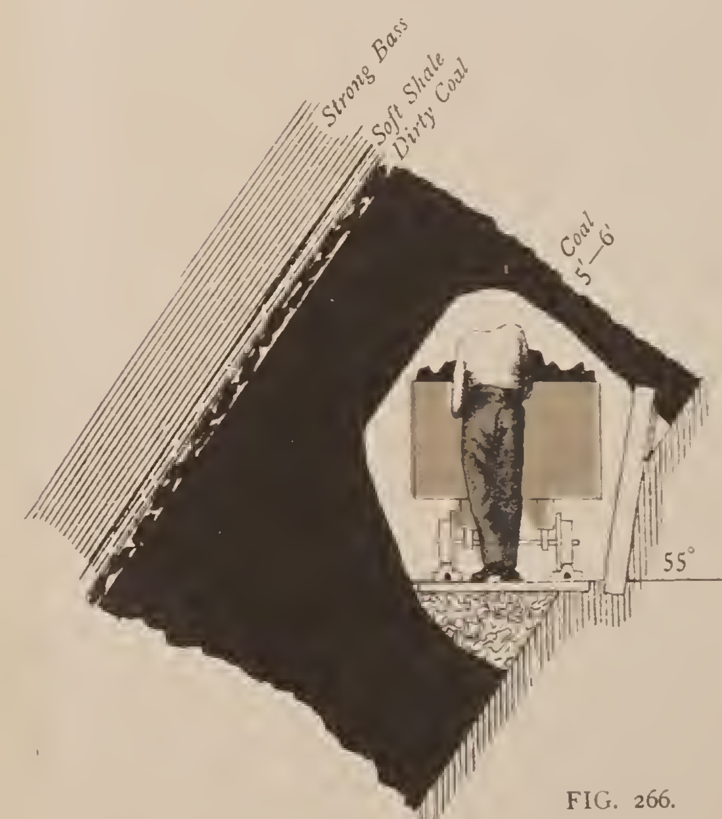


FIG. 266.

Fig. 266. Section S. The bass roof has a very light specific gravity, and peels off in large flakes, but it is good. Lancashire method, with headings 8 yds. apart.

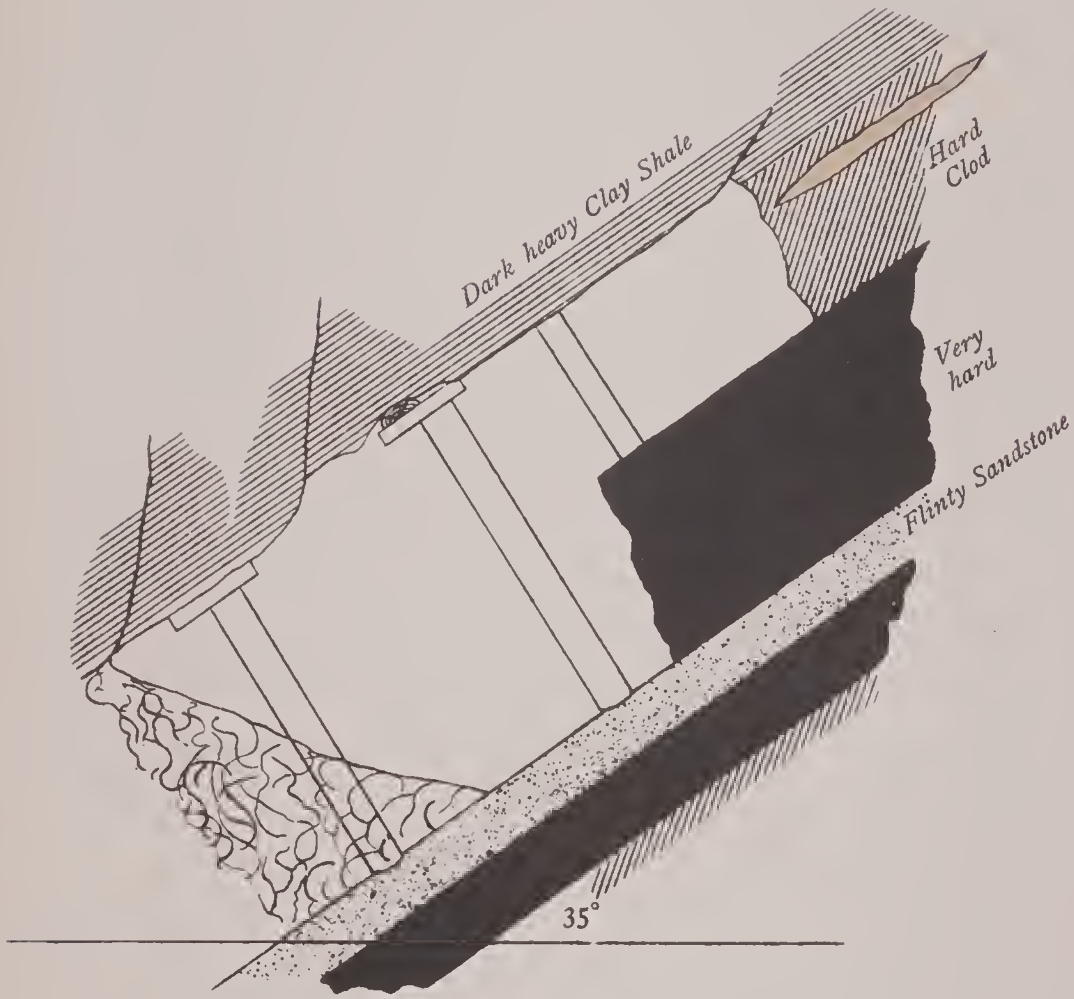


FIG. 267.

Fig. 267. Section in Centre. The Bottom Coal is left. Eastwards the Bottom Coal becomes thicker (2′), and the flinty sandstone dwindles down to 5″; the holing is then done in the Bottom Coal, or in the fireclay when soft enough. The coal is sladdered down. The longwall drifts are 15 yds. on each side the sladder, and the coal is danned to it. The posts are not stamped, owing to the hardness of the floor; they are slightly sharpened, and a small incision made with a blunt pick for their reception. The gob is nearly filled up. There are numerous slips in the roof, which run in the direction of level, about 6′ apart, and tail into the plane of stratification. The coal is very hard, and the cleat indistinct. A fatal accident occurred to a collier in a drift from a piece of roof 12′ long × 2′ in width × 1′ 3″ thick falling off one of these slips. It was visible, but was not provided against.

STONEY EIGHT FEET COAL.

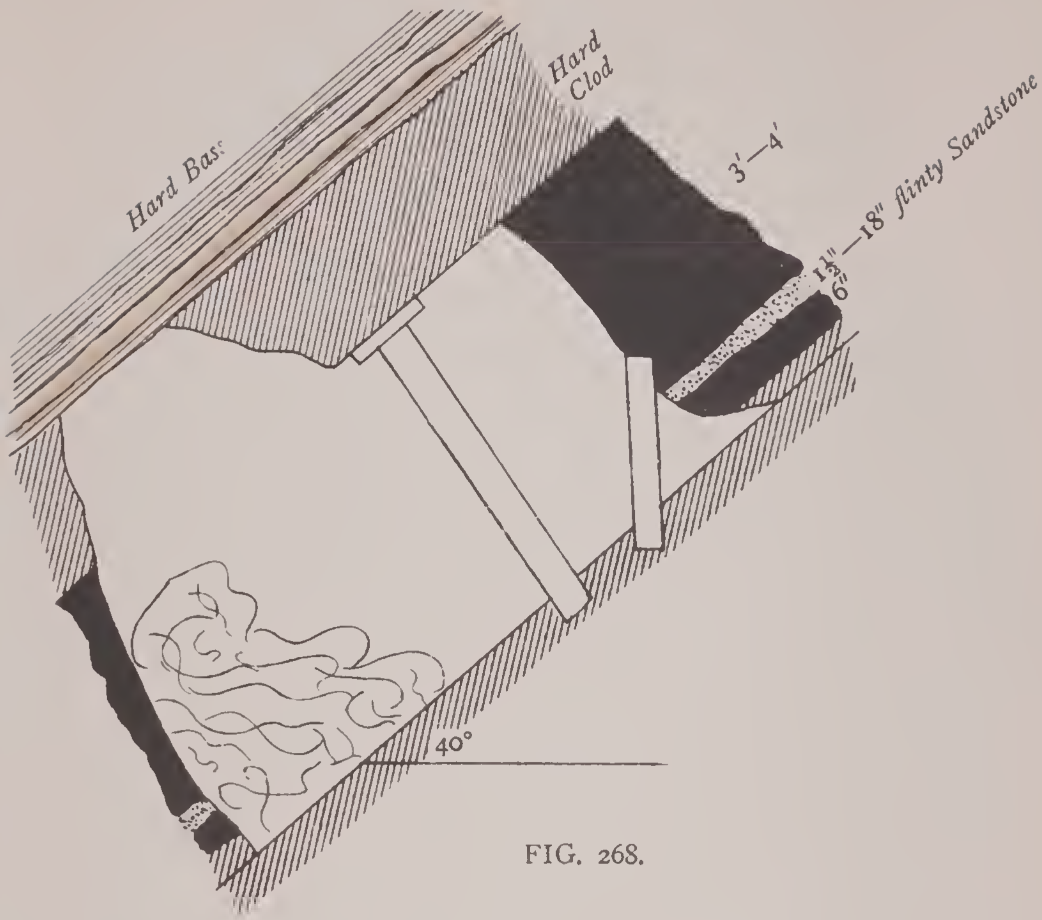


FIG. 268.

Fig. 268. Section S. Starting a shoulder. Worked by headings 7—8 yds. apart, and drifting back diagonally ; shoulders 5' wide being taken off. The clod comes down in the drifts, and holing is done underneath the Bottom Coal. A fatal accident occurred from the collier passing in front of the coal face, from which he had withdrawn the sprags A large piece of coal became detached and fell on to him. Not more than two or three posts are set in each of the drifts.

TEN FEET COAL.

Fig. 269. Section NE. The roof is good, except in places. Worked by Lancashire method. The pillars are worked off in 5 yds. lengths. Pinnings are built to the Top Coal, about half-way up the drift. The Top Coal is then recovered by loosening the pinning, and a new length started from below. The coal is blown down throughout ; 4—5 shots being necessary to start the length. No posts are set in the drifts, only stretchers against the pinnings when the Top Coal is loose in going up. Cleat 25° NE ; not distinct. Towards the Centre the coal is 6' thick ; inclination 35° ; headings are driven 8 yds. apart, and the coal is rated off. Cleat 15° NW ; distinct.

Southwards, the coal is 8' thick ; the roof consists of hard and strong bass, but contains treacherous slips near faults. Fatal accidents have occurred from pieces of roof falling out unexpectedly.

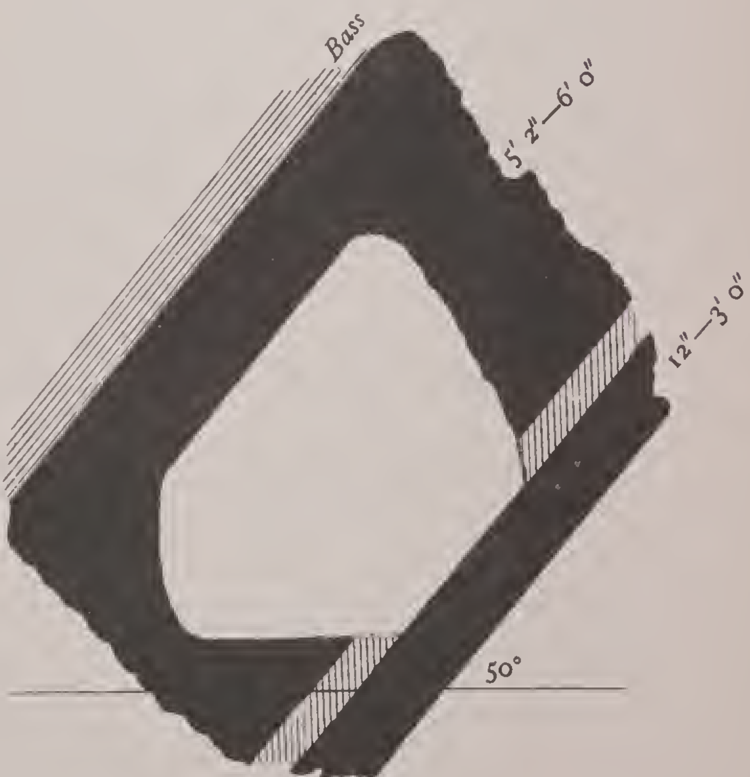


FIG. 269.

TOP TWO ROW COAL.

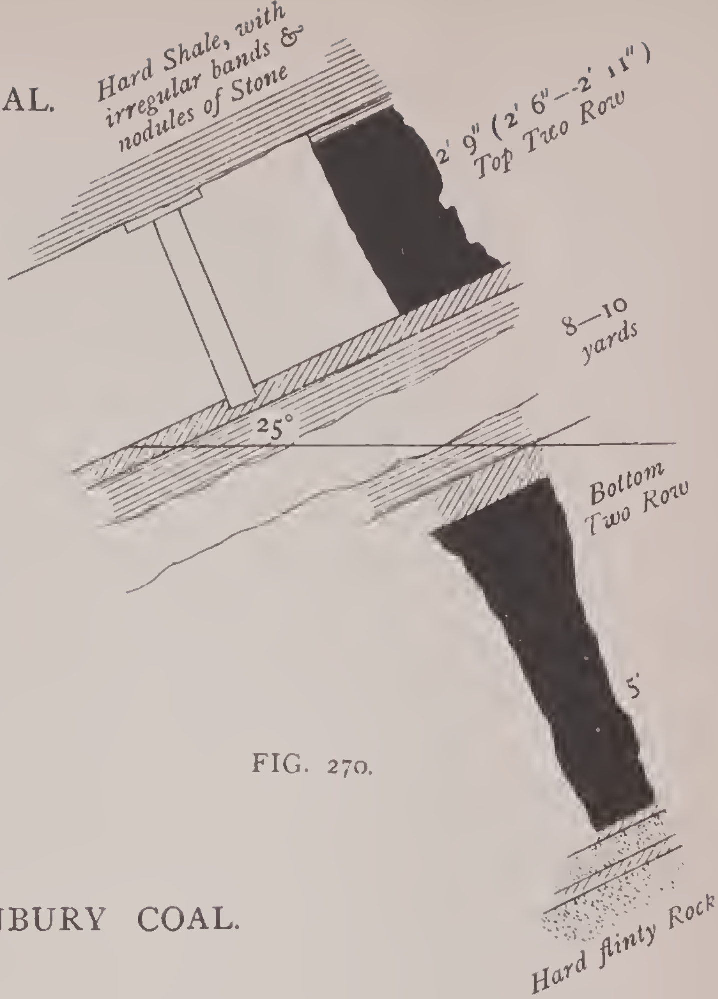


Fig. 270. Section C. Lancashire method; heads 8 yds. apart. The roof is very good, but uneven, and the coal sticks to it. Where the floor is hard holing is done in the top of the coal. Posts are set about 3′ apart, and four rows are maintained. The seam is very dusty, and Cleat 20° NW, not very distinct. This seam thickens to 6′ Eastwards, and is there called Big Row; the Bottom Two Row being named Little Row. In place of section the roof was slightly worse, from the Bottom Two Row having been previously worked.

FIG. 270.

SEVEN FEET BANBURY COAL.

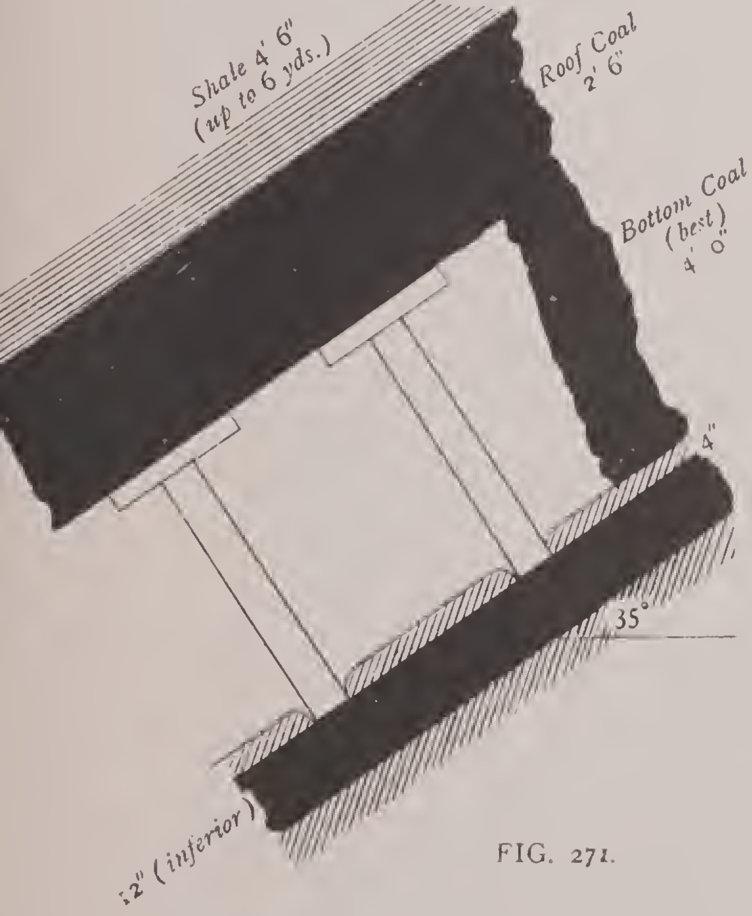


FIG. 271.

Fig. 271. Section of drift C. The shale which lies between the Banbury Rock and the coal forms a bad roof, and necessitates much timbering in the roads. Lancashire method; headings 8—9 yds. apart. 2′ 6″ of coal forms the roof in the drifts; there are five rows of posts, about 27″ from each other; the posts in each row being 1—$1\frac{1}{4}$ yds. apart. The roof coal drops, or is got down on drawing the back rows of posts, and little of it is lost. Long posts are sometimes set to the shale roof whilst the coal lumps are being loaded. Cleat: 10° NW, distinct.

NE. the coal is 3 2″ thick, and 3″—6″ of Rockbinds intervene between the sandstone and the coal. Cleat 80° NW, pretty distinct.

W. the sandstone lies on the coal, and is strong, except where thin veins of coal breed into it. The coal is from 7′ 6″—10′ thick; 12″ at the top and at the bottom are inferior. Worked by wide boards and pillars. Chocks are built freely.

On one occasion, when a long face was being worked without any coal supports being left, or much timber set, a fall of roof occurred over nearly six acres. This fall resembled an explosion in its physical effects; doors were blown open and wagons smashed to pieces; clouds of dust ascended the shafts. As it was Sunday there was no one underground at the time. The surface, 200 yds. above, at once subsided 6′.

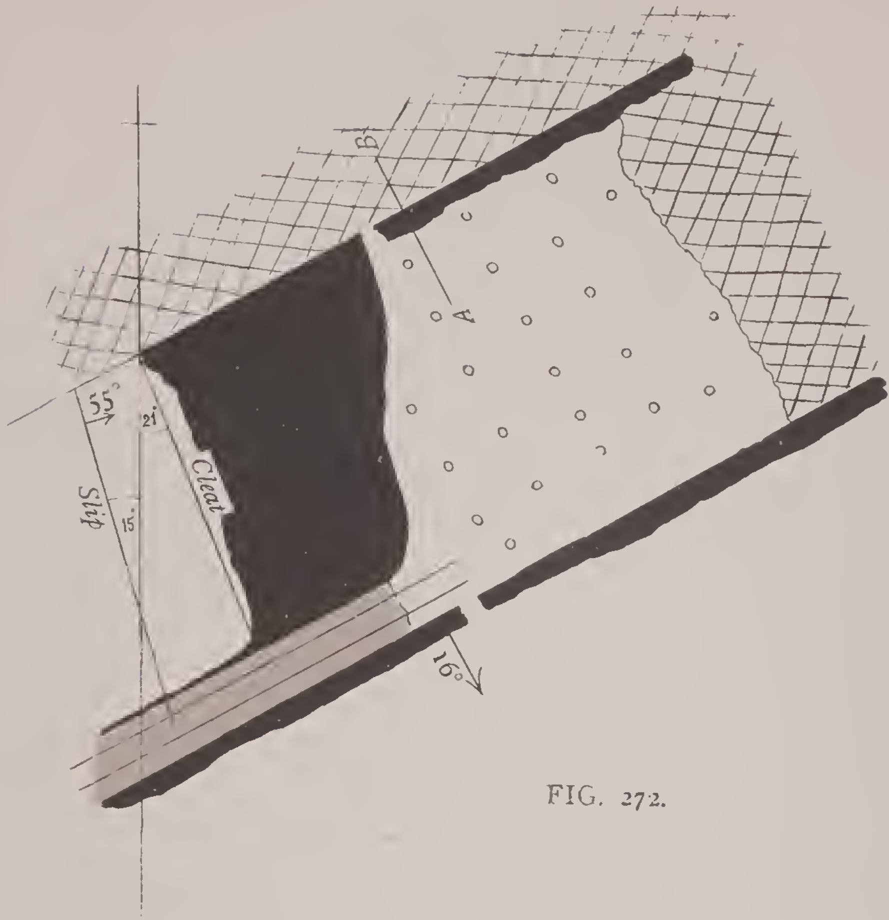


FIG. 272.

Figs. 272 and 273. Plan and Section of a face way drift W. Lancashire method. Top Coal left in headings. Cleat distinct in patches. Slips frequent.

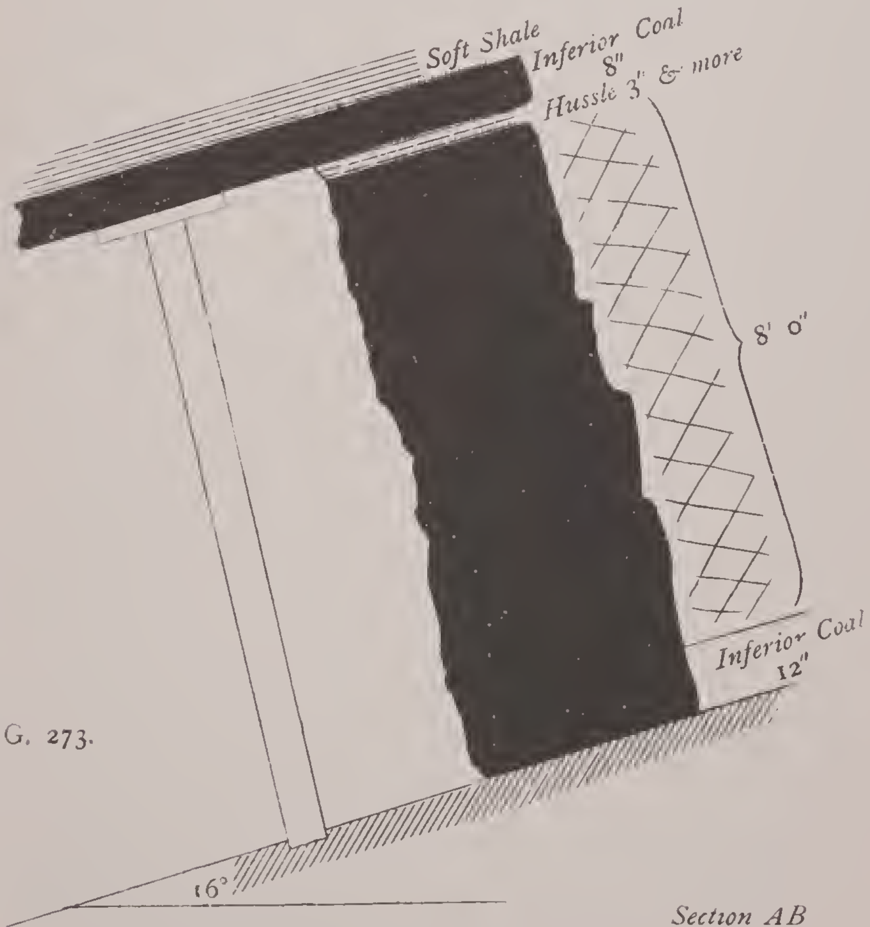


FIG. 273.

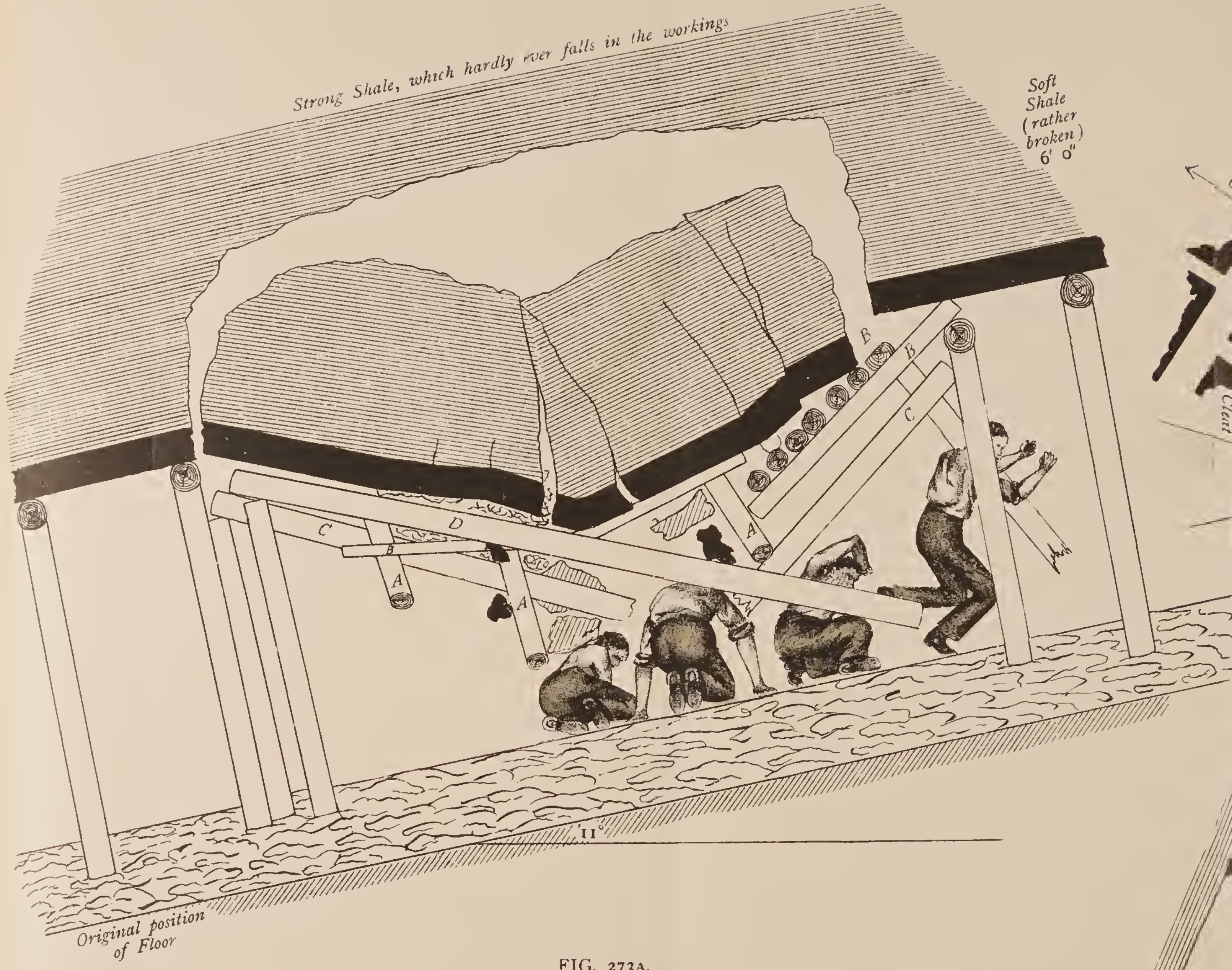


FIG. 273A.

Fig. 273A. Section of junction between an engine dip and a main level W, illustrating a fatal accident which occurred whilst some defective timber was being repaired. Three crossbars *A*, covered with pollings *B*, on which the roof rested, were supported on one side of the dip by two bars. One of these was safely replaced the previous week by a new bar *C*. The other had just been removed, and another new one *D*, was being put in, when bar *C* suddenly broke, and about 20—30 tons of roof fell, killing a man and injuring two others more or less severely. The heading was unusually wide at this point, owing to its being a pass bye, and long bars (about 15'—16') had to be set. This accident shews the importance of not removing defective bars until they have been lined by new ones, and of setting temporary posts under the bars or the roof during the operation.

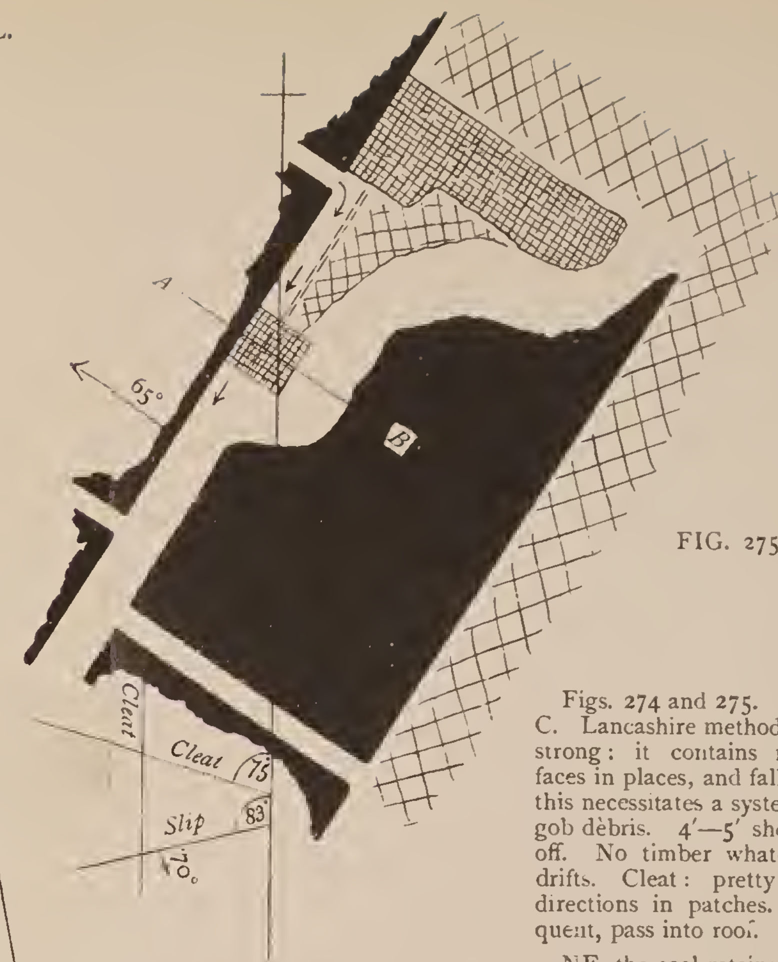


FIG. 275.

Figs. 274 and 275. Plan and Section C. Lancashire method. The roof is not strong: it contains numerous smooth faces in places, and falls in small lumps; this necessitates a system of packing with gob dèbris. 4'—5' shoulders are sliced off. No timber whatever is set in the drifts. Cleat: pretty distinct in two directions in patches. Slips: very frequent, pass into roof.

NE. the coal retains its thickness; the dip is 55°; pinnings are built more slantwise and only far enough to shoot the gob. No timber is set in the drifts, and the safest place is not under the roof, but under the coal face. Cleat indistinct, but slips frequent 15° NW.

N. the cleat is very distinct 60° NW.

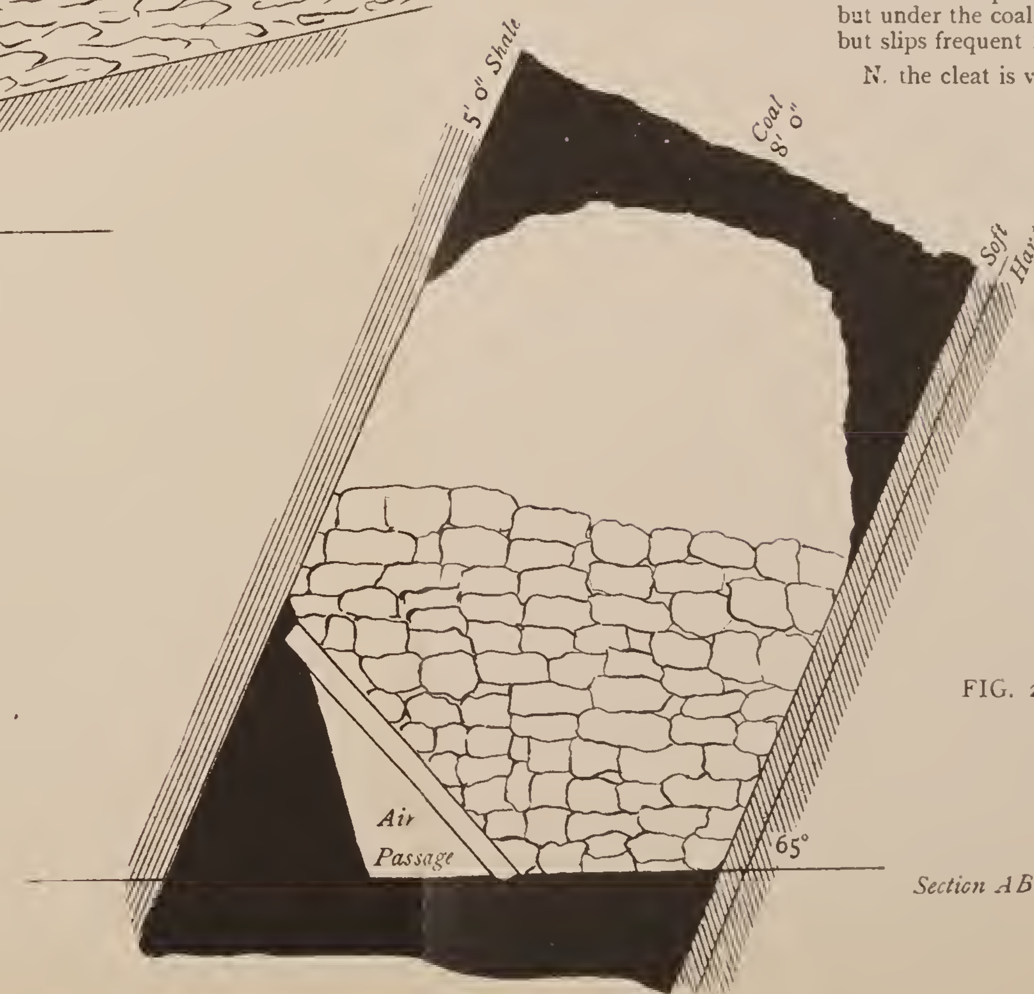


FIG. 274.

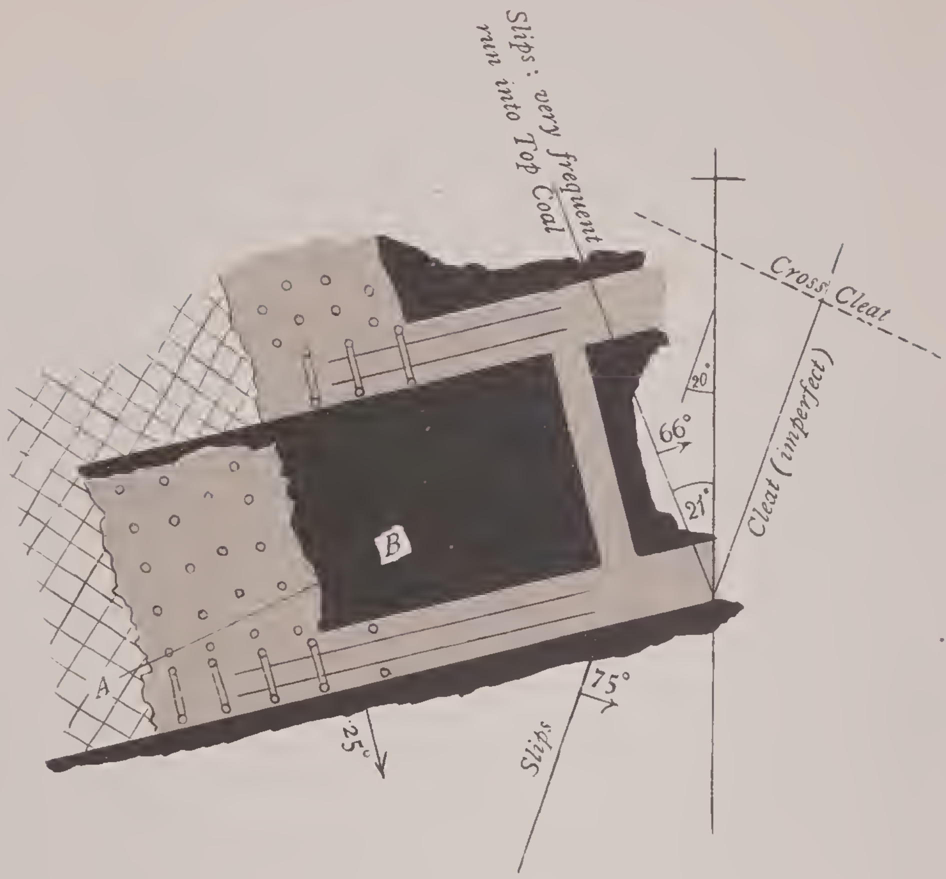


FIG. 276.

Figs. 276 and 277. Plan and Section C. Lancashire method. The Top Coal is left up in the drifts to support the roof, which is very tender. It is dropped, and got on drawing the timber.

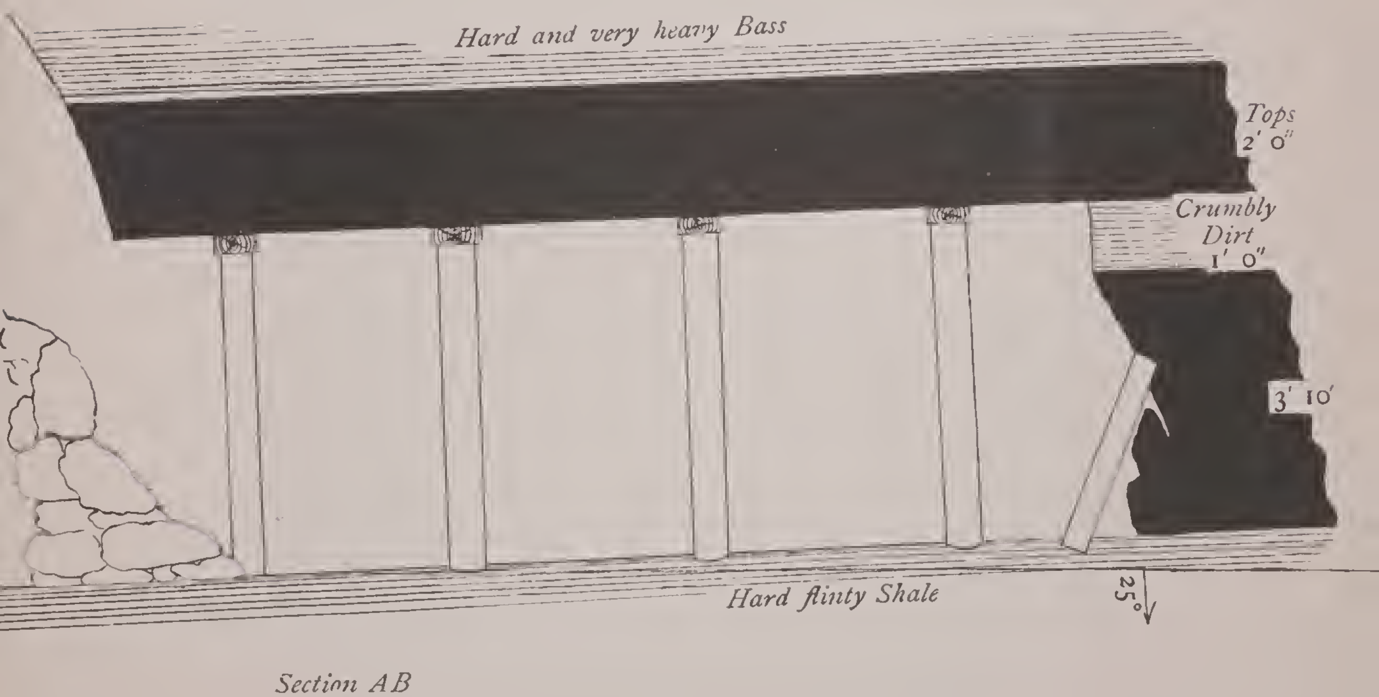


FIG. 277.

BULLHURST COAL.

FIG. 278.

Fig. 278. Plan C, shewing a method of working by "walls" (walling), which has lately been adopted, and is considered better and safer than heading and drifting. Each wall is 9—10 yards wide, and is driven for a distance of 60 yards from either side of a jig, beginning at the top. Another pair of walls is started below the first as soon as the latter is completed. Packs are formed of broken pieces of roof, which breaks above them. The lower pack of the top wall forms the upper pack of the bottom wall. The roof breaks down in the wastes, and the pressure over the levels is thereby relieved. The Top Coal is cut at the high side of the packs, and most of it is recovered. The advantage of this variety of longwall in a level direction is that good air roads are maintained, which in the other method close in rapidly, however well-timbered, and impede the ventilation. 3—4 rows of posts are set, 1 yd. apart, the posts being from 4′ 6″—5′ apart in each row. If the dip is to be kept open a 10 yards pillar is left next to it in each wall.

CHEADLE AND IPSTONES DISTRICT.

FIGS. 279—284.

TWO YARD COAL.

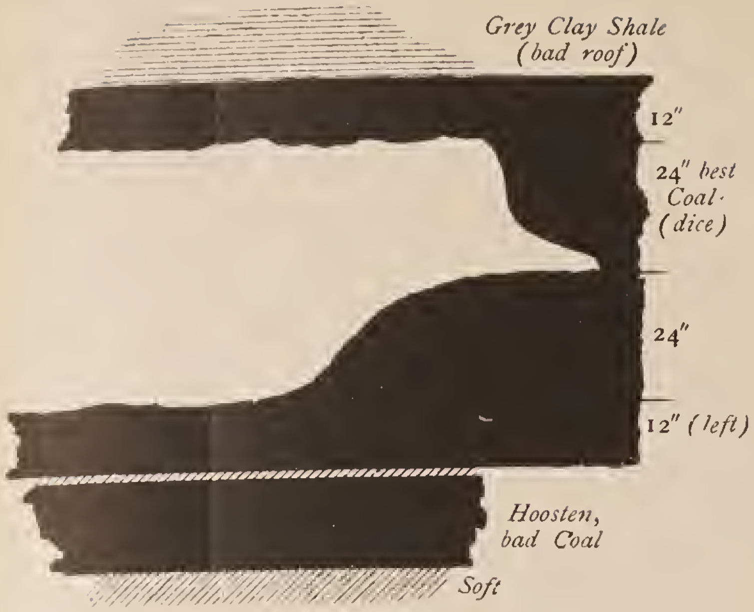


FIG. 279.

Fig. 279. Section of narrow head SW. of Cheadle. The roof being bad 12" of coal are left up. Coal is also left underfoot, to prevent the heaving action of the floor. The coal is very open-grained. There are open spaces as much as 1" wide between some of the cleat planes. Wooden wedges are driven into these spaces. Cleat distinct 52° NW.

COBBLE COAL.

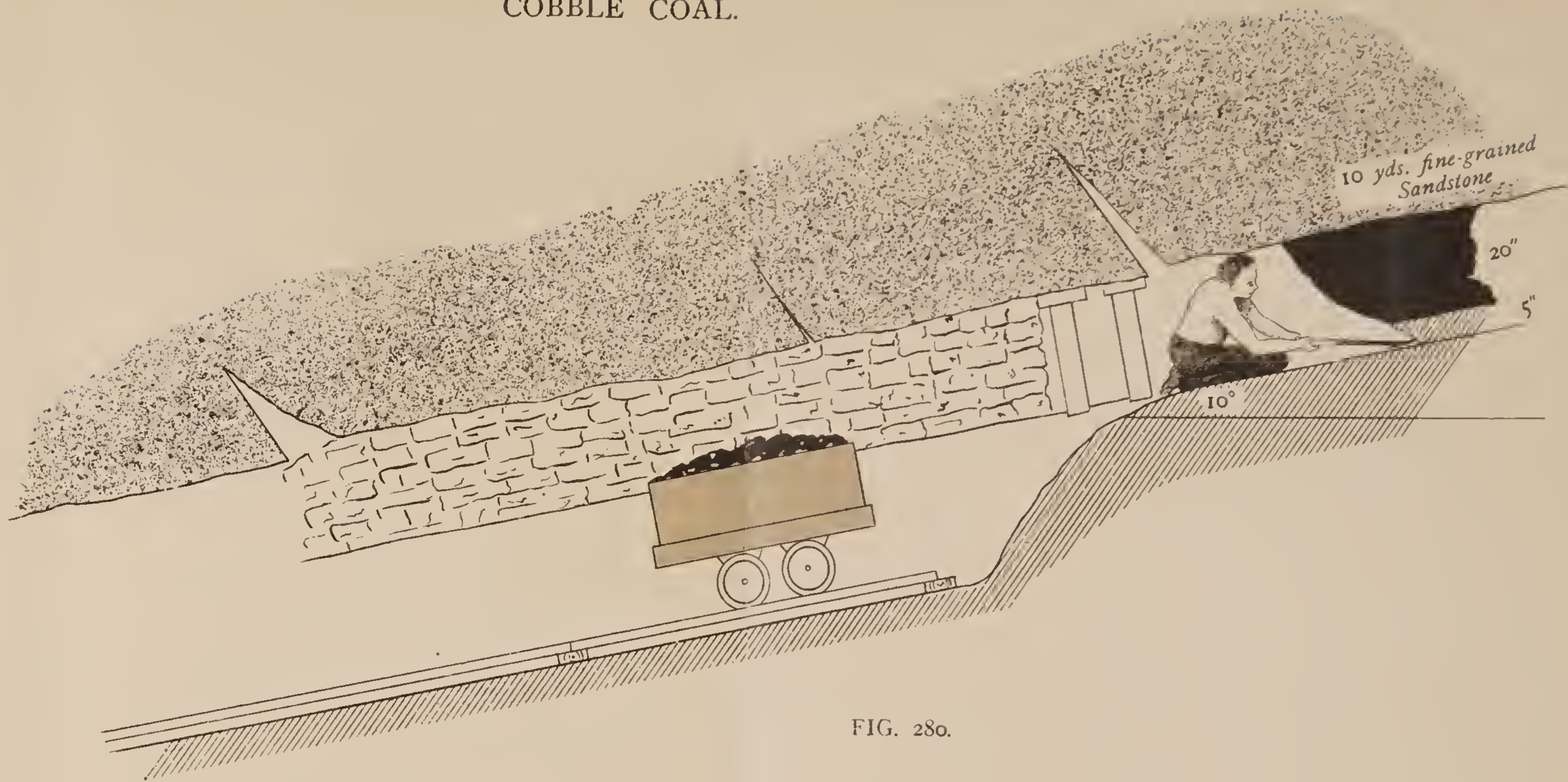


FIG. 280.

Fig. 280. Section W. (near Dilhorn). Worked by longwall.

WOODHEAD COAL.

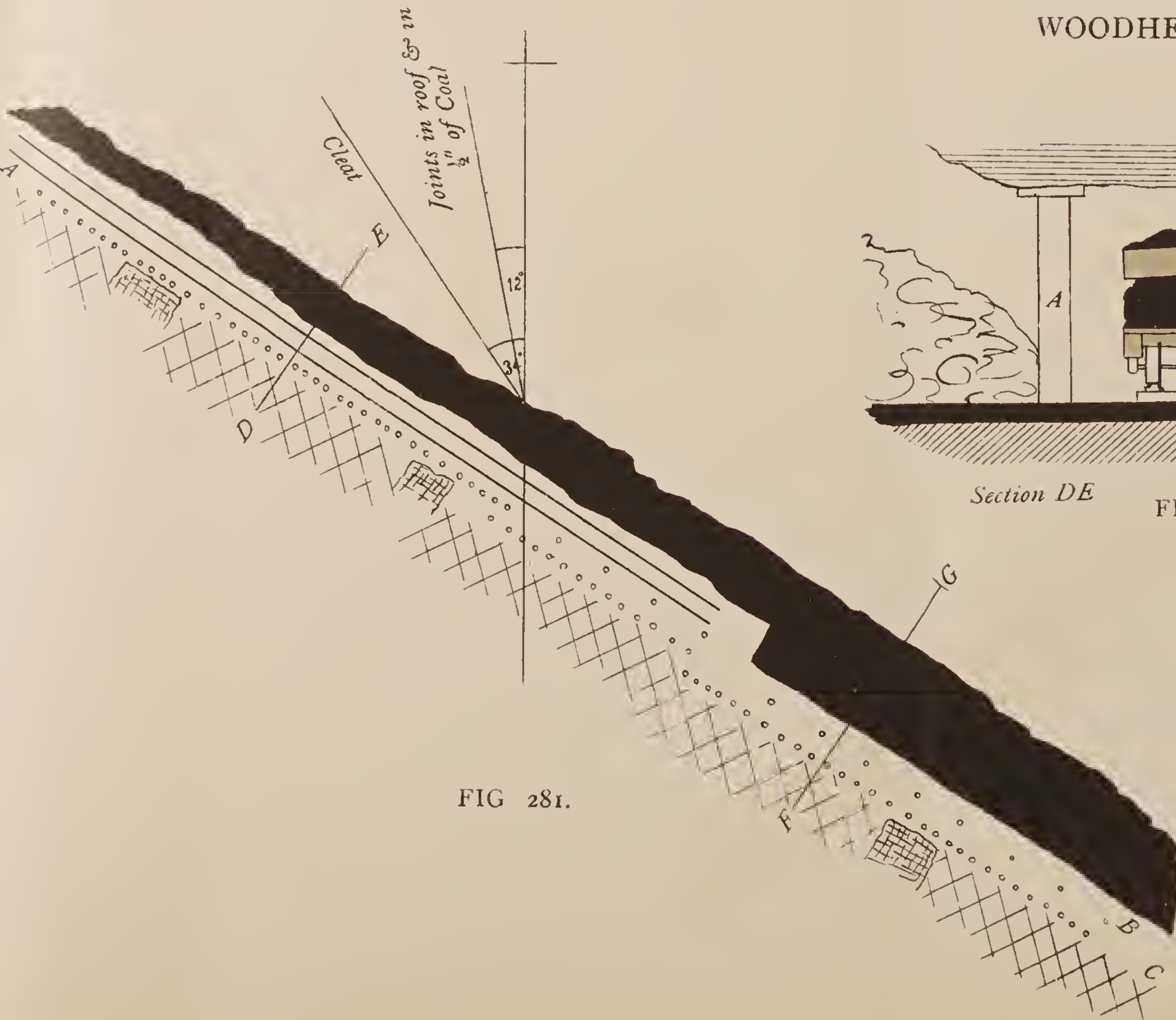
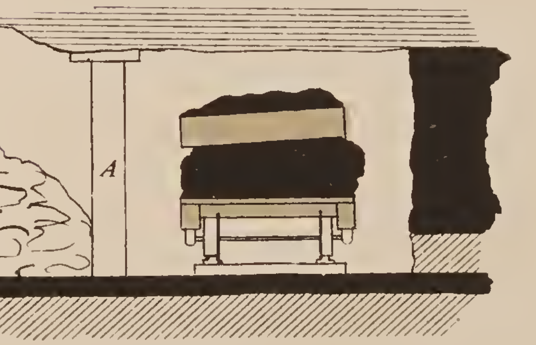
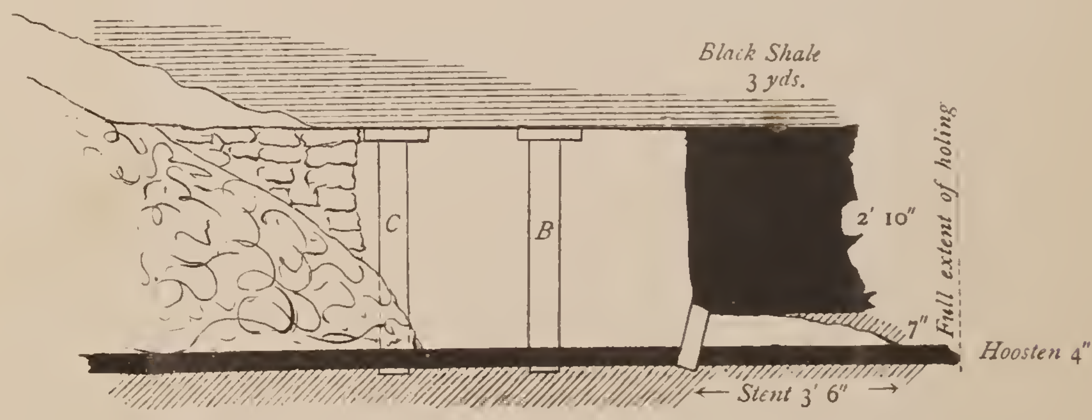


FIG 281.



Section DE FIG. 282.



Section FG FIG. 283.

Figs. 281, 282, 283. Plan and Sections. Worked in 40—50 yds. longwall faces. Weights occur every 9—10 yds. Cogs are more or less frequent. The coal gets best when the face forms an angle with the cleat; if square on end the coal is "too fast." Foreset posts *B* are set before holing. As the "buttock" advances the backrow posts are drawn and set in between the foreset posts. Two men were killed by a fall of roof at the face. It was known that the roof "stirred" by knocking; but the coal, though holed, was expected to support it, and the men were engaged removing a post to reset it at a short distance, without previously setting a temporary one. The workings had been standing a fortnight, and the roof and coa were broken behind the holing, unknown to the men.

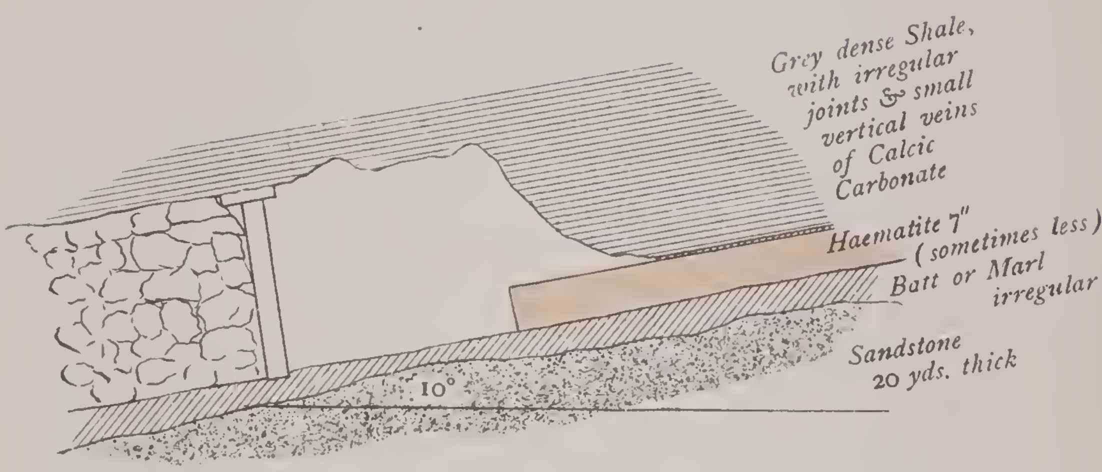


FIG. 284.

Fig. 284. Section C. (near Kingsley). The stone, which is of a deep red colour, and contains from 35—40 °/₀ of iron, varies in thickness from 3"—16". The shale forms a pretty good roof; it is highly impregnated with iron. The marl is occasionally absent; the stone resting directly on the sandstone. There is sometimes ½" of marl above the stone, which facilitates the holing. Worked by 24 yds. longwall faces; the gob is closely packed; some shale having to be sent out. The rails (20" guage) are carried near to the face in the jig or level, and the smaller pieces of stone carried to them in boxes. A row of posts is set every 2' 6", the posts being from 3' 6"—5' apart; as a new row is set the packing is carried up to it, and the back row drawn. No sprags are set. Water is used to soften the holing. No powder is used; the stone is wedged from underneath.

Near the surface the roof is extremely loose, and the stone is easily worked. Bars and posts are set at the face, 18" apart, and slabs placed over the bars in places. The timber is much broken.

At Ipstones 18" of coal underlie the stone, and the latter varies from 6"—27".

TIMBERING
IN TRAVELLING ROADS.

FIGS. 285—296.

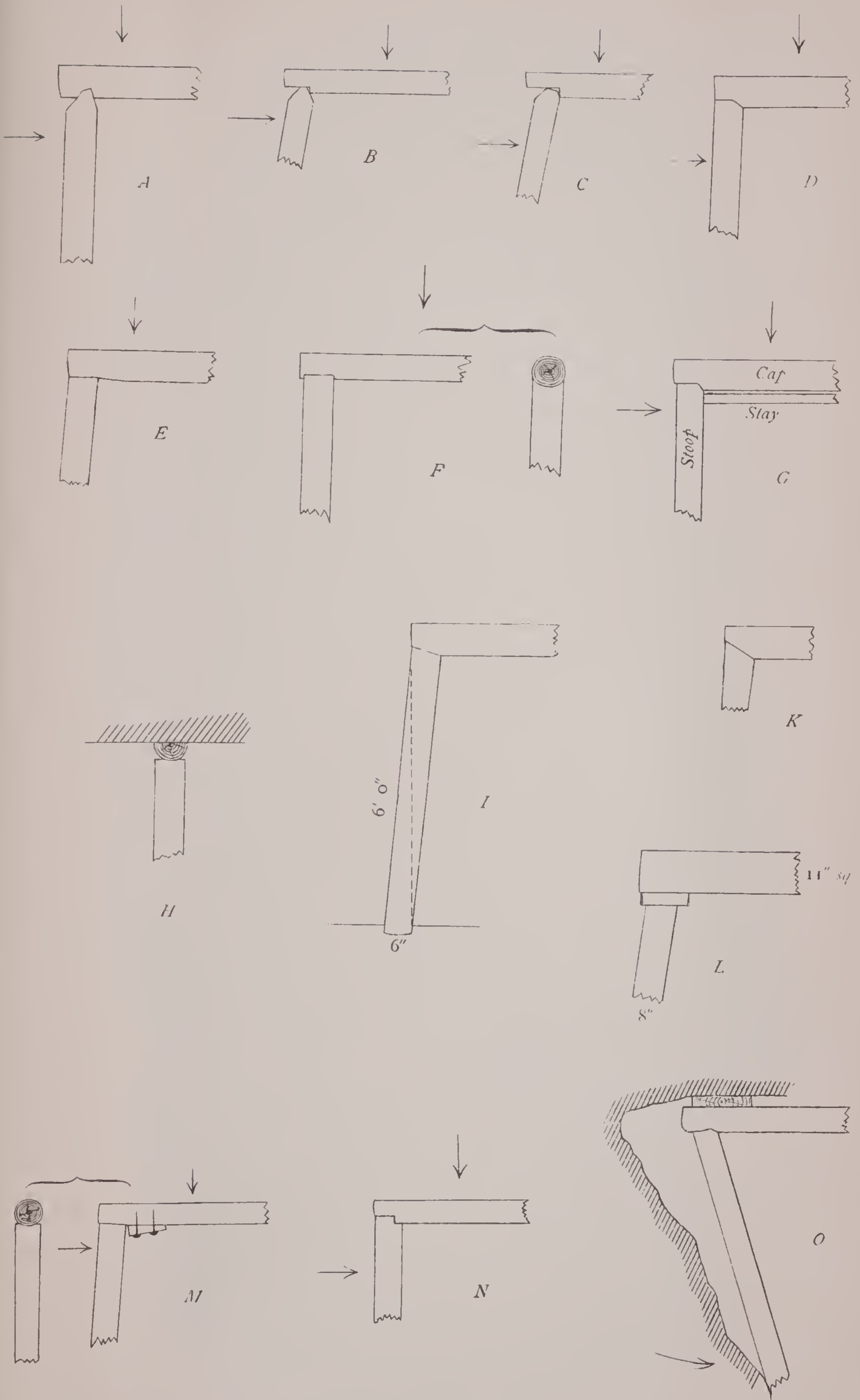


FIG. 285.

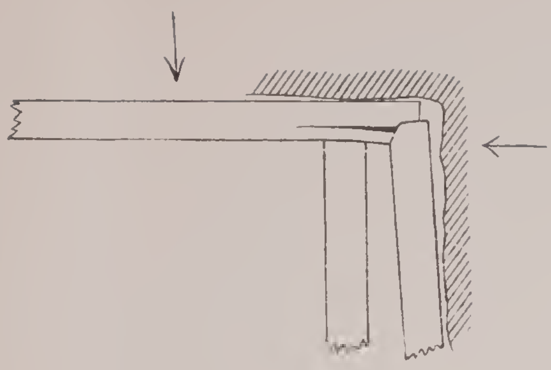


FIG. 286A.

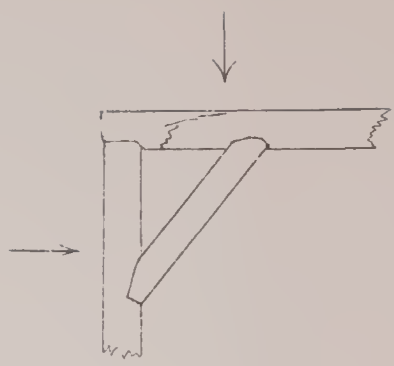


FIG. 286B.

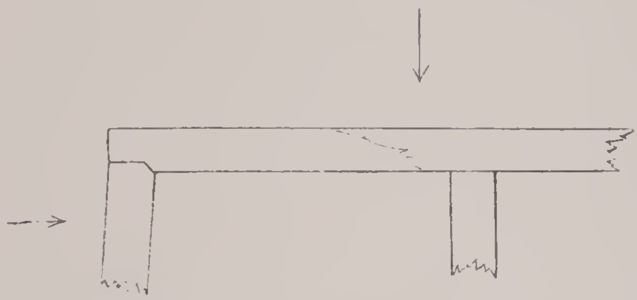


FIG. 286C.

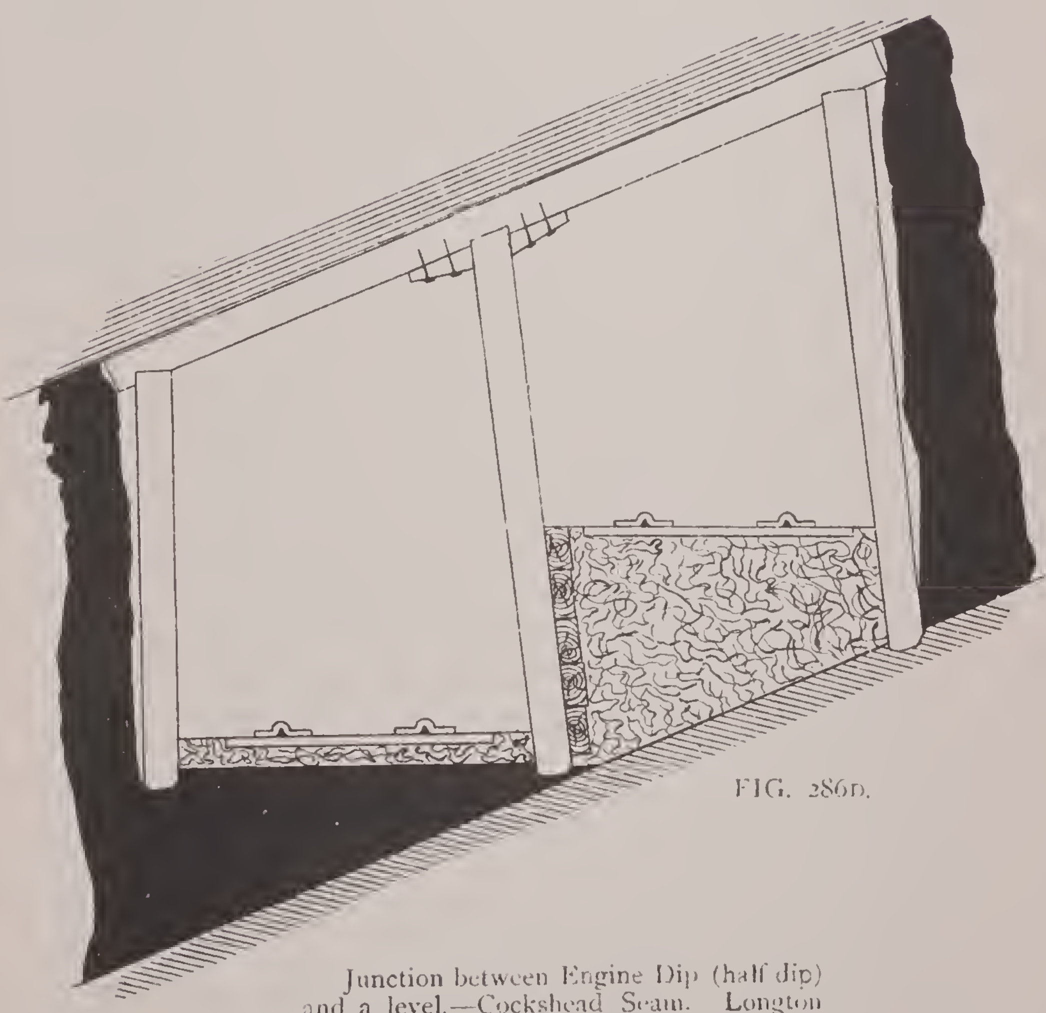


FIG. 286D.

Junction between Engine Dip (half dip) and a level.—Cockshead Seam. Longton District.

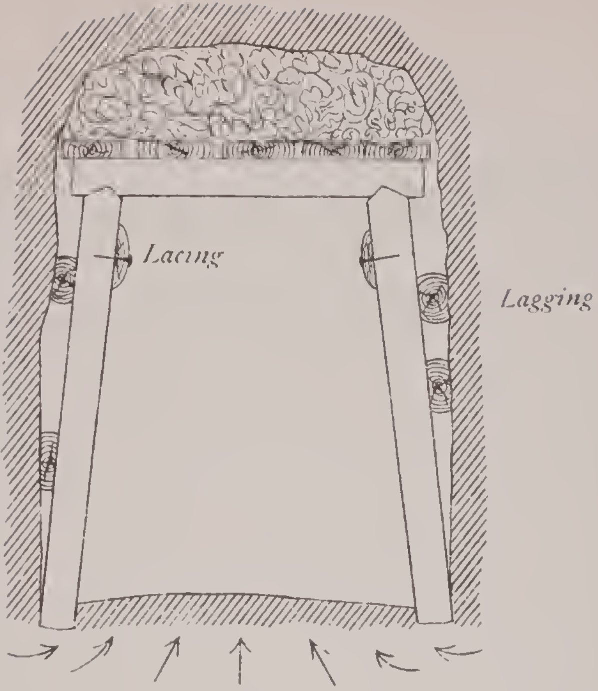


FIG. 287A.

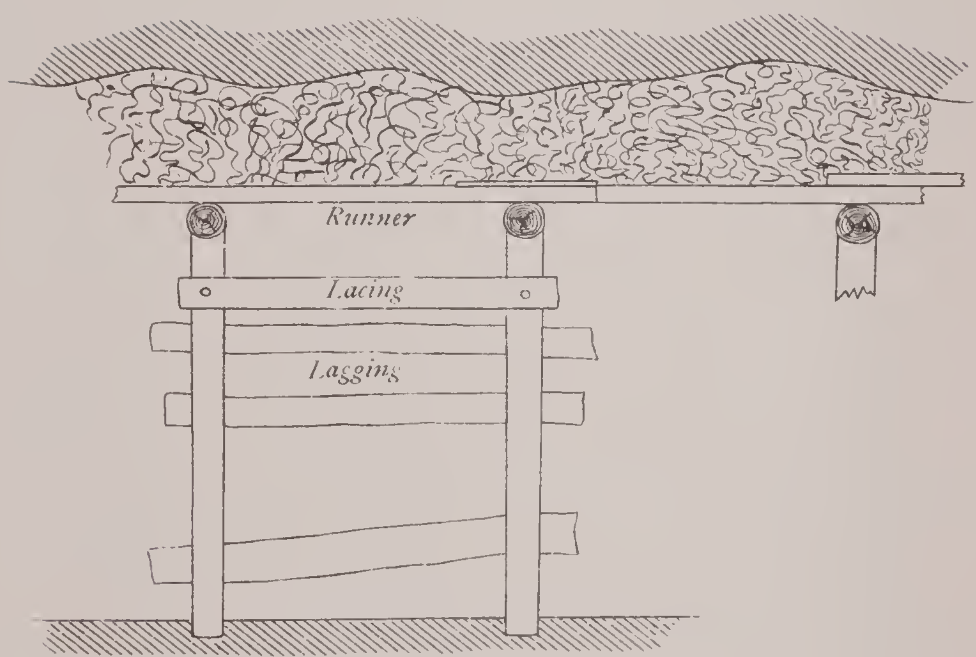


FIG. 287B.

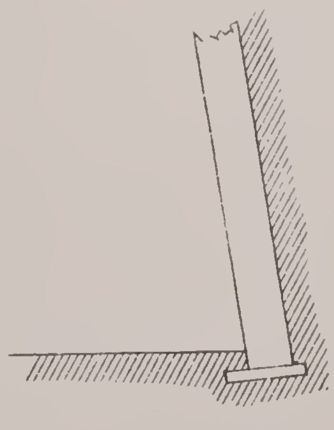


FIG. 287C.

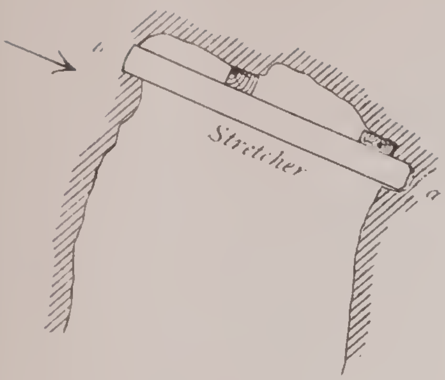


FIG. 288.

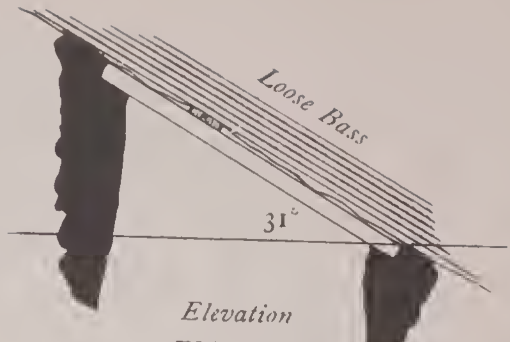


FIG. 289A.

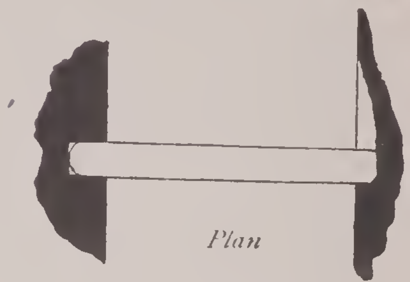


FIG. 289B.

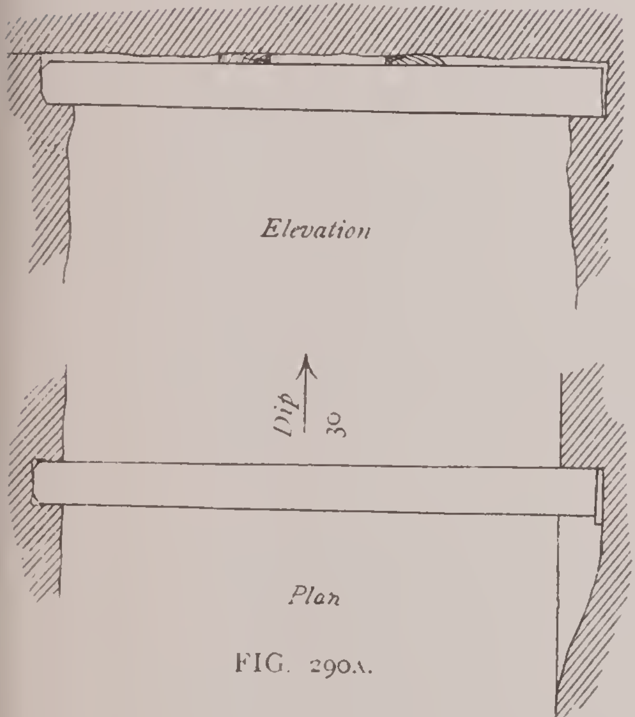


FIG. 290A.

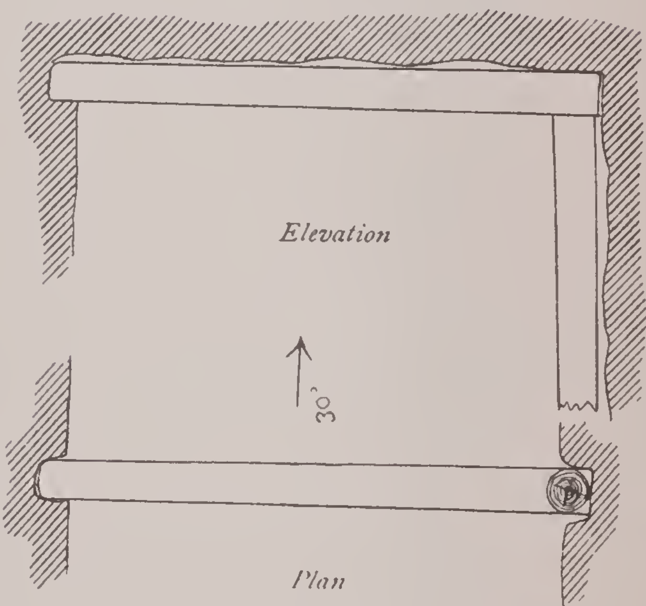


FIG. 290B.

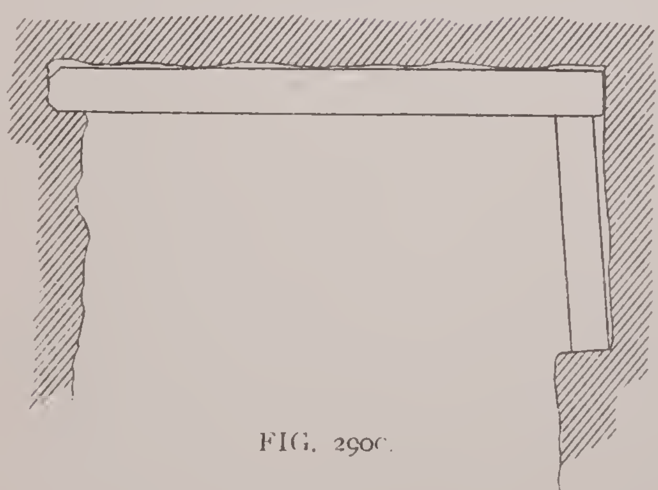


FIG. 290C.

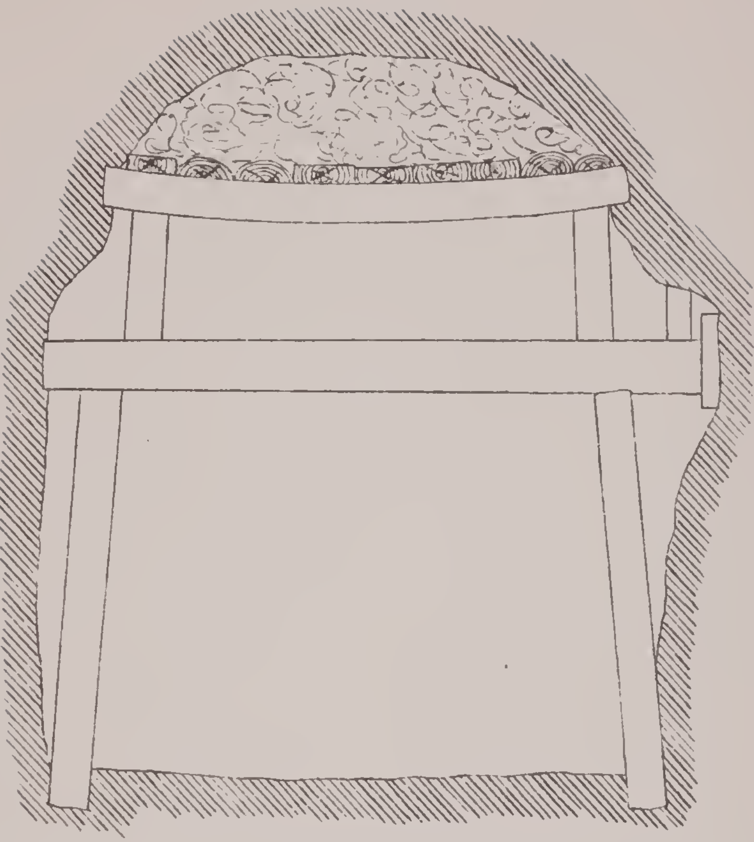


FIG. 291.

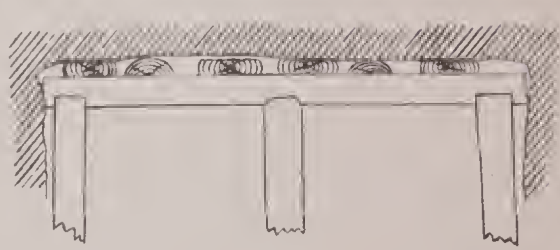


FIG. 292A.

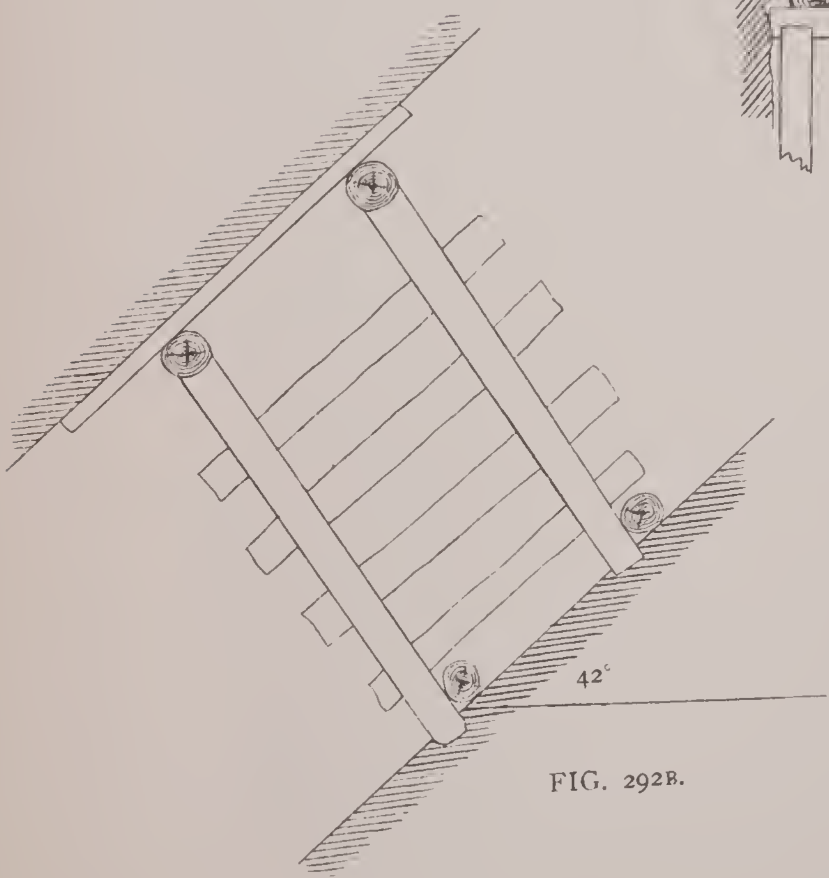


FIG. 292B.

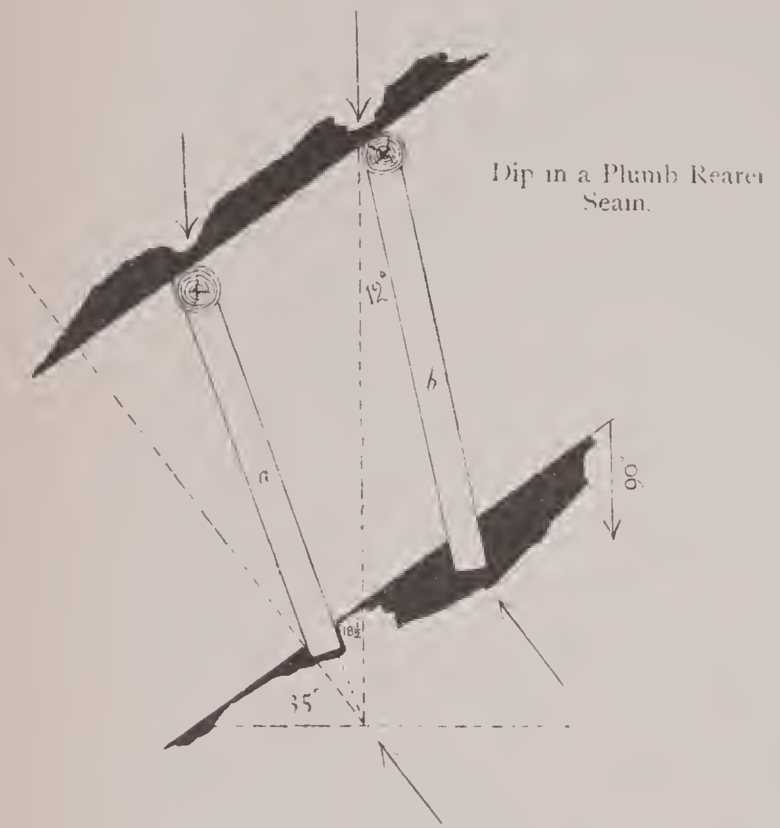


FIG. 293.

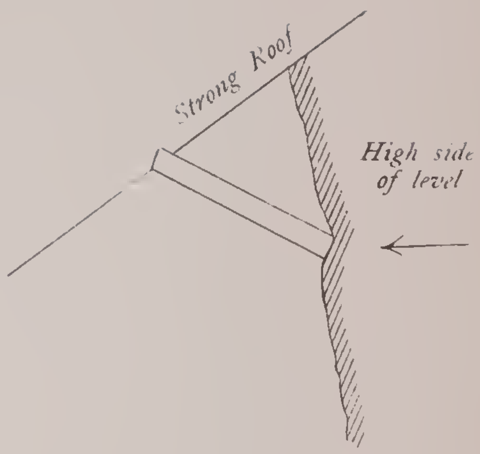


FIG. 294.

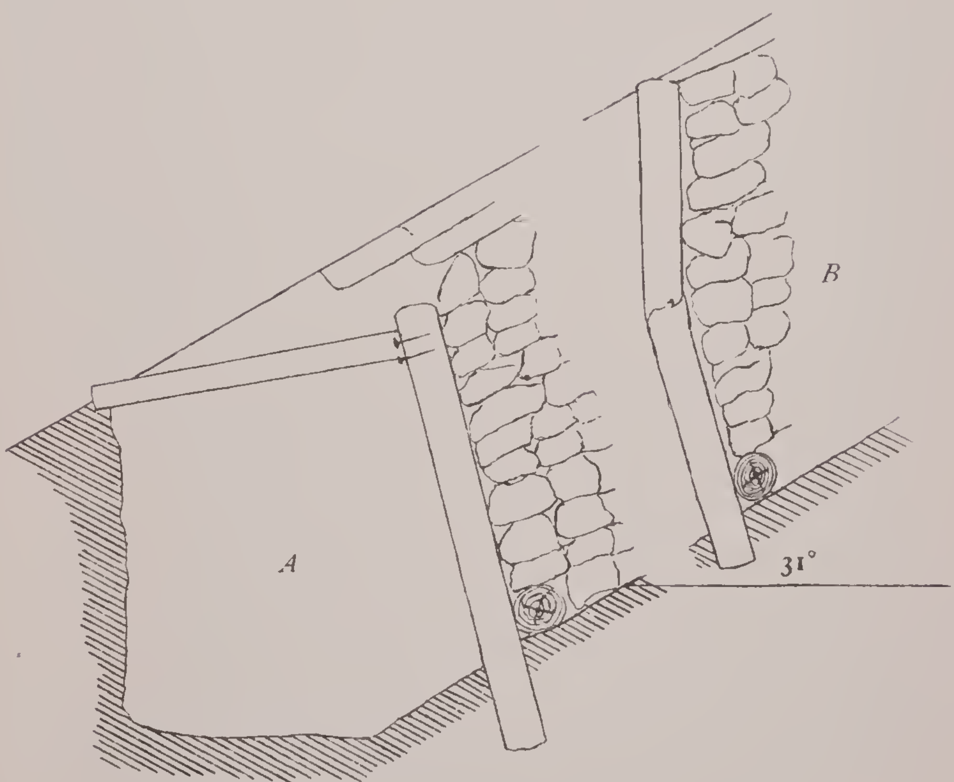


FIG. 295.

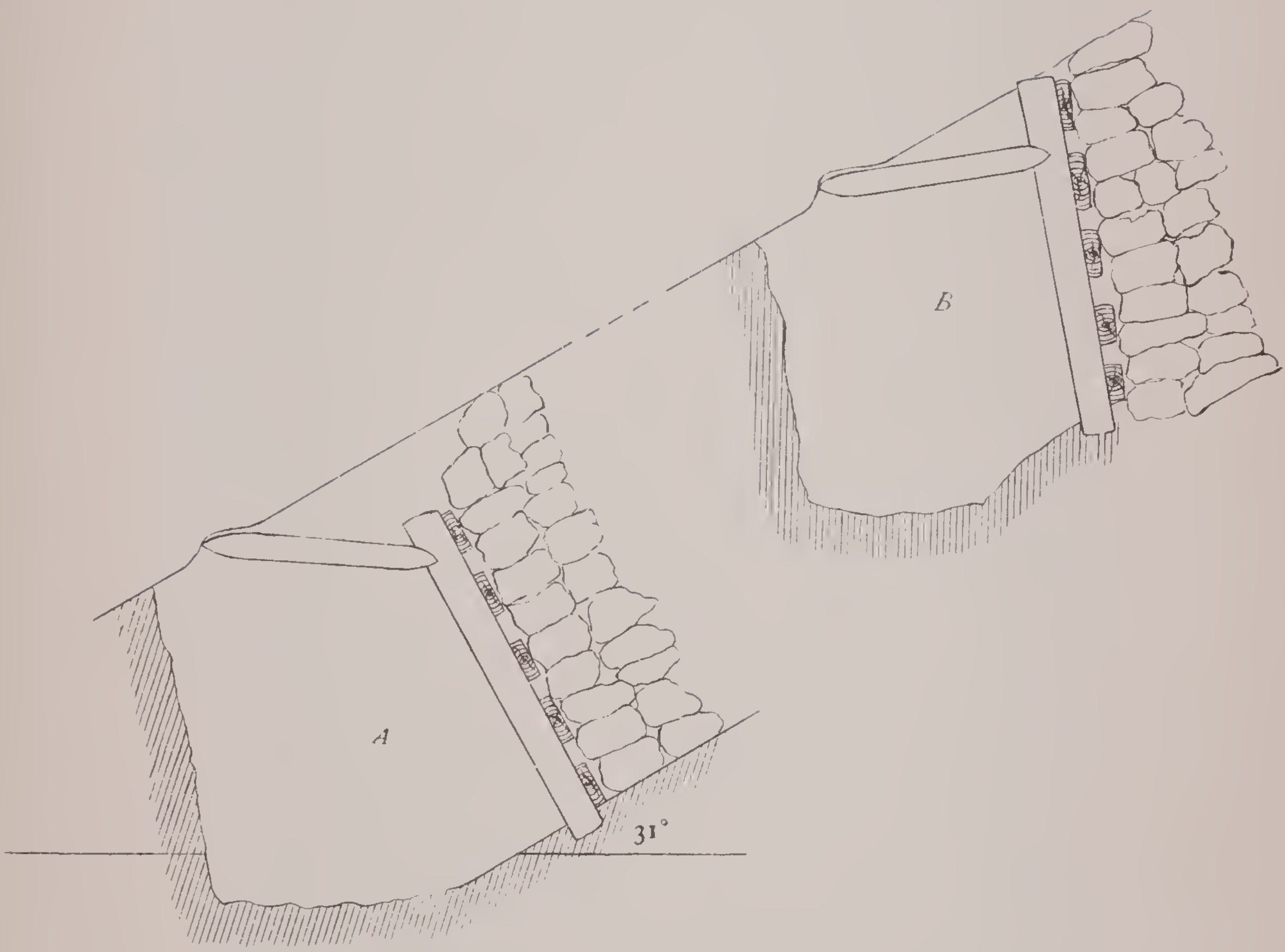


FIG. 296.

MISCELLANEOUS.

FIGS. 297—302.

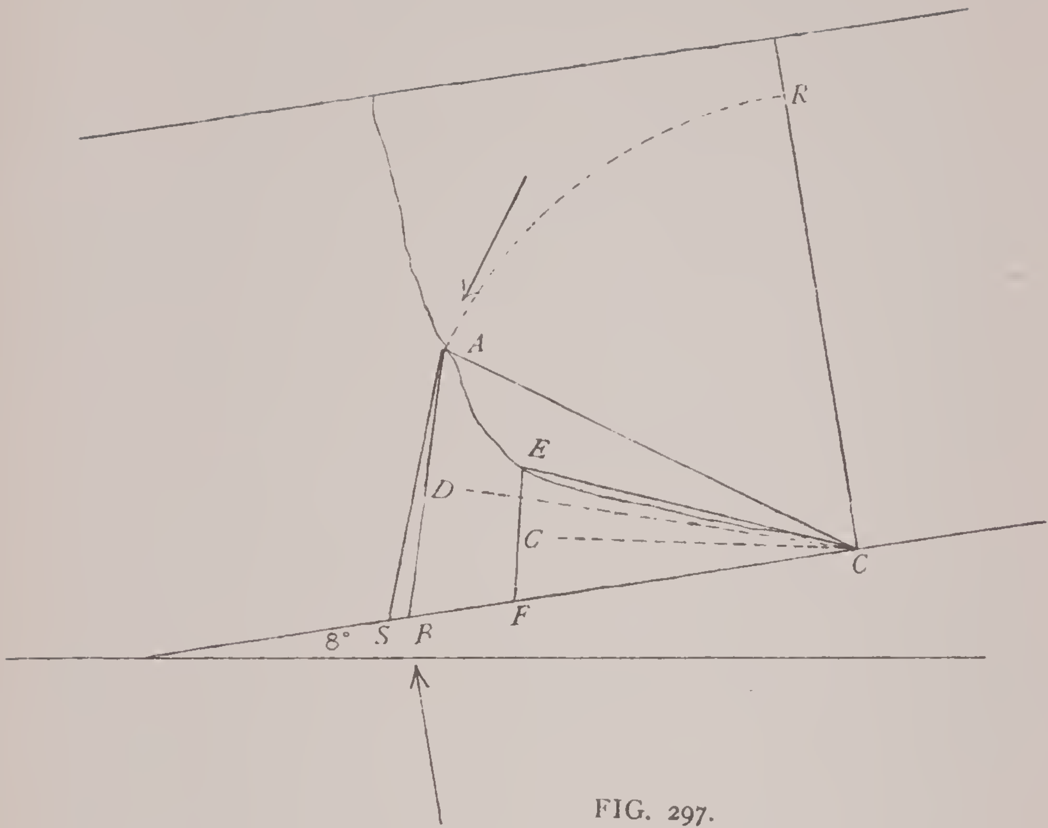


FIG. 297.

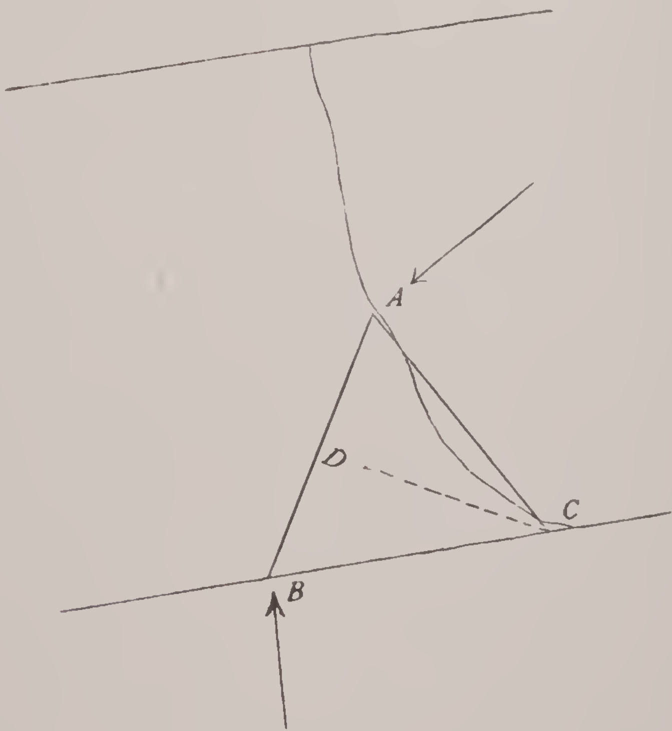


FIG. 298.

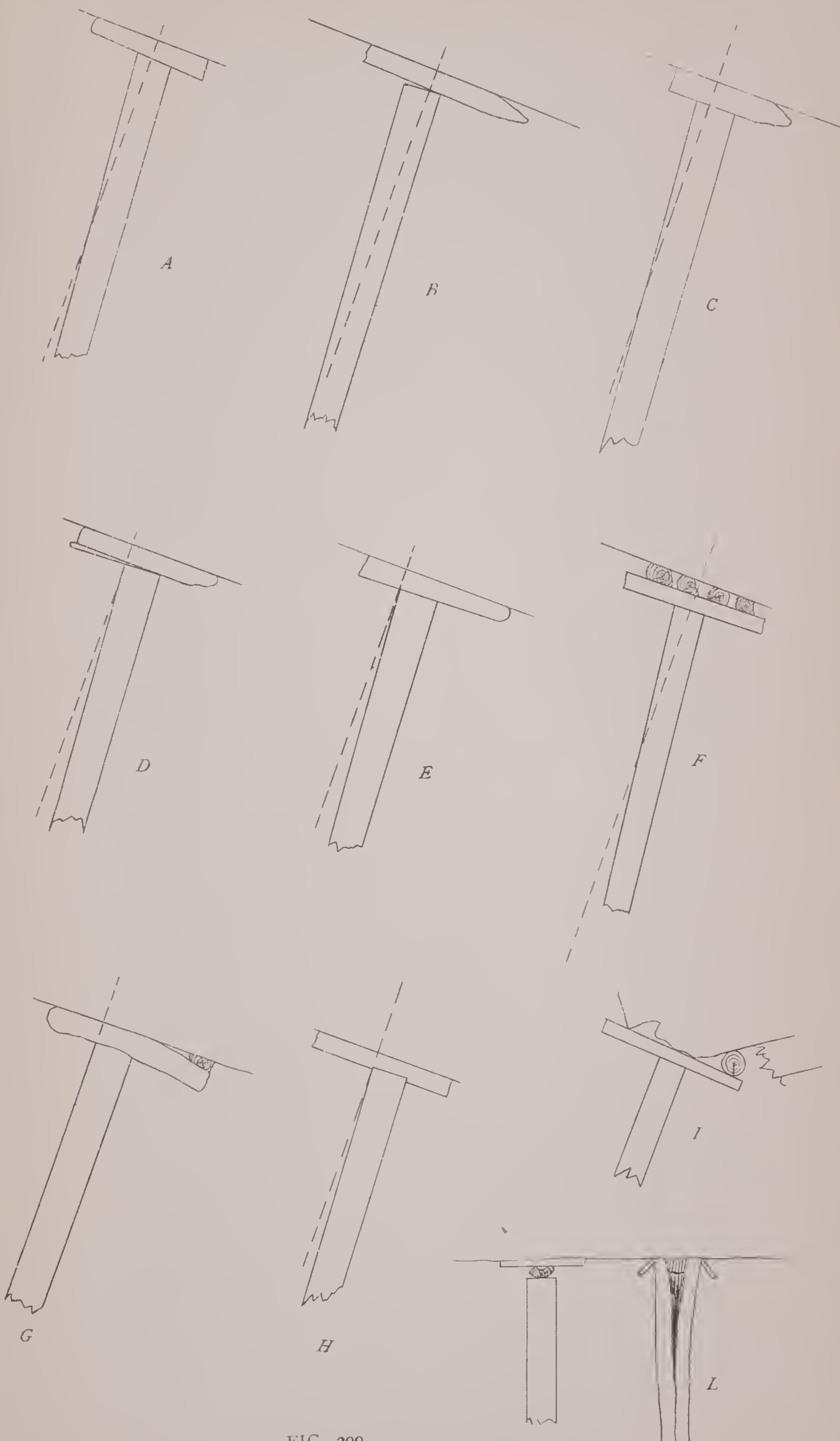


FIG. 299.

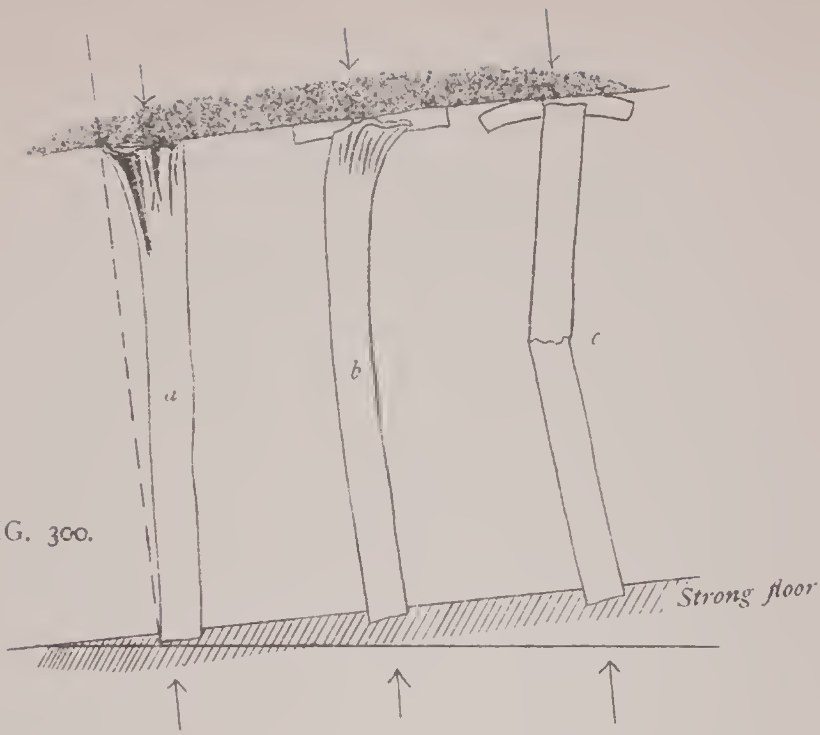
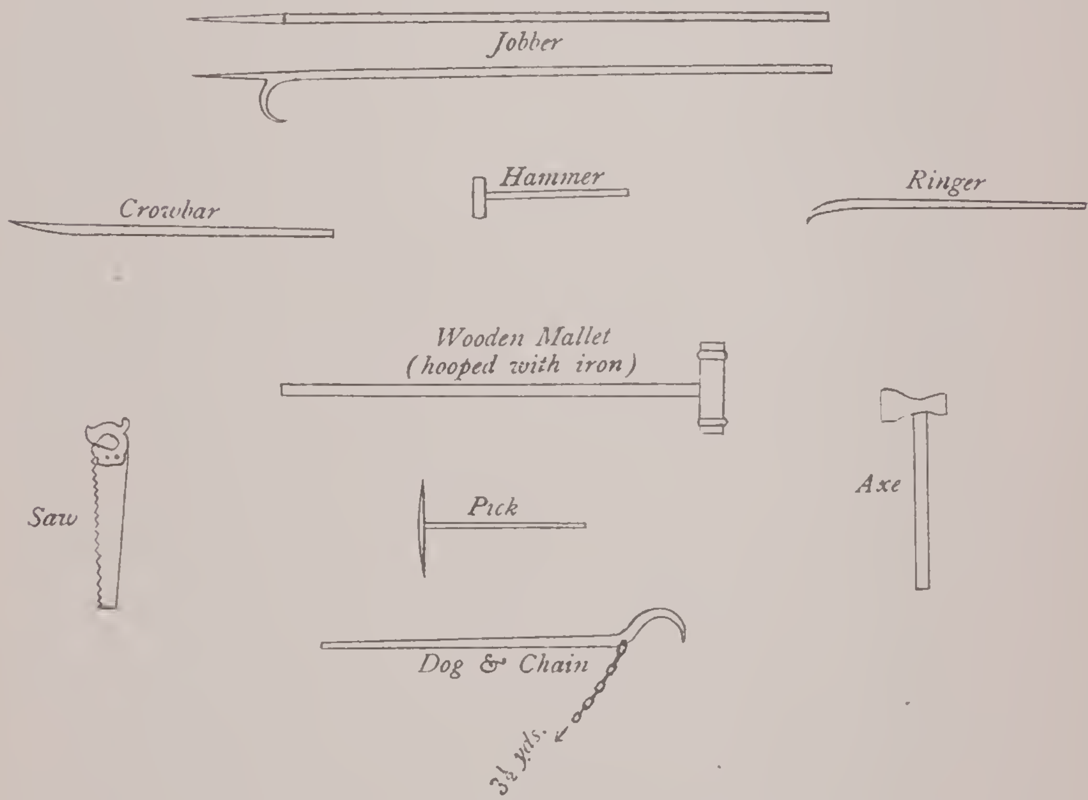


FIG. 300.

TOOLS AND APPLIANCES FOR SHAPING AND DRAWING TIMBER.



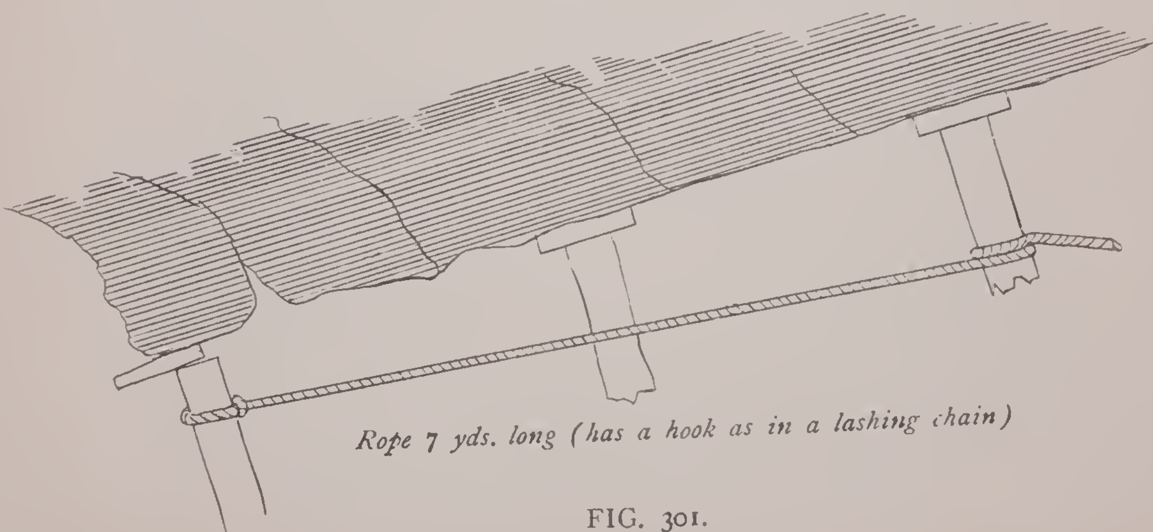


FIG. 301.

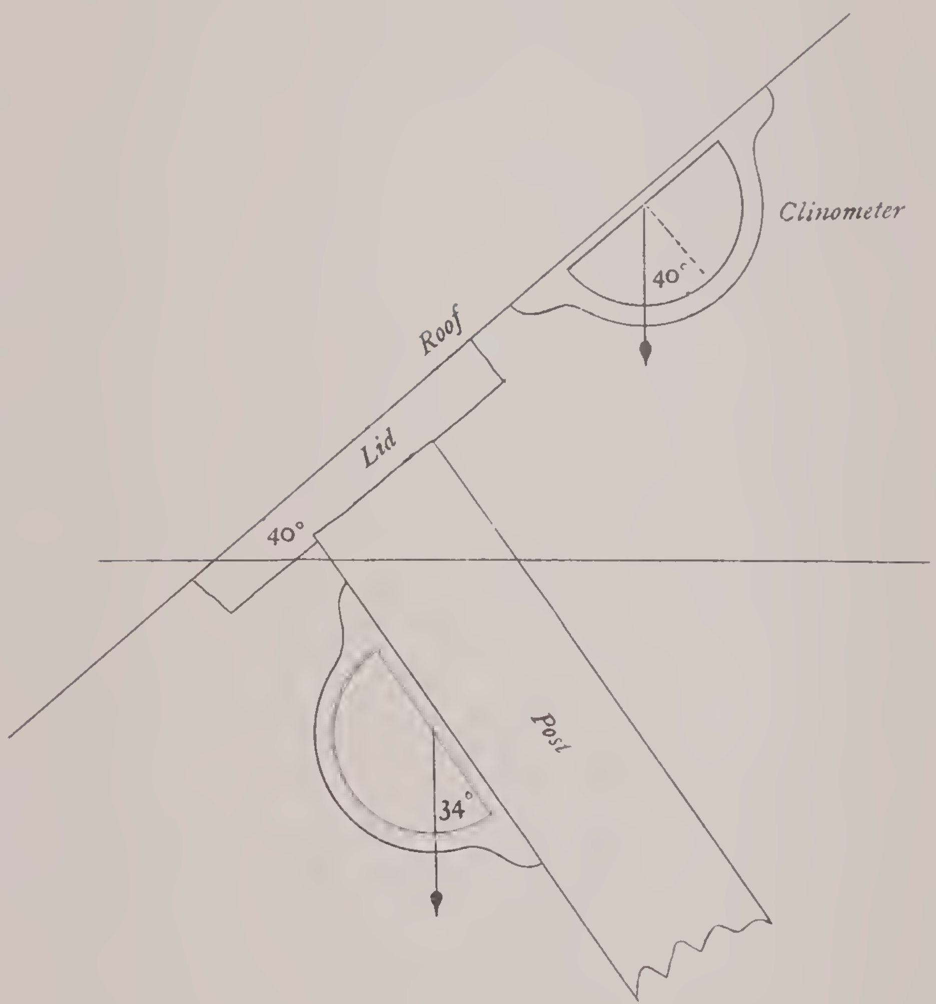


FIG. 302.

TABLE SHEWING THE DEPTHS OF THE WORKINGS FROM THE SURFACE.

Figs.	Depth in yds.	Figs.	Depth in yds.
1 & 2	138	77	120
3 & 4	160	78	300
5 & 6	150	79 & 80	500
7 & 8	150	81	500
9 & 10	140	82	350
11 & 12	110	83	350
13 & 14	170	84	480
15 & 16	150	85	460
17	280	86	400
18, 19 & 20	130	87	100
21	180	88 & 89	500
22, 23 & 24	320	90 & 91	480
25 & 26	180	92	160
27	200	92A	310
28 & 29	200	93, 94 & 95	280
30, 31 & 31A	180	96 & 97	450
32 & 33	330	98	280
34	150	99	340
34A	280	100	180
35 & 36	250	100A	370
37 & 38	180	101	150
39 & 40	180	101A	390
41 & 42	180	102 & 103	220
43, 44 & 45	180	104	200
46	280	105A & 105B	160
47 & 48	280	106 & 107	280
49 & 50	460	108	240
51 & 52	180	109 & 110	180
53	200	111 & 112	220
54	400	113—117	440
55 & 56	300	118 & 119	380
57 & 58	300	120 & 121	380
59	200	122	480
60	460	123 & 124	530
61	200	125 & 126	390
62	200	127	400
63	200	128, 129 & 129A	565
64 & 65	460	130 & 131	440
66 & 67	460	132	550
68 & 69	200	133 & 134	600
70	200	135	300
71, 72, 73, 73A & 73B	315	136 & 137	740
74	350	138 & 139	580
74A	100	140 & 141	695
75 & 76	300	142 & 143	250

DEPTHS OF THE WORKINGS FROM THE SURFACE.

Figs.	Depth in yds.
144 & 145	750
145A	664
146 & 147	280
148 & 149	350
150 & 151	430
152 & 153	350
154 & 155	350
156 & 157	200
158 & 159	350
160 & 161	430
162	230
163 & 164	470
165	400
166	260
167 & 168	400
169	300
170	250
171	340
172 & 173	150
174	275
175 & 176	120
177	120
178	120
179	50
180	280
181 & 182	110
183	110
184	280
185	110
186	300
187	112
188 & 189	320
190	150
191 & 192	350
193	20
194	160
195 & 196	110
197	60
198	10
199	25
200 & 201	60
202	30
203	180
204 & 205	180
206 & 207	600
208 & 209	360
210 & 211	320
212	240
213 & 214	150
215 & 216	220
217 & 218	480
219 & 220	350
221	310
222 & 223	500
224	320
225 & 226	520
227 & 228	130
229 & 230	130
231 & 232	540
233 & 234	620
235	200
236, 237 & 238	250
239 & 240	650
241 & 242	200
243	300
244 & 245	620
246, 247, 247A & 247B	200
248	300
249	240
250	400
251 & 252	370
253 & 254	280
255	200
256 & 257	220
258	240
259	70
260	100
261 & 262	160
263 & 264	160
265	230
266	200
267	200
268	200
269	265
270	230
271	350
272, 273 & 273A	350
274 & 275	160
276, 277 & 278	280
279	30
280	90
281, 282 & 283	196
284	100