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special reference to the effect of the industry on the
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The
Technical Education
of the
Mine Worker
with
Special Reference
to the
Effect of the Industry
on the
Receptivity of the Student

FOREWORD.

It is always maintained that Technical Education stands or falls by its contribution to industrial or commercial needs; further, that it is "material" in outlook and lacks the "culture" of academic education. It should, however, be possible with a carefully constructed curriculum, to devise a course which, based upon the common activities of the worker, will give him a liberal education, and so fit him not only for his work but for a more cultured use of his leisure.

Mining Education has failed, or has been less successful than it might have been, because there has been a tendency to regard the worker as part of the equipment of the mine and to provide for him a type of education that has been too narrowly restricted to his vocation. The purpose of this thesis is, therefore, to consider primarily the limitations of the present system of instruction to workers in mines and of the mining examinations and to suggest alterations in these schemes. Throughout the chapters the writer has made copious references to the effect of the industry on the assimilation of instruction and has attempted to show that mining education cannot be classed with other forms of technical education since the "getting" of minerals makes special demands on the workers and these demands must be carefully considered before any form of education can be arranged.

Sunderland.

7th Feb'y. 1935.

Robt. L. Hay.....

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C H A P T E R I

A Description of Modern Mining Practice in Great Britain. -----

This Chapter briefly describes modern mining practice and is intended to place before the non-technical reader a skeleton survey of the conditions under which the miner works. The advances which mining has made in the use of mechanical and electrical appliances in coal "getting", together with a synopsis of the knowledge essential to the mine official for the efficient discharge of his duties, are also shown.

A DESCRIPTION of MODERN MINING PRACTICE in GREAT BRITAIN.

Introduction.

In 1931 there were employed in the coal mines of Great Britain 880,000 persons and the output of coal for that year was 219 million tons of which 43 million tons were exported. These figures do not establish a record for in 1913 over one million persons were employed and 287½ million tons extracted. Unfortunately, the figures continue to shrink but the coal mining industry is still essential to the nation as a trading asset. Other countries, for instance; Poland, Czecho-Slovakia, Russia, China and Japan are now competing in world markets of which Britain, at one time, had the monopoly and the opening up of coal fields in these countries has introduced a competition in prices and quality which before 1921 did not exist.

Success, and perhaps existence, of our coal industry depends on having, in the first place, leaders of high technical and commercial knowledge, mine officials well instructed in the practical and technical sides of mining and workers who have a sound knowledge of mining or who have had a good general education.

The "getting" of coal is becoming more mechanised and this calls for mine workers of a higher intelligence than was required in the past. The safety of the personnel underground is of the utmost importance and a "safe" mine can only exist if the workmen realise that they are part of a team, every man depending on his workmate conducting himself in a manner showing a true perspective of the dangers existing and knowing how those dangers should be met. This can only be achieved by education, preferably along the lines of the industry but not necessarily so. Any well-planned course of education will sharpen the mine workers' powers of observation and improve that alertness so necessary in the mine. The art of mining is unlike all others in that minerals have to be extracted^t against all the agencies of

of/ nature and this necessitates the employment of experienced men who can carry out the "getting" of minerals in a scientific and safe manner. An inefficient workman is a positive menace, not only to himself but to every workman in the mine.

In order to show the urgency of a wider range of technical knowledge among the workers, the following is a short description of modern mining practice:-

COAL "GETTING". (Illustrations -Pages 3 & 4.)

Whilst the old method of coal extraction by means of the pick and wedge still accounts for about half of Britain's output, mechanical appliances are now rapidly superseding the hand pick. Coal cutting machines driven by compressed air or electricity are now undercutting the coal and in many modern collieries the hand pick has been discarded for bringing down the coal and mechanical picks have been adopted with success. The passing of coal from the face to the tub which, in the past, was solely done by manual labour, is now being carried out by "shaker" or belt conveyors working parallel to the face. The coal is only handled by the miner from the face to the conveyor, the maximum distance being about 5 feet, and in some collieries where conditions are suitable, the coal is transported from face to tub with no handling whatever.

After undercutting, the coal cannot always be brought down by the pick alone and in most collieries explosives have to be used for blasting both coal and rock, the use of which demands great care on the part of those detailed for the work and only certificated workmen are allowed to carry through these operations.

The explosives, although specially prepared to reduce to a minimum the amount of flame, are still a possible source of ignition and, therefore, special precautions have to be taken in the charging and "stemming" of the shot hole. An over or undercharged hole, inefficient "stemming"

stemming/ or the crossing of breaks in the shot hole
may cause a serious explosion if inflammable gas is in
the vicinity.

— COAL "GETTING" —
UNDERCUTTING BY HAND.



UNDERCUTTING BY MACHINE.



— COAL "GETTING" —
PREPARING THE SHOT HOLE



TRANSPORT OF COAL BY CONVEYOR



THE "JOY" MECHANICAL LOADER.



UNDERGROUND TRANSPORT. (Illustrations - Pages 5, 6 & 7.)

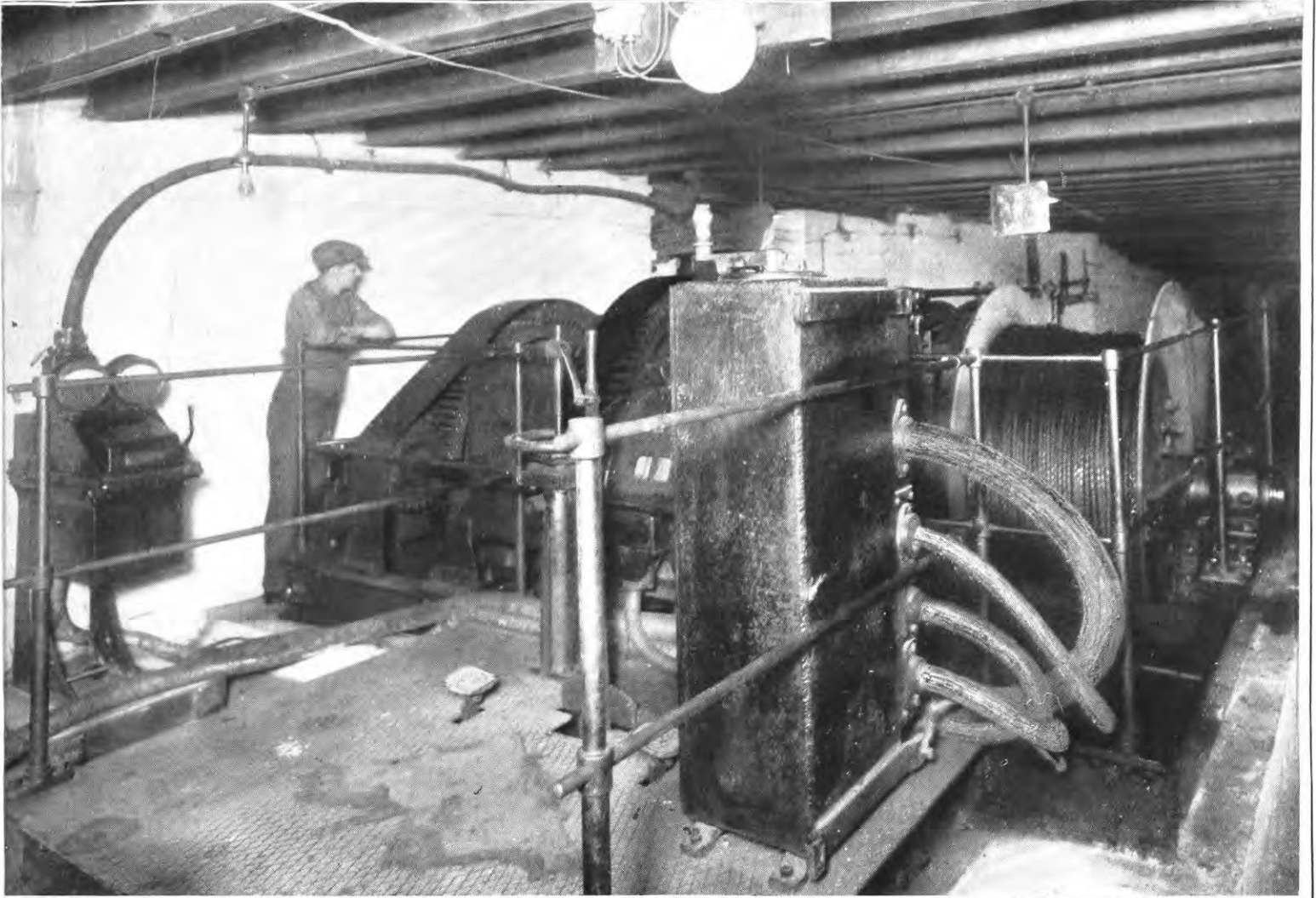
The transport of coal from the "face" to the collecting centre is still largely carried out by horses but from the collecting centres it is conveyed to the pit bottom by rope haulage and in some cases by battery locomotives. Some modern collieries have displaced the haulage by large belt conveyors along the main roads. These conveyors transport the coal to underground loading centres where the tubs are loaded before being wound to the surface. Gradients underground are far from constant and it is quite common to have three or four different layouts of haulage in the one colliery. In the passing of coal from the seam, tubs may be lowered down steep gradients, along level roads and then hauled up inclines before reaching the pit bottom. The one layout of rope cannot be adopted in a case like this and so coal may be hauled by three different methods in its journey from face to shaft. Chaos will result if a well designed plan of haulage is not adopted and as a colliery is constantly expanding the haulage system must be arranged to meet all the demands when the underground workings have reached the extreme boundaries of the colliery leasehold.

— UNDERGROUND TRANSPORT. —

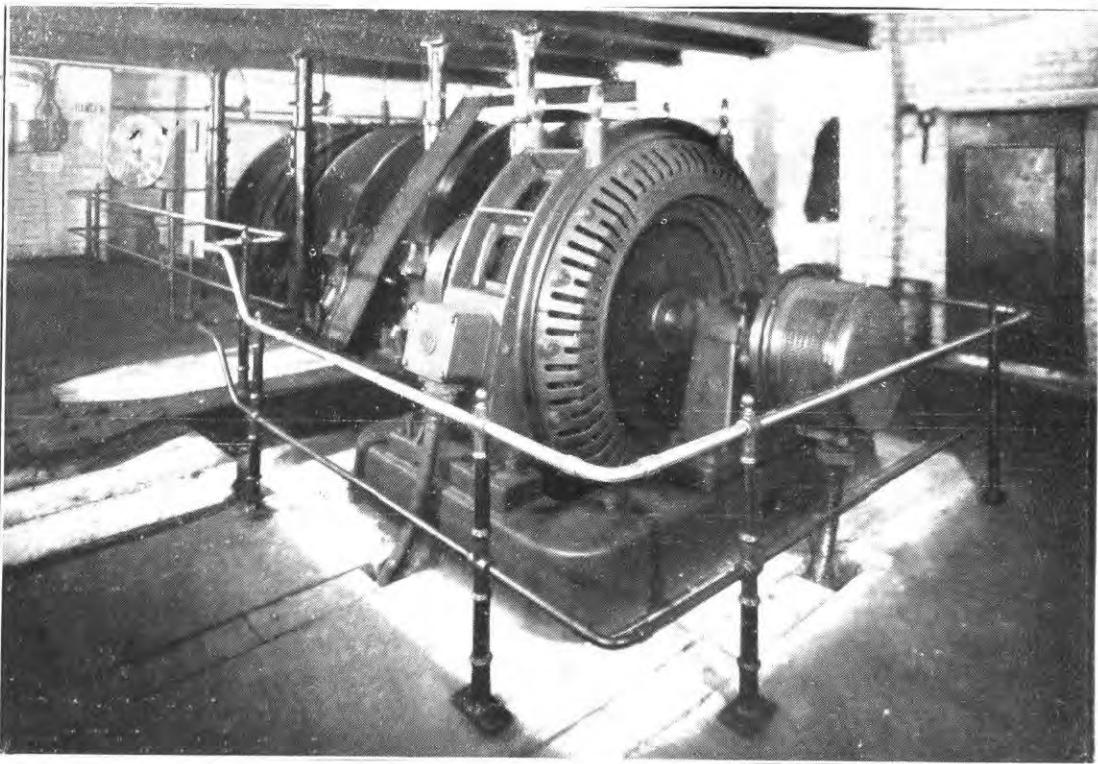
SMALL COMPRESSED AIR AUXILIARY HAULER.



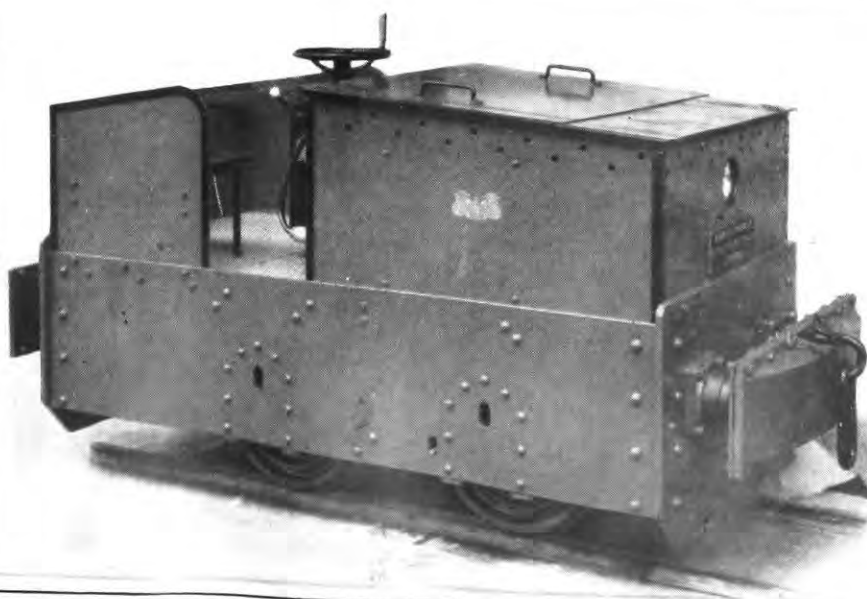
— UNDERGROUND TRANSPORT. —
250 H.P. MAIN AND TAIL ROPE HAULAGE.



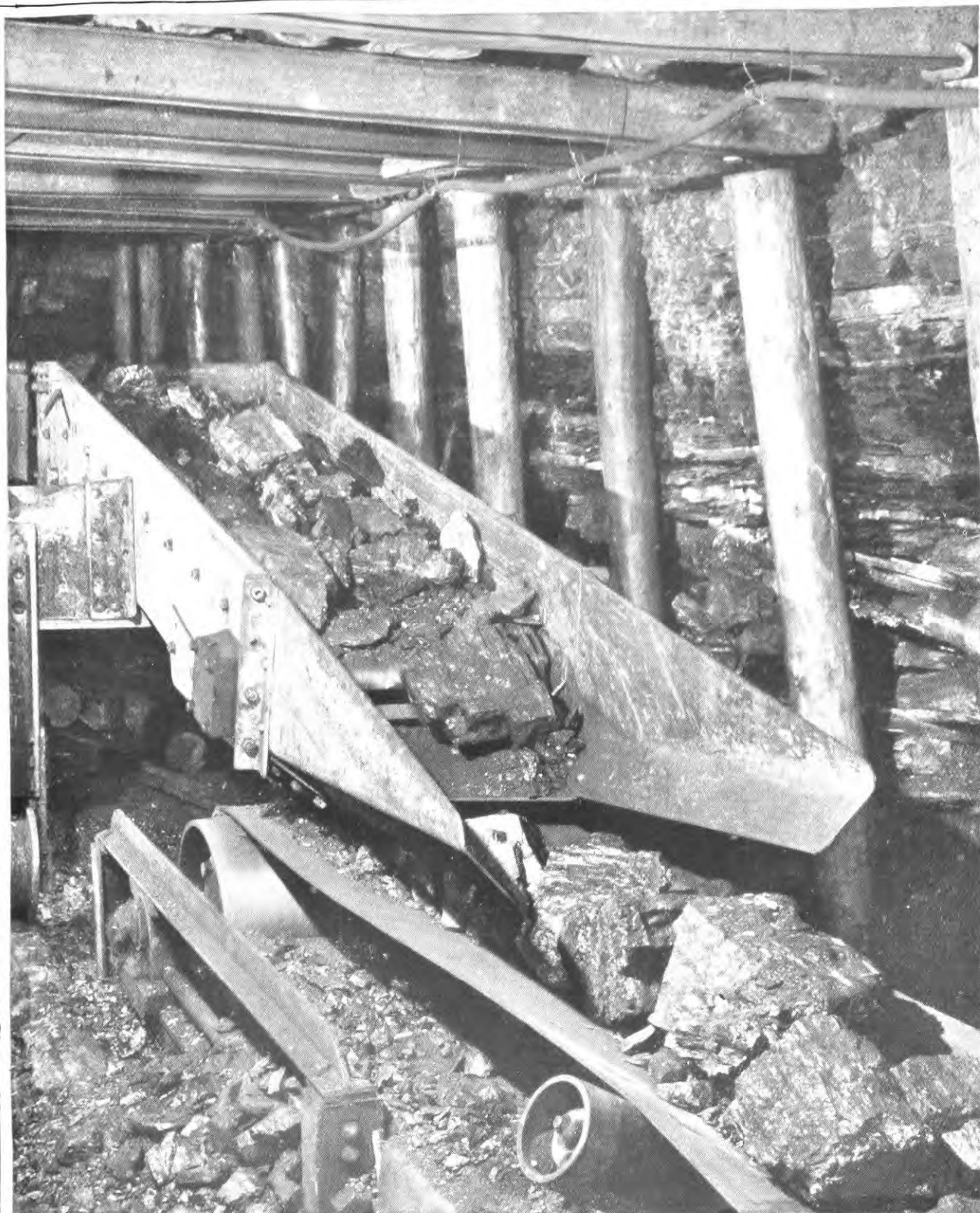
375 H.P. MAIN AND TAIL ROPE HAULAGE.



BATTERY LOCOMOTIVE CAPABLE OF DRAWING 12 TONS.



— UNDERGROUND TRANSPORT —
COAL TRANSPORTED FROM FACE TO GATE CONVEYOR.



TRANSPORT OF COAL ALONG MAIN ROAD TO LOADING STATION.



UNDERGROUND ROOF SUPPORT. (Illustrations - Pages 9 & 10.)

To-day we have a number of shafts which exceed 2,500 feet in depth and workings which are more than 3,000 feet below the surface. (In one colliery in Lancashire 3,800 feet has just been reached and as time goes on our collieries must extend their workings both laterally and in depth.) The increasing depth of working introduces many complicated problems since greater pressures occur and, therefore, underground support has to be carefully considered and the methods of working the coal to suit the conditions modified. While wood supports may give satisfactory results, for economical and safe working of coal more elaborate forms of support have to be adopted in many deep workings. At the "face" steel supports are now extensively used with excellent results. The use of steel in this connection has resulted in the lowering of costs as the props are extracted and replaced nearer the face as the workings advance, whereas when wood is used most of the props are left in the waste and never recovered. Besides being more economical than wood the use of steel results in more efficient getting of the coal and in safer working. The support of the main roads by wood is now being rapidly replaced by more elaborate methods such as steel, masonry, brickwork and reinforced concrete. Official Government Reports state that approximately sixty five per cent of the accidents in mines are caused by falls of ground, therefore underground support must receive careful consideration by all officials and workmen.

— UNDERGROUND ROOF SUPPORT —
— THE COAL FACE - ROOF SUPPORTED
BY WOOD —



THE COAL FACE - ROOF SUPPORTED
BY STEEL.



MAIN ROAD SUPPORTED BY WOOD.



— UNDERGROUND ROOF SUPPORT —

MAIN ROAD SUPPORTED BY STEEL ARCHES.



VENTILATION and the PREVENTION of EXPLOSIONS in MINES.

(Illustrations - Pages 13,14)

(a). Mine Fans.

In order to obtain safe and economical working of minerals ventilating fans of high capacity must be installed on the surface and the underground layout of the workings must be such that the full advantage of the ventilating machinery is obtained. The fact of greater depths being reached makes efficient ventilation of a colliery still more difficult as temperature rises with increasing depth and, since this is usually accompanied by an increase in the humidity of the air, the health of the workmen may be impaired and the output seriously affected if the ventilating current is inadequate.

The main object of ventilation is stated in the Coal Mines Regulation Act, 1911, Section 29, 1, viz., "An adequate amount of ventilation shall be constantly produced in every mine to dilute or render harmless inflammable or noxious gases." In the Act the standard of ventilation is definitely stated and no part of a mine is considered safe unless it contains not less than 19% of oxygen and not more than $1\frac{1}{4}\%$ of carbon dioxide. In order to comply with these requirements many large collieries have installed fans which are capable of passing up to half a million cubic feet of air per minute..... that, is, about 1000 tons of air per hour.

(b). Mine Gases and their Dangers.

"Firedamp" is the name given to the most common inflammable gas met with in coal mines. This gas mainly consists of methane or carburetted hydrogen (CH_4) and is exuded from the pores of the coal and from the "breaks" in the strata in close proximity to the coal seams. The quantity of firedamp passed into the air varies widely but one case may be cited, which although exceptionally high, shows the necessity of having adequate ventilating arrangements. In this particular colliery over ten million cubic feet of firedamp were discharged in twenty-four hours and this continued for some time. In most coal mines firedamp is present and, therefore,

therefore,/ great care must be exercised in order to prevent its reaching dangerous proportions.

Firedamp is physiologically inert but when in certain proportions it is highly explosive. We may ascribe the cause of practically all underground explosions to the presence of this gas. Other gases found in mines are carbon dioxide and carbon monoxide, both gases being formed by the chemical action of the oxygen of the air and the coal. Carbon dioxide, although not poisonous, is an inert gas and therefore dangerous to life if present in certain proportions. On the other hand, carbon monoxide is highly poisonous, as little as 1% causing death if breathed for a short time.

In order to avoid serious accumulations of gas underground an efficient ventilating system is obviously necessary but as the danger of gas is ever present ~~and~~ all workmen should be trained in their detection and those in charge well conversant with the behaviour and treatment of gases and, further, with the theory and practice of ventilation.

(c). The Dangers of Coal Dust.

Another danger existing underground is coaldust which, when raised in a cloud, has high explosive qualities. Dangerous gases are only found in isolated parts of the mine but coaldust is present throughout. To counteract its explosive properties all parts of the mine are treated periodically with inert dust so that the combustible content of the minerdust shall not exceed 50%. The carrying out of this operation has, to a great extent, eliminated the possibility of an explosion being propagated throughout the underground workings.

(d). The Sources of Explosions.

In order to prevent explosion care must be taken to reduce to a minimum any possible source of ignition. Light is a necessity underground but every light, no matter of what kind, is a potential

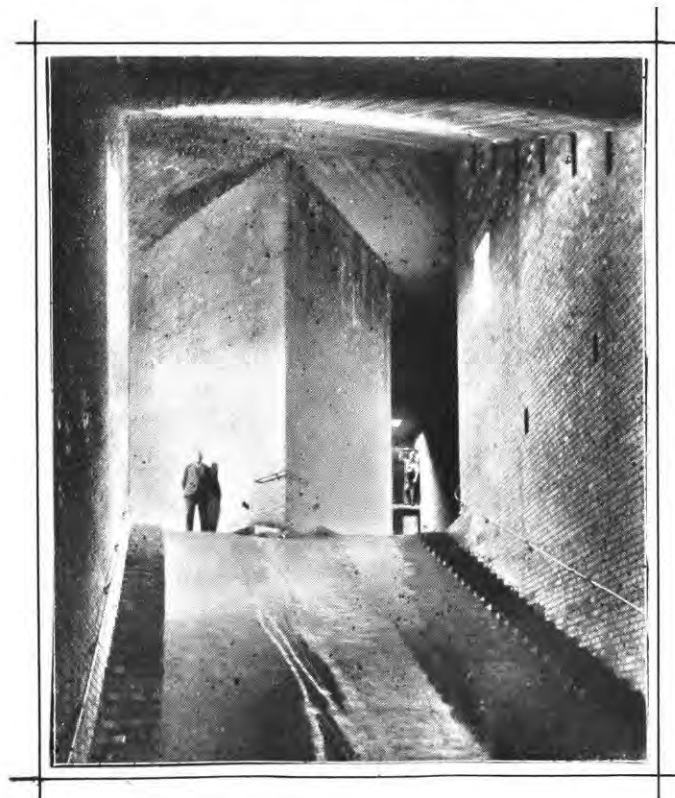
potential/ danger and, therefore, all safety lamps are required to pass an official Government test before being used underground but it rests with the workman to see that he uses the lamp with care while it is in his possession.

The use of explosives for both coal and stone is necessary in every colliery and although only "permitted" explosives may be used, none is devoid of flame, and certainly blasting operations in the mine are the most likely sources of ignition. The "permitted" explosive is only safe if the shotfirers and firemen carry out their duties according to instructions laid down in the Coal Mines Act.

Electrical apparatus is another possible source of explosion and, therefore, only apparatus which has passed an official test may be used underground. It is, however, a matter of extreme importance that electrical appliances should be installed by experienced men and that they should be kept in good condition, in order to prevent accident due to open sparking.

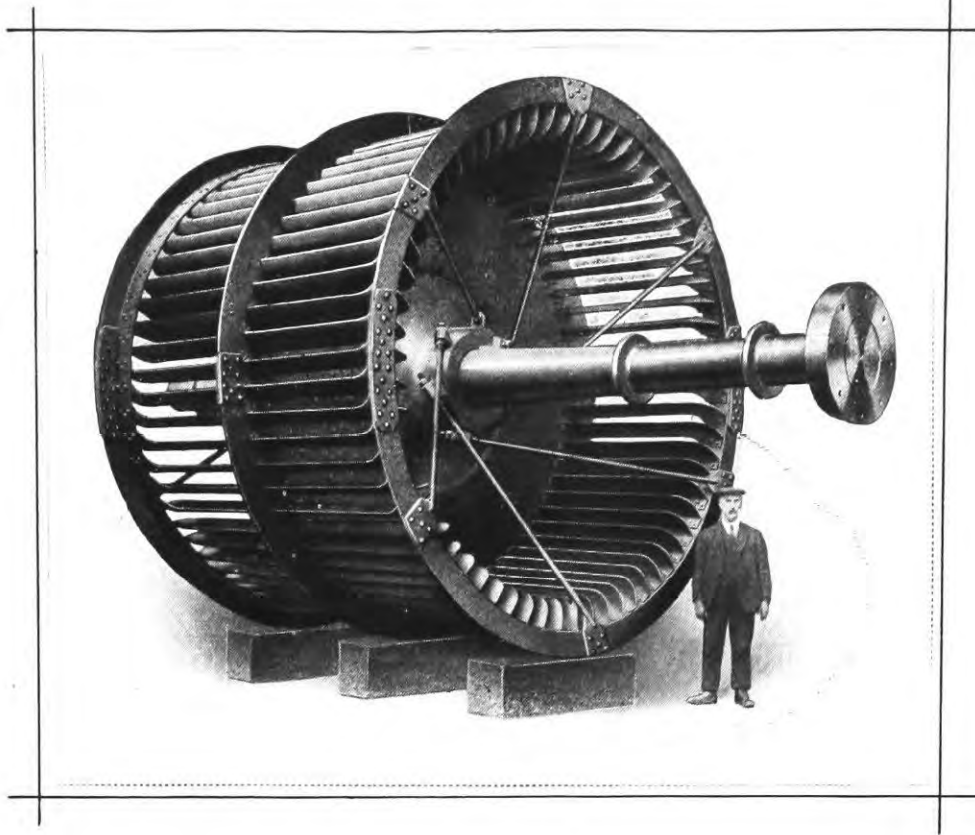
— THE FAN DRIFT —

CONNECTION BETWEEN FAN AND SHAFT.

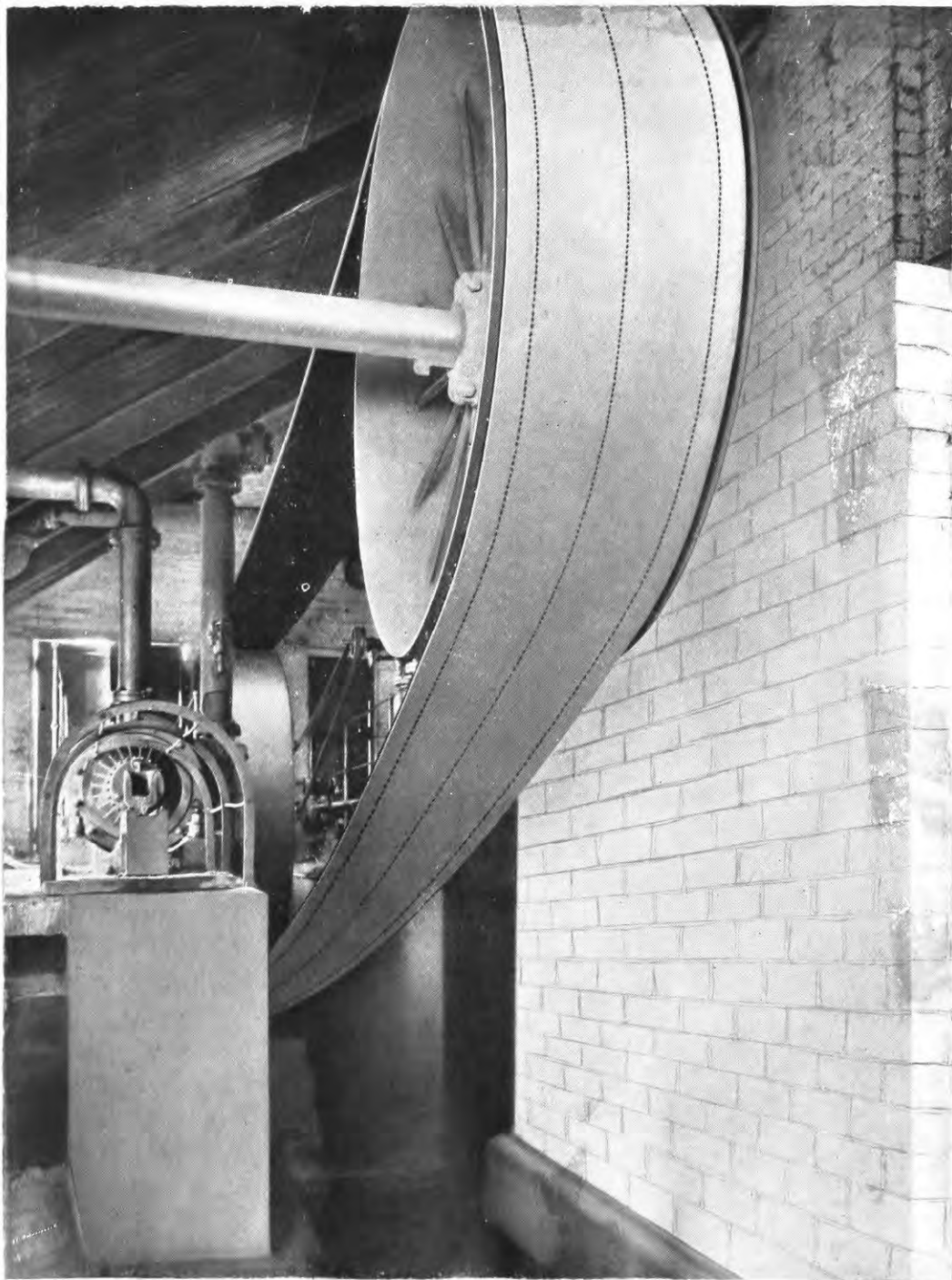


— THE ROTOR OF A MINE FAN. —

CAPABLE OF PASSING 500,000 CU. FT.
OF AIR PER MINUTE.



THE DRIVE OF A MINE FAN.

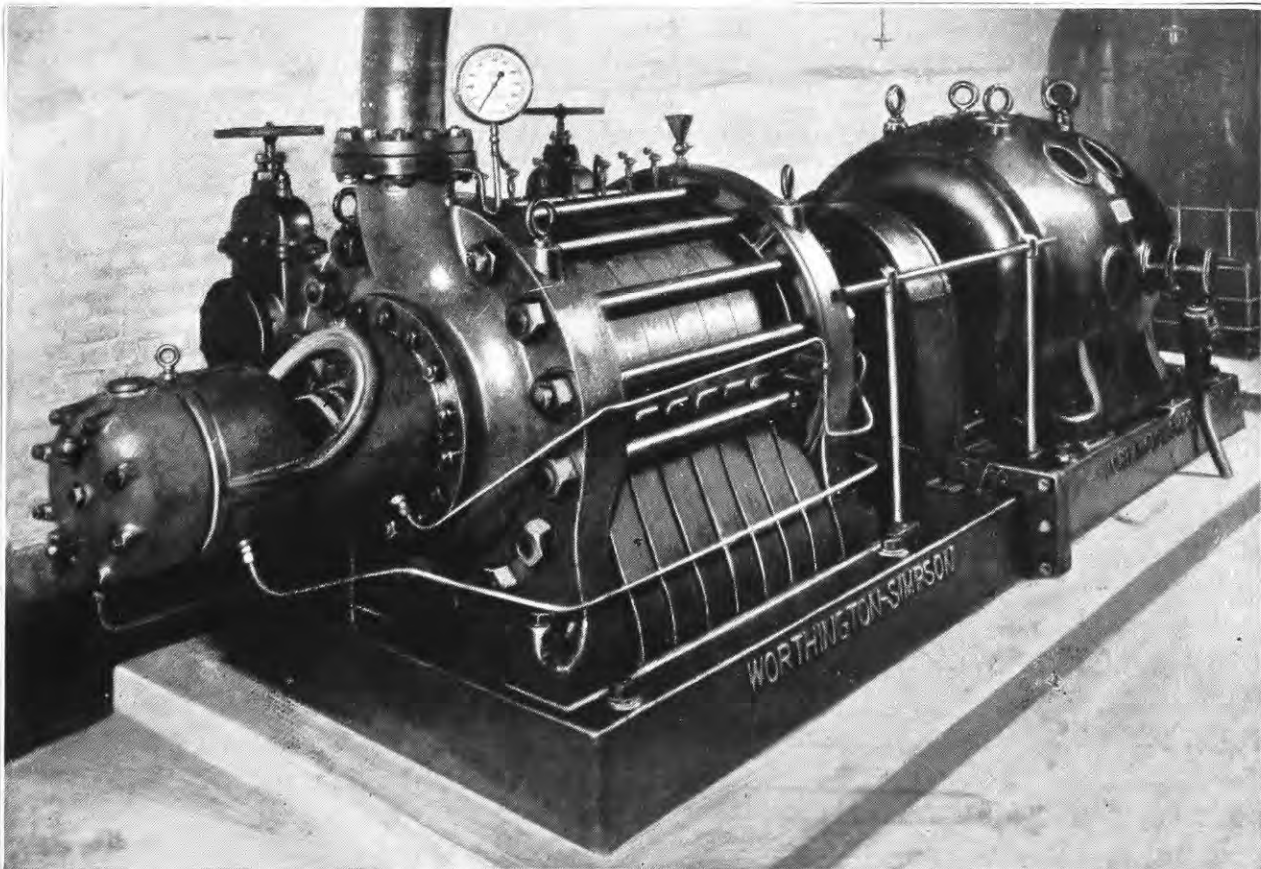


PUMPING.

In practically all coal mines there is an ingress of water from the adjacent strata and this water has to be collected from all parts and raised to the surface through pipes which are installed in the shaft. The elimination of the water from the workings depends on the underground layout and natural drainage to the shaft bottom is the ideal method. This, however, is not always possible and pumps driven by compressed air or electricity have to be installed inbye in order to convey the water to the sump from which the main pump conveys it to the surface.

— TURBINE PUMP. —

10,000 GALLONS PER MINUTE.



SURFACE ARRANGEMENTS. (Illustrations - Pages 17, 18 & 19).

The coal, on reaching the surface, is classified into large and small sizes. The former is passed over travelling belts where the stone is taken out by hand while the "smalls" are cleaned by hydraulic or pneumatic methods. The product of a colliery must be of highest quality and, therefore, efficient cleaning is of vital importance and demands close supervision on the part of the manager and the surface officials.

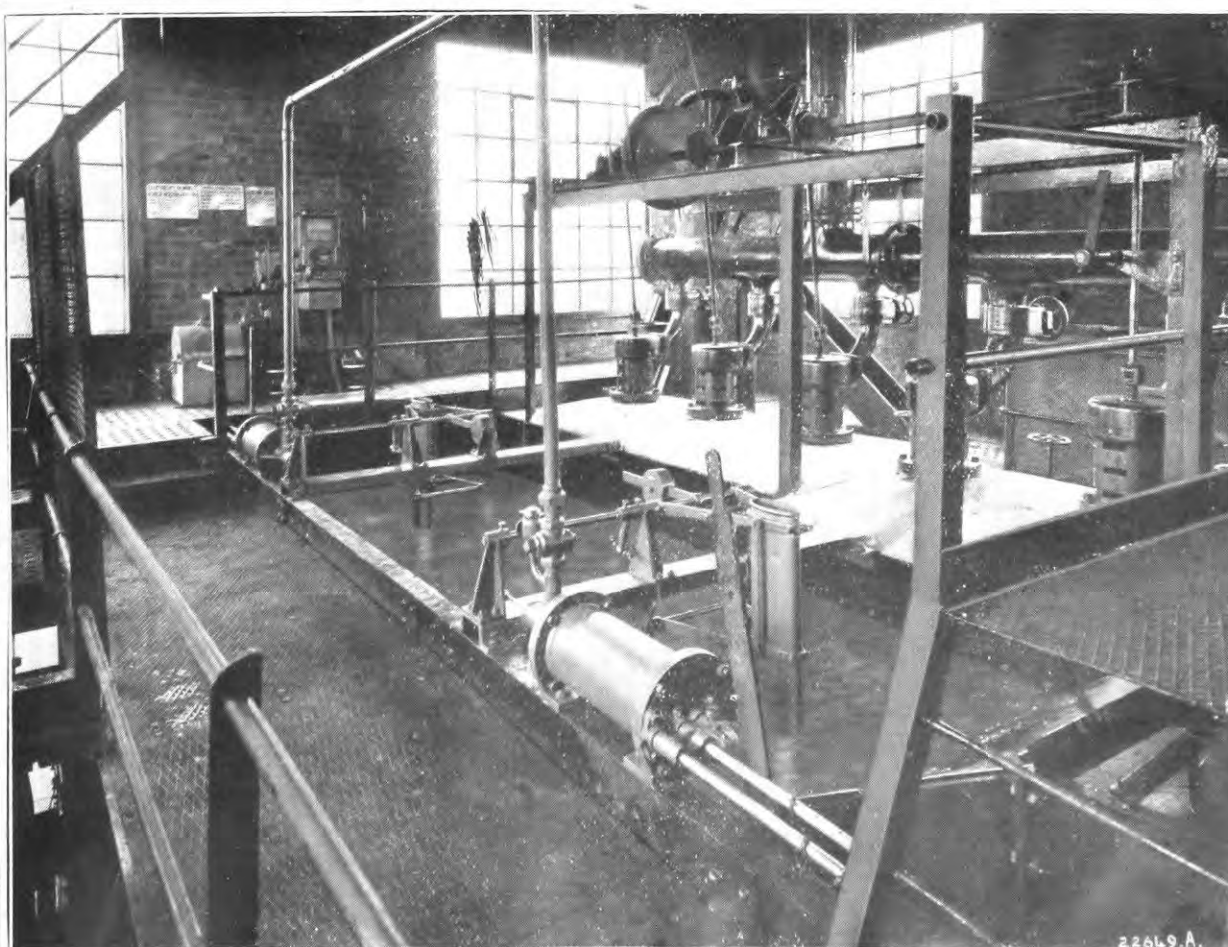
In a modern colliery the surface plant includes the following:-

- (1). Coal Plant (Transport to screens, picking belts, washer, etc.
- (2). Plant for disposal of debris.
- (3). Steam Plant (Boilers, steam turbines, etc.)
- (4). Ventilating Fan.
- (5). Compressed Air and Electrical Plant.
- (6). Winding Gear.
- (7). Workshops, (Mechanical, electrical and joinering shop).

— SURFACE ARRANGEMENTS. —
CLEANING OF COAL BY HAND PICKING.



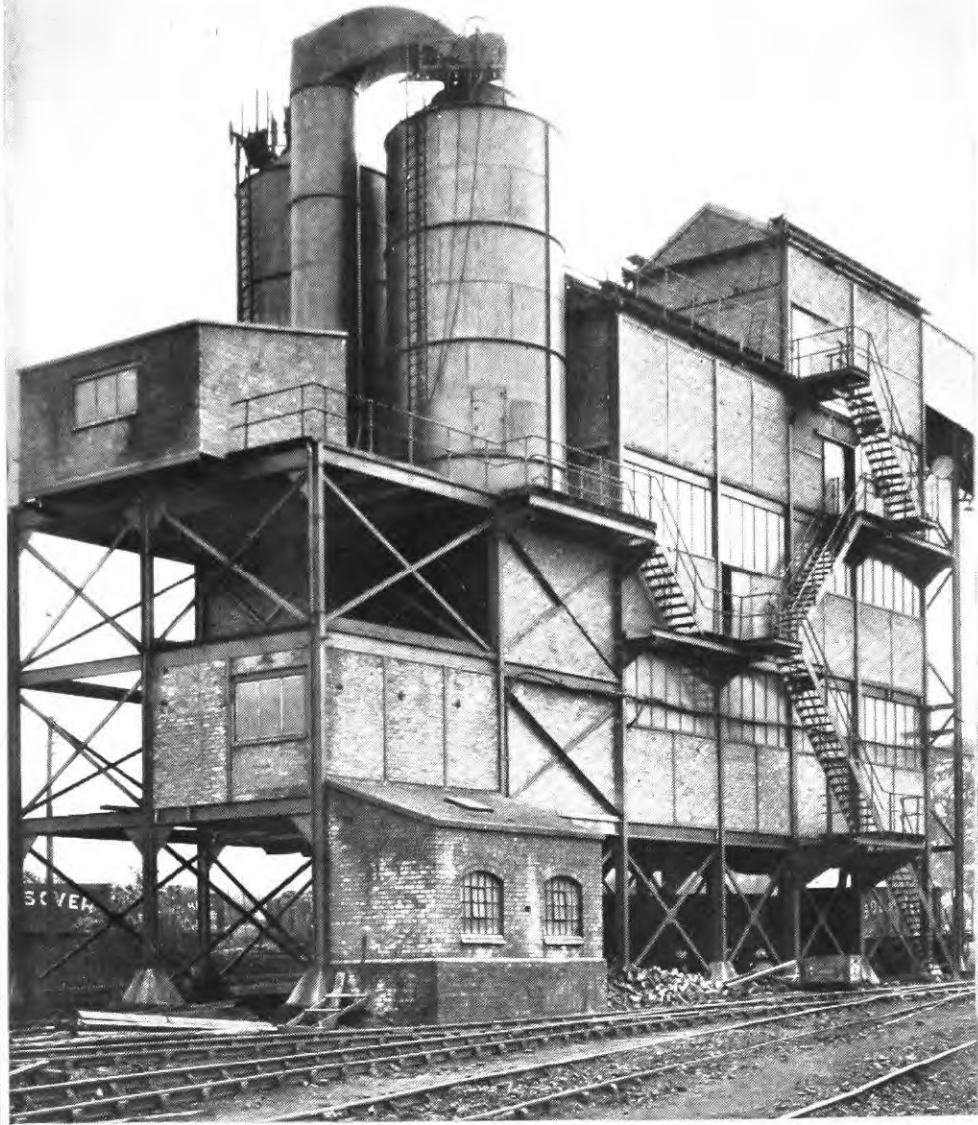
CLEANING OF COAL BY WATER.
THE WASHING TANK OF A "BAUM" WASHER.



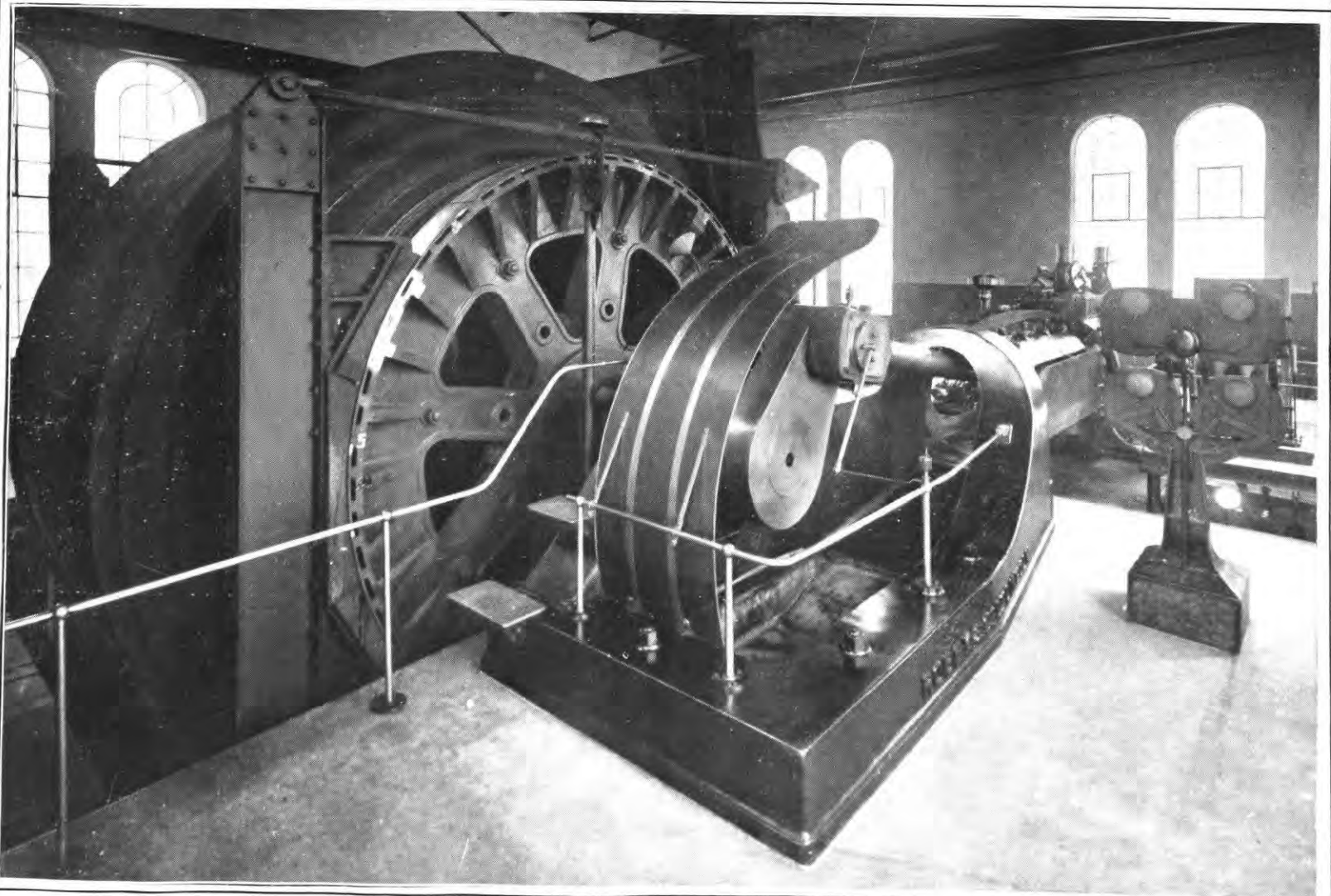
SURFACE ARRANGEMENTS.

CLEANING OF COAL BY AIR.

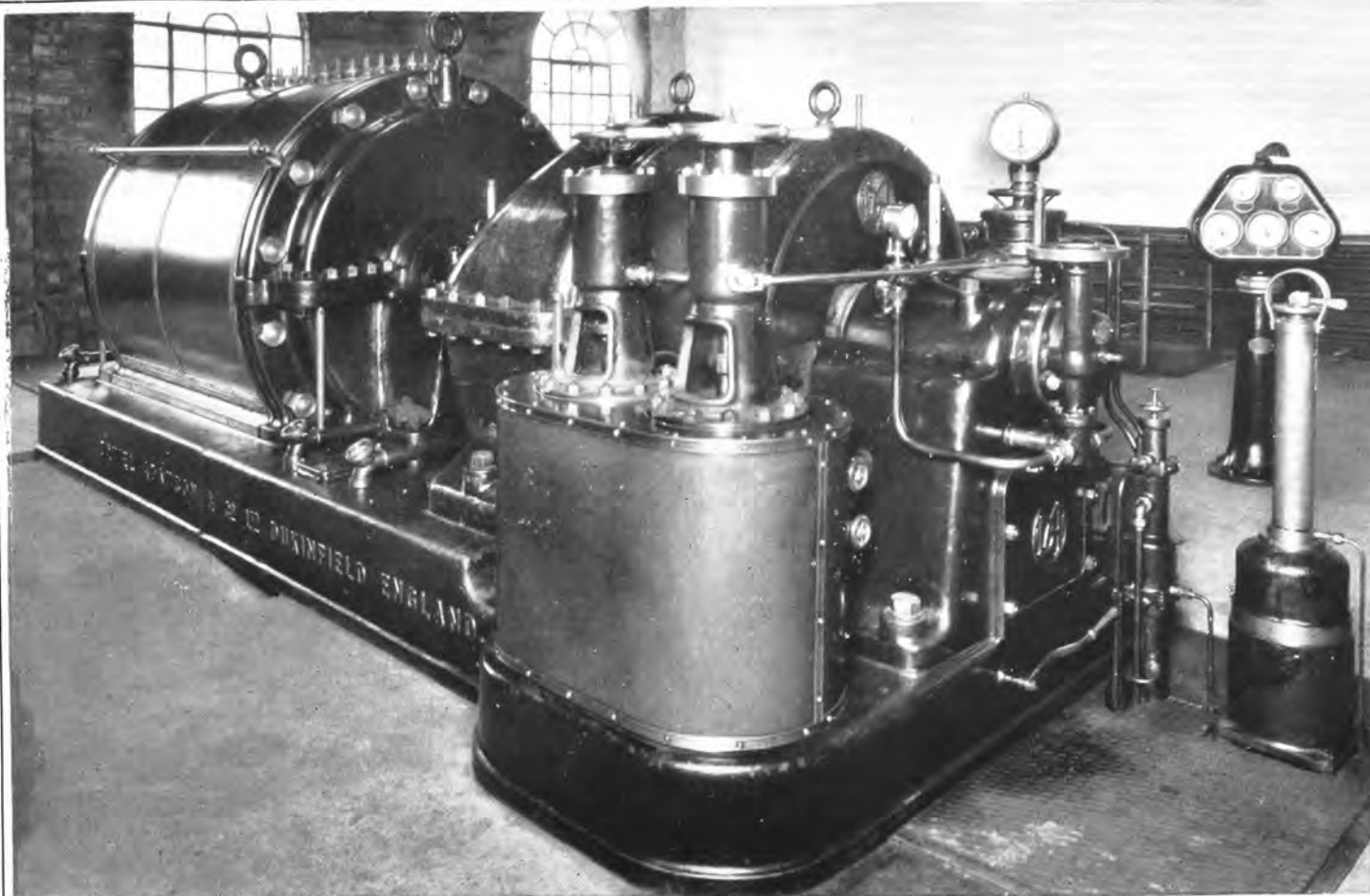
A "BIRTLEY" DRY CLEANING PLANT.



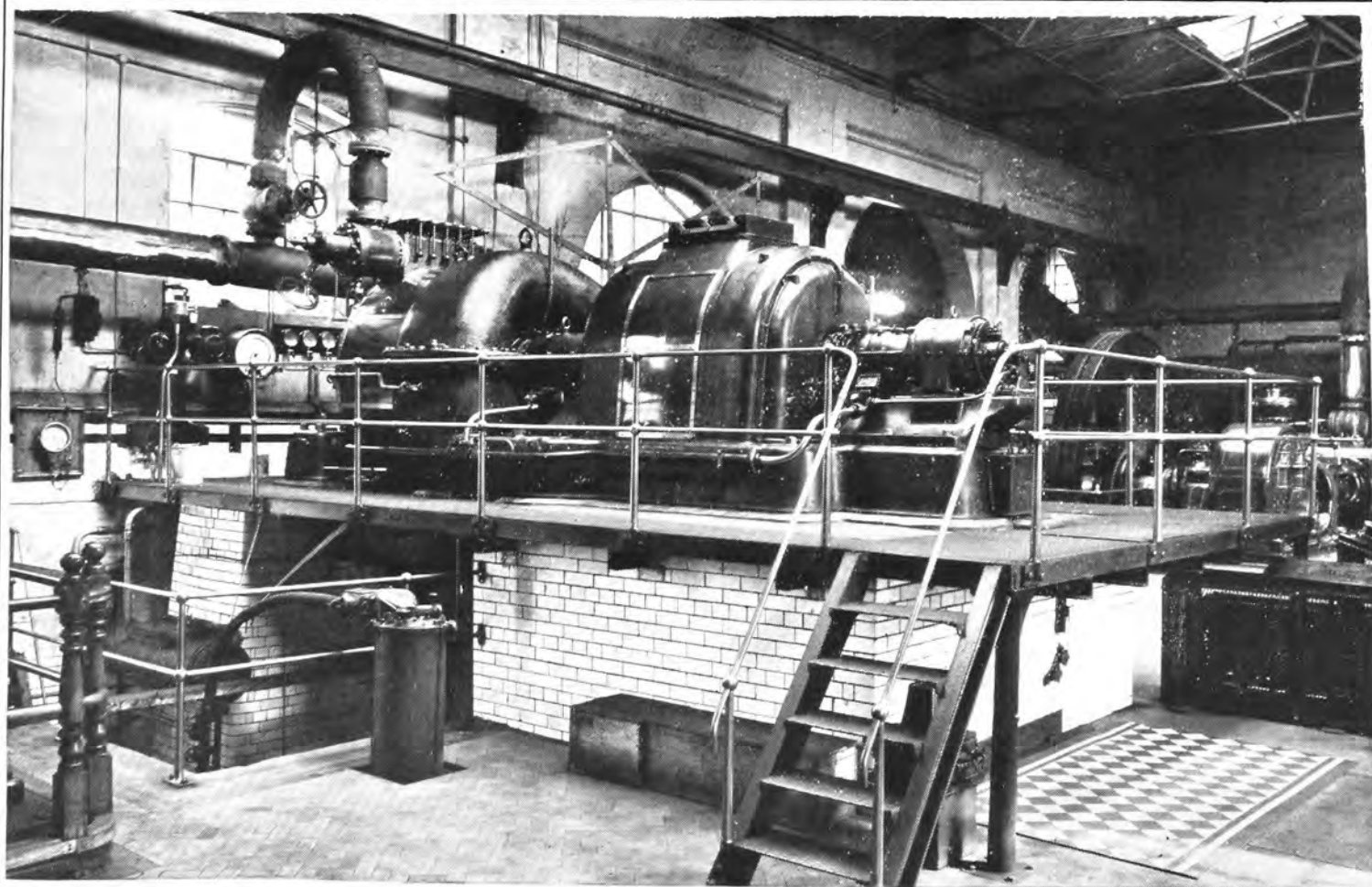
STEAM WINDER WITH CILINDRO-CONICAL DRUM



SURFACE ARRANGEMENTS.
A TURBO-AIR COMPRESSOR - 6000 CU. FT. OF AIR PER MINUTE.



ELECTRICAL GENERATING PLANT.



THE LAMP ROOM.



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"The Colliery Guardian."

"Colliery Engineering".

"What every mining man should know" issued by the Safety in Mines Research Board.

C H A P T E R II

A Historical Review of Mining Education.

The aim of this Chapter is to show that the beginnings and early development of mining education were due to the appalling mine disasters which occurred periodically in all parts of Great Britain. References to these calamities are, therefore, made throughout the chapter and also to the many Royal Commissions which were appointed to enquire into the mining conditions existing at the various periods. Special reference is made to those parts of the official reports connected with Mining Education.

A HISTORICAL REVIEW OF MINING EDUCATION.

Birth of the Geological Survey and Mining Record Office.

In 1815, William Smith, a surveyor by profession and with no wealth to undertake great things, published the first geological map of England. The publishing of this map attracted attention to the science of geology and we find that eminent men, among whom was no other than the Prince Consort, became impressed with the importance of the subject. Henry de la Beche carried on the work of Smith and, at his own expense, made a careful and prolonged study of the geology of England. He felt that the survey of the mineral resources of this country should not only be carried out immediately but that the State should recognise its importance and also its economic advantage to the nation. In 1832, after much striving with the British Government, the Geological Survey of the British Isles was established and recognised as an important office of the Government.

The lack of geological knowledge was being felt in all mining districts and, as one example of the ignorance which prevailed, the old proverb "no coal under limestone" was difficult to disprove, with the result that coal mining on the Tyne and Tees was jeopardised. The importance of keeping geological and mining records was also recognised by the British Association and an appeal was made to the State for a building to house these treasures. Two houses near Charing Cross, London, were granted to Henry de la Beche and so the first Mining Record Office was established. A laboratory was attached where geological and mining matters could be dealt with.

In 1851 a new Museum of Practical Geology and Mining Record Office was opened by the Prince Consort. This was

was/ to be the first home of the Royal School of Mines.

Beginning and Development of Mining Education.

In 1838, Sir Charles Lemon, a native of Cornwall, issued circulars to all the mine owners in that county and made this liberal offer:- "With a view, to ascertaining how far there is a real demand for such (mining) instruction, I will take on myself the responsibility of an experiment for two years. If I should find, on considering the details, that my plan offers a reasonable measure of success.....I will endow the institution in such a way as shall afford a reasonable hope of its permanence." X The project never materialised owing to the lack of support from the mine owners.

From 1840 to 1845 appalling mine explosions occurred all over Britain involving the loss of hundreds of lives. A Royal Commission was appointed and in 1849 presented their report to the House of Lords. Referring to education the Report states "Among those best qualified to speak upon the point, a want appears to be felt of facilitations for acquiring mining education such as are provided by the mining schools established in the principal mining districts of the continent, apparently with the most beneficial results."

Further, in 1850, in a Report on Mine Ventilation by John Phillips, F.R.S., the following statement occurs:- "To provide easy and sure means of imparting the due amount of practical and scientific requirements to the managers of mines, well-appointed provincial mining schools suited to all grades and duties of mining officials are essential". These were the first official statements that were made on the lack of education among those holding

X Circular to Mine Agents on "Safety in Mines".
by Sir C.Lemon.

holding/ responsible positions in mining. There had been 100 years of disastrous explosions before it was realised that these catastrophes were to a great extent due to the ignorance of the mining officials. No reference was made to the necessity of educating the miner as well as the official.

Sir Henry de la Beche, realising the ignorance of technical matters among those engaged in the mining industry, pleaded the cause for a National School of Mines being established and in an address given in public he said, "The importance of the mineral wealth of the United Kingdom far exceeds that of any other European State and furnishes four ninths of raw material derived from all Europe. Although the annual value of the mineral produce of this Kingdom amounts to £24, 000,000 (Twenty-four Million Pounds) and the capital and labour employed in its extraction and application represents a much larger sum, no school, having for its special object the instruction of persons engaged in mining operations, has yet been established in the United Kingdom." X

The owners of the mines were also demanding a better education of their responsible employees. Pits were being sunk to deeper levels, ventilation, or, rather, the lack of it, was creating a serious problem and explosions continued to occur at regular intervals, involving heavy loss of life. The miner was becoming alarmed by these repeated disasters and the public who, up to the present time, had been indifferent to the

X History of the Royal School of Mines by M.Reeks.

the/ miner's lot, now appealed to Parliament for some form of legislation. The miners' poet even pleaded the cause:-

Was there ever so slaving and slashing a trade
Such a trade as this horrible hewing,
I wish I'd been bred to the plough and the spade
To building or baking or brewing.

I'm up in the morning afore it is light
And down in the pit in the dark
And tho' I get home afore it is night
I'm asleep from my terrible wark.

On November 6th, 1851, the Government School of Mines was opened. The purpose of the School was stated to be as follows:-

"The educational course of this school differs essentially from that given in Colleges, where general education is the primary object. Although it is intended to give general instruction in science to those who may require elementary knowledge, still the chief object of the institution (to which everything else is subsidiary) is to give a practical direction to the course of study so as to enable the student to enter with advantage upon the actual practice of mining or of the arts which he may be called upon to conduct."

With regard to the numbers of students attending the Government School of Mines, complete success could not be claimed. The numbers enrolled were as follows:-

Session.	Matriculated.	Occasional.	Total.
1851-52	15	49	64
52-53	14	50	64
53-54	18	47	65
54-55	16	46	62
55-56	17	48	65
56-57	9	54	63
57-58	11	45	56
58-59	12	68	80

It is, however, interesting to note that the lectures in general science given to working men in the evenings were completely successful. In the first year approximately 1,000 attended and three years later double the number applied but could not be admitted.

While it may be said that the Government School of Mines (re-named the Royal School of Mines in 1861) could not boast of much success and that it actually drew no students from the mining districts, it has to be remembered that there was no educational foundation on which to build such subjects as mining, geology and metallurgy. About this time Elementary Schools of Mining were commenced in Cornwall, Glasgow, Bristol and Wigan but did not show much progress owing to the lack of the rudiments of knowledge on the part of the students.

In 1864 the Miners' National Association (predecessor of the Miners' Federation of Great Britain) presented a petition to Parliament urging "That all agents, overmen and chief managers of mines be subjected to a scientific examination and that a certificate of competency be given by some qualified person, or Board of Examiners as your Honourable House may be pleased to direct, previous to any mine being placed in their charge."

After this report was received a Select Committee of the House of Commons was formed to investigate the matter with

with/ special regard to the qualifications of managers and of any other person holding responsibility in the mine. Up to this time no acknowledgement of the State obligation to the workmen's causes had been made. This is shown clearly in a Report submitted to Parliament in 1868---".....in Belgium more especially and in France, the right of interference by the State in the management of mines is founded in their being, to some extent, State property, and is partly exercised with the object of securing to the State its due share of the produce." This was in reply to some claims that had been made that since certain States in Europe could intervene in the management of mines, there was no reason why the British Government should still persist in its idea that interference was uncalled for. After the investigation, members of the Committee reported that although they thought it desirable that a little technical knowledge would be helpful, they did not think it^{at} all necessary to carry the subject so far as the Miners' Association suggested "since the owners of mines, in assuming to themselves the uncontrolled selection of officers whose duties, so far as they concern the safety of those employed in mines are of a public nature, take upon themselves both morally and legally, a greater responsibility than would attach to them if their choice was limited by legal conditions."

It is interesting to note that attempts were made by the miners in Alloa, Scotland, to form a school not for the teaching of mining but for the general education of the miners' children. An old report issued in 1853 states " From their removed locality the excellent advantage of the Scotch Parish School cannot benefit them. They are, therefore, in the same predicament as the English miner... ..but they must have their children educated and have, therefore, formed a Society for this purpose. It is a Society of a great many years' standing and the only advantitious aid we believe it has had was at first from the grandfather of the present Earl of Marr who gave a donation of £100 to aid in establishing it. That institution has worked well for two generations." (1).

(1). "The Coal Mines--Their dangers and means of safety." J. Mather 1853.

While the lack of mining knowledge was to be deplored no real advance could be made until the elements of education had been established. The Industrial Revolution was accelerating a movement in this direction, while in mining the installation of machinery for pumping and ventilation had allowed of greater depths being reached with subsequent greater dangers from explosions of firedamp. This, in itself, called for greater enlightenment of all engaged in the mining industry and, coupled with the great industrial progress, education of the masses became imperative. It may, therefore, be said that no real specialised instruction was given to miners (apart from that given at the Royal School of Mines) until the passing of the Education Act in 1870 and not until 1880 was the benefit of this Act felt in any of the branches of technical education.

Until the year 1872 no standard of competency was required for mine officials with the result that many men, who had no education whatever, were holding responsible positions in the mining industry, but in that year an introduction was made into the code of mining legislation stipulating that all mine managers should be examined before being allowed to hold the position. Bills were introduced into Parliament in 1869, 1870 and 1871 resulting in much controversy but finally the Act was passed in 1872. This Act stated that mines of coal, stratified ironstone, shale and fireclay must now be under the control and daily supervision of a manager who must be a holder of a certificate granted under the Act. Persons already in charge of collieries, on especial application being made to the Mines Department, were granted certificates.

The necessity of officials of mines holding certain qualifications resulted in the setting up of an Examination Board in each mining district to carry out the administration. These boards were appointed by the Secretary of State and each was composed of ten persons, three representing the owners, three representing the workmen, three officials and one inspector of mines. Each board had its own standard of qualification and also selected its own examiners. This system was continued for 15 years but it was certainly

certainly/ open to criticism owing to its lack of uniformity.

In 1887 an Act of Parliament was passed in which two different standards of examination were introduced. One of these was to be taken by persons desirous of being managers of mines while the other was set to suit working miners. The major portion of the latter examination was arranged along practical lines and successful candidates were allowed to hold the position of under-manager in a mine. The Manager's (or First Class) Certificate was raised in standard, making it necessary for the candidates to have a more advanced technical knowledge of their subject. Another statutory condition added made it compulsory for candidates to have five years practical experience before taking the examination.

Up to this time mining education had been confined to those in circumstances which permitted of their travelling to and attending classes in the large centres. There were very few students from the ranks of the working miner. Local evening schools, however, began to be formed after the Technical Instruction Acts of 1889 and 1891 and the Local Taxation Act of 1890 had been passed. The working miner for the first time was given facilities to obtain evening instruction in the art of mining.

In 1906 a Royal Commission was appointed " to enquire into and report on certain questions relating to the health and safety of miners and the administration of the Mines Act." In referring to the necessary qualifications for officials of mines the Committee condemned the whole method of examination. Their chief objections were as follows:-

- (1). That the examination had not kept in line with scientific progress.
- (2). The total lack of uniformity between the districts.
- (3). Interpretation of the statutory conditions not the same in each district.

As an example of the knowledge required by candidates and also the diversity of subjects in the separate districts, the following

following/ particulars taken from "Instructions to Candidates" are given:-

(1). Broughty Ferry.....1888.

Candidates will be examined in the following subjects:-

- (1). The Coal Mines Act---General Knowledge.
- (2). Ventilation, Theoretical and Practical Knowledge.
- (3). Modes of working coal, ironstone and other minerals.
- (4). Sinking, fitting and pumping with the theory of the steam engine.
- (5). Winding, haulage and strength of materials.
- (6). Underground surveying and drawing.
- (7). Arithmetic up to fractions with calculations of areas and velocities.

(2). Northumberland District.

Candidates will be examined in the following subjects:-

- (1). Ordinary education--Reading writing and arithmetic.
- (2). Engineering--general principles, including pumping.
- (3). Practical Mining--sinking, working, timbering, bratticing and ventilation.
- (4). The nature and properties of gases.
- (5). The duties of a manager as described by the Mines Act.

(3). West Lancashire and North Wales.

Candidates will be examined in the following subjects:-

- (1). The practical working of mines in the mining district of West Lancashire and North Wales, including the provisions of the Coal Mines Act, 1887, and the principles of mechanics.
Note:- The attention of candidates is directed to Goodwin's "Principles of Mechanics" or other text-book on the subject.
- (2). An examination on "A Practical Treatise on the Gases met with in Coal Mines and the General Principles of Ventilation." by J.J. Atkinson.

(4). Nottingham and Derbyshire.

Candidates will be examined in the following subjects:-

- (1). Writing.
- (2). Arithmetic.
- (3). The winning and working of mines of coal, mines of stratified ironstone, mines of shale and mines of fireclay.
- (4). Machinery.
- (5). Ventilation.
- (6). Safety of Mines and miners and opening works after being closed for a period.
- (7). Surveying and plans.

A viva voce test on the foregoing will also be given and candidates will also be examined in reading.

(5). South Wales.

Candidates will be examined in the following subjects:-

- (1). Writing from Dictation and correcting spelling.
- (2). Geology of South Wales Coal Field.
- (3). Arithmetic.
- (4). Coal Mines Act 1887.
- (5). The working and winning of coal, stratified ironstone and fireclay.
- (6). Practice and theory of ventilation.
- (7). Practical knowledge of the machinery and boilers generally in use in collieries.
- (8). Underground Surveying.

It can be easily seen by comparing these schemes of work how divergent the standards were. It is also striking the amount of knowledge that was required as early as 1888 before any person could hold a position of responsibility in the mining industry.

The Commission of 1906 also stated that district Boards should be abolished and one central Examination Board established and that examinations should be held simultaneously in seven centres of the principal coal fields of the country. It was also recommended that each candidate submitting himself for examination should at least be twenty-five years of age and should be required to show that he had had an all-round experience in mining. A viva voce test was also recommended as being essential since it gave the candidate the opportunity of supplementing his written work and acted as a test of his general knowledge.

In a Bill presented to Parliament in 1911 all these proposals were included. The Central Board of Examiners was composed of 15 members who were represented as follows:-

- (1.) Six representing the owners or agents of mines or managers of mines or mining engineers.
- (2). Six representing the workmen employed in mines.
- (3). One chief inspector of mines and two divisional inspectors of mines.

Two persons eminent in mining and scientific knowledge have been incorporated in the Board since 1911 making a total of 17 persons. The present requirements regarding the qualifications

qualifications/ of mine officials are, except for a few minor details, as stated in the Act of 1911.

Since 1920 Mining Education has been considerably developed owing to the assistance provided by the Miners' Welfare Fund from which has been allocated approximately £750,000 to the various schemes in connection with Universities, Colleges and mining centres throughout the country. In fifteen counties organisers give their whole time to the furtherance of education among the mining community. In most coal-fields evening classes are held in the villages where the elementary work is done and in the larger towns advanced centres have been instituted for the benefit of those who wish to attain the goal of 1st and 2nd Class Certificates.

Much detail has been given regarding the legislative aspect of mining knowledge but this has been rendered necessary since it was greatly due to compulsion that mining education began so early. It has also to be noticed that before any person can rise in this profession he must obtain a very high standard of technical knowledge and, bearing in mind that this has been the case since 1872, it is realised that the mining industry has for sixty years stood alone in demanding such definite qualifications from persons holding positions of responsibility. At the same time, however, it holds promise for the rank and file since they are given every opportunity of studying and obtaining the necessary certificates entitling them to fill the higher positions in the industry.

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C H A P T E R III

Statutory Examinations in Mining with Criticism thereon. -----

Mining Education has always been controlled by the requirements of the Examinations as detailed in the Coal Mines Act and Regulations. It is, therefore, necessary to include a chapter on this subject. No progress can be made in mining education until the examinations are so arranged that instruction to the student may be given in a more comprehensive and orderly manner. With this aim in view, the writer has suggested a re-organisation and grouping of the examination subjects. Many references have been made to the "Holland" Report^{*} and criticism has been based on the statements contained in this publication.

* See Page 34.

STATUTORY EXAMINATIONS IN MINING with CRITICISM thereon.

Introduction.

Mention has already been made regarding the qualifications required by statute from persons who intend holding positions of responsibility in the mining industry. These qualifications are laid down in the Coal Mines Act and Regulations.

The official examinations are as follows:-

- (1). Examination for 1st Class (Manager's) Certificate of Competency.
- (2). " " 2nd " (Undermanager's) " "
- (3). " " Fireman's (Deputy, Examiner) Certificate.
- (4). " " Shotfirer's Certificate.
- (5). " " Surveyor's "

In the criticism of the examinations many references are made to the "Report to the Secretary for Mines of the Committee appointed by him to enquire into the qualifications and recruitment of Officials of Mines under the Coal Mines Act." This Committee was composed of mining engineers and educationalists under the chairmanship of Sir Thomas H. Holland. About fifty witnesses from all associations connected with mining were interviewed and all the views stated embodied in the Report. It was, therefore, thought expedient that the Report should be taken as the basis of criticism of the present conditions of examination, the criticism being made from an educational point of view.

1st and 2nd Class Certificates of Competency.

There are two certificates granted, viz., 1st and 2nd Class Certificates of Competency. An applicant for the first must be at least 23 years of age and for the second at least 21 years of age. *

An applicant must submit testimonials and certificates of his preliminary qualifications as follows:-

- (1). Testimonials of his sobriety and good conduct.
- (2). A certificate of proficiency in First Aid.
- (3). A Fireman's Certificate (as to his ability to test for inflammable gas.)
- (4). Record of his practical work in mines. (The candidate must have not less than five years practical experience or not less than three years if he is a holder of an approved degree or diploma.

* An applicant is not registered as a holder of a Second Class Certificate until he attains the age of 23.

To obtain a Certificate of Competency the candidate must qualify in a written examination and oral test.

Written Examination.

Details of the examination subjects are as follows:-

- (1). Winning and Working: Geology. Boring and Sinking. Underground Layout. Machine Mining. Support of Roofs and Sides. Explosives.
- (2). Theory and Practice of Ventilation: Gases met with in Mines. Ventilation of Mines. Distribution of air Underground. Safety Lamps.
- (3). Explosions: Mine Gases. Coal Dust. Spontaneous Heating. Rescue Operations. Working near water-logged strata and old workings.
- (4). Machinery: Winding, haulage and pumping. Generation and transmission of power(electrical, mechanical and compressed air). Strength of materials.
- (5). Surveying: Surveying by compass and theodolite. Levelling. Drawing and Plotting. Volumes and Areas. Connecting surface and underground surveys. Mine plans and sections. (Note:- Each candidate must submit a plan and section showing an underground survey made by himself.)
- (6). General Management and Mining Legislation. Layout of Surface arrangements. First Aid and Ambulance Work. The Coal Mines Act. Writing of Reports.

The examination for the First Class Certificate demands a high standard of technical knowledge. The other is set on more practical lines.

STANDARD OF EXAMINATIONS.

Written Examination.

- (1). An applicant qualifies if he obtains 40% or more of the maximum marks for each subject and 55% or more of the maximum marks upon the subjects taken collectively.
- (2). An applicant who fails to obtain 40% in one subject or in two subjects but who obtains 60% or more of the maximum marks upon the six subjects collectively is eligible for re-examination at the next succeeding written examination. If he obtains 40% or more in these two subjects he has qualified in the written examination. X

Oral Examination. (Only taken if the candidate has passed in Written Examination.) The pass mark is 50%.

X This condition only came into force for the examination held in May 1934. Previously the whole examination had to be taken in one sitting.

Combined Written and Oral Examinations.

(1). The candidate must obtain at least 60% of the maximum marks of the whole of the examination (Written and Oral), in order to qualify for a certificate.

(2). If a candidate obtains at least 60% in the written and at least 50% in the oral examinations but fails to obtain 60% of the maximum marks of the whole examination he must be re-examined at the next oral examination. Failure at the oral test necessitates his taking the written examination again.

Fig.1,p49 shows in table form how the examination standards are estimated. All the marks shown are minimum marks.

The standard demanded by statute, as illustrated in Fig. is very high. To cite one case-- a candidate who obtains 55% as an aggregate in all subjects of the written examination must obtain at least 77% in the oral test to qualify. In comparison with other professions this examination standard is one of the most stringent. Against this, of course, the standard of marking has to be considered. There can be no doubt as to fair valuation being placed on the candidates' papers since no script is marked by one individual, all results being submitted to the Central Examiners. On referring to the results of post-war examinations approximately one third of the candidates qualify at each test. No objection can be made regarding the high standard demanded. The manager or under-manager of a colliery has grave responsibilities to those under him and it is, therefore, imperative that his technical knowledge of all subjects pertaining to mining should be of such a standard that he is able to meet all problems in his profession with equanimity.

Criticism on Mining Examinations.

Approximately 90% of the candidates presenting themselves for examination are miners or those holding minor official rank in the mines. The common method of studying is by attending evening continuation classes, most candidates completing six to seven years before taking any statutory examinations. No conditions are made regarding the number of hours instruction and if the intending candidate can furnish the necessary certificates and testimonials he may go forward to the examination. The examinations, as already described, cover many varied subjects and questions might quite easily be set on material which he has studied in the first years of the mining course. There is no objection to this principle but it is claimed that after, say, a six-years' course, no examination will accurately test the student in the knowledge which he has accumulated during all these years. The examination as it is at present, attempts to test simultaneously general education and highly specialised work.

In a Report to the Secretary of Mines on the Recruitment of Officials of Mines (1930) the following statement occurs:-

"They (the Central Examiners) stated that the existing rules provided sufficient latitude to enable the examiners to take into consideration clarity of expression, spelling and other elements of general education; and that, subconsciously, their marking is influenced by these matters".

The examinations fixed by statute are essentially to test the candidate's knowledge of mining and he should, therefore, not be penalised if he has not facility of expression.

By having one final examination at the end of a mining course the whole educational structure is made "top-heavy". The obvious solution is to have a preliminary examination at the beginning of the course in order to test general education. Not only is this educationally sound but it is to the student's advantage since he is able to estimate at the very beginning of his studies his ability in general subjects, such as English, Drawing, Science and Mechanics.

In many of the Reports made by the Central Examiners the following statements recur:-

"There were bad mistakes in simple arithmetic."

"The descriptions were poor".

"The sketches were carelessly drawn". etc.

By demanding a certain standard of education (either by special examination or by accepting certain standards of the various Education Authorities) at the commencement of a course in mining the quality of work submitted at the final examinations would be of a much higher order, and valuation of the papers would be solely on the technical knowledge shown by the candidates. Of course, the instituting of a Preliminary Examination would not of itself suffice as the candidate has still to study a diversity of subjects of which his knowledge is tested in a two-days' examination.

The following alternative schemes are suggested:-

(1). To have an intermediate examination about the fourth or fifth year of the evening course, to be followed by the final test in its present form.

(2). To have an intermediate examination with grouping of subjects in the final examination.

The Intermediate Examination.

An Intermediate Examination is, for First Class students at least, already in vogue to some extent. as quite a number, before taking the higher qualification are holders of a Second Class Certificate. The latter, however, is not exactly of the type that would be set as an intermediate test since it is actually a specialised mining examination set along practical lines.

An intermediate examination suitable for mining students would include the following subjects:- English, Mathematics, Science, Drawing, Electrotechnics, Mechanics.

All those subjects would be studied with special application to mining. The advantage of such an examination needs very little comment. Having passed a Preliminary and Intermediate Examination the student has now a sure foundation on which to build his specialised studies. It is interesting to note that approximately 70% of candidates holding degrees or diplomas pass the examinations whilst only 30% of the non-holders are successful. To quote the Holland Report:-

"This startling comparison led us to investigate... to what causes this high rate of failure can be attributed. Our investigations revealed that the standard of preparedness among the degree and diploma candidates is, as a rule, more complete than among non-diploma candidates. Their training has been developed on comprehensive lines and the possession of an academic qualification is in itself evidence that they have acquired some measure of general as well as technical knowledge." X

The writer, in his experience with mining students, has found that in most cases there is impatience as regards the number of years of necessary study and many promising students become discouraged and terminate their attendance at classes. But by taking, at various stages, statutory examinations the candidate would be encouraged to carry through his studies until the final examination.

Owing to the increasing difficulties met with in mining it has been suggested that the standard of the examinations should be raised but in fairness to the candidates the present examinations cannot be made more difficult as they already call for an amount of knowledge which must be accumulated with little educational order.

On the other hand, there is the general opinion that no more restrictions can be placed in the way of allowing the right type of candidate to qualify as this would result in the standard of technical knowledge being controlled by state and, therefore, the industry itself would have very little say in the matter. This view is clearly given in the following statement:-

"Restrictions of this kind cannot be to the economic advantage of a productive industry striving for commercial results in an age of competition. Given that every existing guarantee for safety must be maintained to the full we think that the State should interfere as little as may be with the possibility of selecting for managements those who are judged to be on the whole the best men for the office."

This statement is certainly to some extent justified since over-interference by the State in any part of industry is detrimental to progress. It is claimed, however, that the arranging of an intermediate examination is not increasing the difficulties of qualification but rather the reverse.

A scheme of instruction to meet the needs of the re-arrangements of the examinations (this will be discussed in the next chapter) would be educationally sound and candidates who qualify would not only have a good technical knowledge of the industry but the course would be more cultural than is possible under the present conditions.

The Group System.

The reason for the condition that the whole examination must be taken in one sitting is made clear in the following statement:-

"Practical mining is full of incident and the mine manager is required to make important decisions quickly (often in an atmosphere of emotion) in any question affecting mining. His knowledge, therefore, should not only be wide but should be developed in such a way that the component parts can be applied concurrently." X

In referring to the group system the statement continues:-

"We consider the group system tends neither to encourage the faculty of mental mobility nor to test it, and that unless the candidate is ready to take the whole range of the examination at the same time he is ipso facto not fully prepared". X

Again,

"It is considered that cramming in the sense of anticipating questions as the result of intelligent observation of the papers set in the past, would be encouraged, since it is easier to select and concentrate on likely questions in a small range of subjects than in a larger one. Finally, it would facilitate the candidates progress in the examination if he were permitted to devote his whole attention to one group of subjects and, having satisfied the examiner, to dismiss from his mind and concentrate on the next group." X

In considering the first statement it cannot be agreed that the candidate who has passed by taking the whole examination at one sitting has shown that "the component parts can be applied concurrently". The subjects, although all pertaining to mining are in themselves diverse in content and it seems feasible that if the subjects are taken in groups, say at six month intervals, the concurrency of thought would not be affected in the least.

The second statement refers to the lack of "mental mobility" which exists if the subjects are grouped but this, surely, is open to severe criticism for where a student is allowed to concentrate on one or two subjects his quality of work improves due, primarily, to orderly thought and study, and at the same time he obtains a true perspective of his subject matter. Transfer of thought to the subjects which follow will most assuredly occur.

"Cramming" has certainly to be employed when all the subjects are taken simultaneously. (See Statement No.3.) It is the writer's experience that, under the present regulations, anticipation of examination questions forms a good part of the candidate's "study". When one considers the amount of divergent information which a student must accumulate it is evident that "cramming" is part of his "hope".

Grouping of subjects is an accepted system in other professions and there appears no reason why it should not be adopted with success in the mining industry. It is conducive to mind development and certainly obviates the intensive study of the subjects at the last moment. It has been suggested that the six subjects be split either into two groups of three subjects or three groups of two subjects. The question immediately arises as to the classification of the studies.

The mine manager, although responsible for the whole mine, is primarily in charge of the actual "getting" of minerals. In order to cultivate concurrency of thought on subjects relating to this, they should be grouped, viz., Winning and Working,

Working/ Ventilation, Explosions, etc., and the Coal Mines Act.

In the examination of May, 1929, details of failures on the various subjects are as follows:-

Machinery.....	25.5%	
Surveying.....	16.5%	
Ventilation.....	13.4%	
Mine Explosions.....	7.6%	
Coal Mines Act.....	4.0%	
Winning & Working...	3.6%	X

The reason for the disparity of results is obvious. The majority of the candidates are employed in the mining of coal and, naturally, they are more attracted by subjects connected with their work where they have the opportunity of seeing their technical knowledge applied in practice. This explains the low percentage of failures in the last four subjects and it seems, therefore, advisable that these subjects should be grouped.

With reference to the subjects, Machinery and Surveying, the results call for improvement and this certainly could be achieved if two separate groups of one subject each were made. Most of the candidates have little opportunity of obtaining experience in surveying or in engineering but, by concentrating on the study of these subjects before taking the mining group, there is every likelihood that the percentage of failures would be reduced. The mine manager has under his charge engineers and surveyors with whom he must consult and, therefore, he must be competent to discuss problems involving engineering and surveying. The actual carrying out of the work, however, is done by the particular officials concerned and so these subjects, in his course, are subsidiary to the mining subjects.

The following grouping is suggested:-

1. Machinery (Mechanical & Electrical).
2. Surveying.
3. Winning and Working.
Explosions, etc.
Ventilation.
Coal Mines Act.

The Groups would be taken in the order shown.

Conclusions.

1. The examinations, under the present conditions of the Coal Mines Act, do not allow of a sound educational course being taken by the students.
2. The examinations are too comprehensive and, therefore, the students are prevented from carrying the study of all the six subjects to the final year of the course. Instruction in at least three of the subjects has to be terminated in one or other of the previous years.
3. In order to make mining education cultural as well as vocational the students should advance to the final test by stages which are marked by examinations at specific points.
4. The following alternative methods of qualifying are suggested:-
 - (a) Preliminary, Intermediate(not grouped)
Final(not grouped) Examinations.
 - (b) Preliminary, Final(grouped) Examinations.
 - (c) Preliminary, Intermediate(not grouped)
Final(grouped) Examinations.

Firemens' (Examiners' and Deputies')Certificates.

Under Section 15 of the Coal Mines Act, 1911, no person is appointed to act as fireman, examiner or deputy unless he possesses the following qualifications:-

- (1). He must be at least 25 years of age and have had a minimum of five years experience in a mine.
- (2). He must have obtained a certificate from an approved mining school or Authority as to his ability, X
 - (a) to make accurate tests for inflammable gas, and
 - (b) to measure the quantity of air in an air current.

(His hearing and eyesight must be such as to carry out his duties efficiently. At the end of five years from the date of the certificate a supplementary certificate must be obtained to the effect that his eyesight is such as to enable him to make accurate tests for gas and that his hearing is good.)

Shotfirers' Certificates.

A shotfirer must obtain from an approved school or Authority X a certificate that he is able to make accurate tests for inflammable gas.

(At the expiration of each five yearly interval his eyesight must be re-examined.)

Examinations for Firemens' (Deputies' and Examiners')Certificates and Shotfirers' Certificates.

- (1). The examination is limited to candidates who have reached the age of 21 years.
- (2). The examination is open to any candidate of this age who presents himself for the test. It is not made a condition of admission to the examination that the candidate has undergone a course of instruction.
- (3). The examination must be strictly limited to the matter detailed under "Certificates".

X Approved by the Home Secretary.

Criticism on Mining Examinations (Firemens' and Shotfirers')

The duties of a fireman or deputy are extremely responsible as his chief occupation is the examination of his "district" in the mine in order that it may always be in a safe condition for those employed therein. He must make periodic tests for inflammable gas, examine the "roof and sides", and be able to deal with the workmen under his charge on all matters pertaining to safety. His duties include frequent reports to the superior officials who must rely upon him to carry out his work in a safe and efficient manner. The shotfirer is in charge of all the blasting operations underground and, as this is a serious source of danger, the person appointed must be one who realises the importance of carrying out the duties with care and intelligence.

In considering the qualifications required by a fireman or shotfirer it is evident that the statutory test is totally inadequate. The views on this subject given in the "Holland" Report by the various witnesses are as follows:-

(1). Coal Owners and Managers.

They were strongly opposed to any extension of the test. They were of the opinion that the obligation of the State "Would adequately be fulfilled if it were satisfied that the candidate had the requisite amount of practical experience, efficient hearing and eyesight, and the ability to make accurate tests for firedamp."

(2). General Federation of the Deputies' Associations of Great Britain.

"The prospective fireman should show some knowledge of shotfiring methods of working and timbering, ventilation and gob fires and the Coal Mines Act and Regulations in addition to the subjects already recognised."

(3). National Conference of Mining Education.

- (a). The examination should be of wider scope than the present examination.
- (b). The proposed examination should be preceded by an entrance examination of an elementary character on (1) English, (2), Mathematics, (3) Handsketching and Drawing, (4) General Elementary Science.

All other witnesses maintained that the character of the whole examination must be revised.

Criticism on Mining Examinations (Firemens' & Shotfirers').

The duties of fireman and shotfirer demand men, who, besides having the practical aptitude, possess some knowledge of that mining technology which will come within the scope of their work. To meet these requirements the following examination scheme is suggested:-

1. Preliminary Examination (Written).

- (1). English.
- (2). Mathematics.
- (3). Handsketching.
- (4). Elementary Science.

2. Final Examination (Oral).

- (1). Testing for Firedamp.
- (2). Methods of Working.
- (3). Timbering.
- (4). Ventilation.
- (5). Coal Mines Act.
- (6). Gob Fires.

Questions in the Oral Examination would include only those matter which come within the statutory duties.

As it is essential that a sufficient number of recruits must always be obtainable the above scheme could not be put into operation immediately. An interval of time, probably five years, would have to be allowed in order that courses might be arranged to meet the requirements of the examination.

Mine Surveyors' Certificate.

A Surveyor's Certificate is granted if the applicant satisfies the Examining Board that he is competent:-

- (a). To make accurate survey of the workings of a mine and to connect such survey with a surface survey.
- (b). To make accurate levels.
- (c). To plot accurately surveys and levellings.

The candidate for the examination must be at least 21 years of age and must furnish satisfactory evidence of his sobriety and general good conduct. He must also have had practical experience in surveying mines for not less than four years (only two years experience is necessary if the candidate holds an approved degree or diploma or has taken an approved course in mine surveying.)

Examinations on Mine Surveying.

All candidates have to undergo a written examination and those who qualify in this have to pass an oral and practical test held at a mine in order to qualify finally for the certificate. The qualifying standard is 60% in both the written and oral examinations but candidates must also obtain 50% of the maximum marks in each of the four parts of the oral and practical examination.

NOTE. As very few working miners take the above qualifications it is not intended to discuss the Surveyors' Examination. It is included in order that the list of mining examinations demanded by statute should be complete.

Mine Officials and their Qualifications.

The following is a list of mining officials and their corresponding qualifications demanded by Act of Parliament:-

- | | | | | | |
|------|---------------------------------|---|---|---|---|
| (a). | Agent and Manager, | First Class Certificate by examination. | | | |
| (b). | Under-manager, | " " | " | " | " |
| (c). | Mine Surveyor, | Surveyor's | " | " | " |
| (d). | Overman, | Second Class | " | " | " |
| (e). | Fireman, Examiner
or Deputy, | Fireman's | " | " | " |

Mine Officials and their Qualifications, contd.

- (f). Shotfirer, Shotfirer's Certificate by examination.
- (g). Electrician, A competent person to be appointed in writing.

FIG. 1

TABLE ILLUSTRATING STANDARD OF MINING EXAMINATIONS
DEMANDED BY STATUTE.

— 1ST CLASS CERTIFICATE OF COMPETENCY —

1ST WRITTEN EXAMINATION TOTAL MARKS 1000	2ND WRITTEN EXAMINATION (RE-EXAMINATION IN ONE OR TWO SUBJECTS)	ORAL EXAMINATION TOTAL MARKS 300	AGGREGATE FOR WHOLE EXAM TOTAL MARKS 1300
ALL SUBJECTS ABOVE 40% TOTAL AGGREGATE 55% [PASS]	PASS TO ORAL EXAMINATION	50% [PASS]	54% [FAIL]
ALL SUBJECTS ABOVE 40% TOTAL AGGREGATE 55% [PASS]	PASS TO ORAL EXAMINATION	77% [PASS]	60% [QUALIFIED]
ALL SUBJECTS ABOVE 40% TOTAL AGGREGATE 63% [PASS]	PASS TO ORAL EXAMINATION	50% [PASS]	60% [QUALIFIED]
ALL SUBJECTS ABOVE 40% TOTAL AGGREGATE 60% [PASS]	PASS TO ORAL EXAMINATION	50% [PASS]	57%
ONE OR TWO SUBJECTS BELOW 40% TOTAL AGGREGATE 60% [PASS TO 2ND WRITTEN EXAMINATION]	MORE THAN 40% IN THE ONE OR TWO SUBJECTS FAILED [PASS TO ORAL EXAMINATION]	50% [PASS]	57% [FAIL]

2ND ORAL EXAMINATION
[CANDIDATE MUST GAIN
AT LEAST 60% TO QUALIFY.]

2ND ORAL EXAMINATION
[CANDIDATE MUST GAIN
AT LEAST 60% TO QUALIFY.]

2ND CLASS CERTIFICATE OF COMPETENCY.

1ST WRITTEN EXAMINATION TOTAL MARKS -1000.	2ND WRITTEN EXAMINATION (RE-EXAMINATION IN ONE OR TWO SUBJECTS)	ORAL EXAMINATION TOTAL MARKS 400	AGGREGATE FOR WHOLE EXAM TOTAL MARKS 1400
ALL SUBJECTS ABOVE 40% TOTAL AGGREGATE 55% [PASS]	PASS TO ORAL EXAMINATION	50% [PASS]	54% [FAIL]
ALL SUBJECTS ABOVE 40% TOTAL AGGREGATE 55% [PASS]	PASS TO ORAL EXAMINATION.	73% [PASS]	60% [QUALIFIED]
ALL SUBJECTS ABOVE 40% TOTAL AGGREGATE 64% [PASS]	PASS TO ORAL EXAMINATION	50% [PASS]	60% [QUALIFIED]
ALL SUBJECTS ABOVE 40% TOTAL AGGREGATE 60% [PASS]	PASS TO ORAL EXAMINATION	50% [PASS]	57% [FAIL]
ONE OR TWO SUBJECTS BELOW 40% TOTAL AGGREGATE 60% [PASS TO 2ND WRITTEN EXAMINATION]	MORE THAN 40% IN THE ONE OR TWO SUBJECTS FAILED [PASS TO ORAL EXAMINATION]	50% [PASS]	57% [FAIL].

2ND ORAL EXAMINATION
[CANDIDATE MUST GAIN
AT LEAST 60% TO QUALIFY.]

2ND ORAL EXAMINATION
[CANDIDATE MUST GAIN
AT LEAST 60% TO QUALIFY.]

C H A P T E R I V

Courses in Mining Education.

Educational Courses in Mining arranged in all the mining areas of Great Britain are described in this chapter. These courses have been criticised and compared with regard to subjects and duration. On the suggested re-organisation of the statutory examination, described in preceding chapter, the writer has put forward a modified course which he claims will not only produce men with a sound knowledge of mining but men having the broader vision required in administration.

COURSES IN MINING EDUCATION.

In any course of education the scheme of subjects is arranged with respect to the value of the particular subject in mind training. In mining, the scheme of instruction has primarily to be formulated with special regard to the examinations set by the Boards appointed for the purpose. In the mining industry the examinations, as described in the preceding chapter, are controlled by Parliament and, therefore, all educational bodies, with no control over the statutory tests, must arrange their courses to meet the needs of those persons who intend to qualify.

1st and 2nd Class Certificates of Competency.

The examinations consist of six papers on mining technology and allied subjects and the mining student is only permitted to enter for the examinations at twenty-one years (Undermanager's) and twenty-three years of age (Manager's). Although the Secondary school system has had some effect on the standard of education of boys entering the industry, the majority are still those who have only attended the elementary school and who leave at the age of fourteen. (In the questionnaire submitted to the students of the Sunderland Technical College, about 15% only had attended a Secondary School and this may be taken as the average for all the mining areas). Again, since all the students attending classes are employed in the mines, provision for continued education must take the form of part-time instruction to suit the shifts underground. In constructing a comprehensive course the following three points must, first of all, be considered:-

- (1). 85% of the students have attended only elementary schools, leaving at the age of fourteen.
- (2). As the age for entering for the statutory examinations is 21 and 23 years, courses should be arranged to extend over seven and nine years respectively.
- (3). The classes must be part-time, to be held in the evening or at other times to suit shift work.

It is to be regretted that very few boys of fourteen years of age enrol in Continuation Classes for mining. The reason is not far to seek, since, by statutory regulations, there is no possibility of promotion until the age of twenty-three and in some cases twenty-five, and as no examination can be taken before twenty-one years of age, the boy of fourteen delays the continuing of his studies until he reaches the age of eighteen or nineteen and even later. As an example of this, the average class ages at Sunderland Technical College for Session 1933-34 were--Preliminary, (Combined 1st and 2nd Year) 20.0., Third Year, 24.0, Fourth Year 26.5, Fifth Year 27.1, Sixth Year 28.7, Seventh Year, 28.1. From the figure of the Preliminary year it might be suggested that a seven or nine years course is excessive as, before a student is sufficiently prepared to qualify, he is at least twenty-seven years of age. But, on examination of the figure of the Seventh Year Course (28.1) it appears that most of the students are already much above the age required for the examinations. The course, however, must be arranged for those students who enrol at fourteen years of age and, as it is necessary that their studies should be continuous, an eight or nine years course for this reason alone is imperative.

Description of the Mining Courses arranged in the Coal Mining Areas of Great Britain.

In order to compare the mining courses in the various centres of Britain, the writer communicated with all the Educational Authorities where definite mining schemes had been drawn up. The information obtained was tabulated as shown in Fig. 2p64. All the courses of instruction contained therein are intended to prepare students to qualify for a First or Second Class Certificate of Competency.

Duration of Courses.

The number of years in each course is shown in the following table:-

No.of Course.	District.	Length of Course.
9	East of Scotland.	5 years.
3	Staffordshire.	6 years.
7	West of Scotland	" "
10	Edinburgh	" "
11	North Wales	" "
1	Sunderland Tech.Col.	7 years.
2	Wigan	" "
5	Warwickshire	" "
8	Glasgow	" "
12	South Wales	8 years.
4	Derbyshire	9 "
6	Yorkshire	9 "

As all the courses have the same aim in view the disparity in the duration of the schemes is striking. The five years course is certainly too short but an explanation on this point is given in the Calendar of the Heriot Watt College, viz.,

"Students who have successfully completed the Five Years Course arranged by the Education Committee of the County of Midlothian are eligible to attend the Fifth Year Course of the College".

Course No.9 may, therefore, be included in the list of seven year courses. The other courses are complete and are tabulated from the various syllabuses and calendars.

The general tendency is to have six or seven years instruction in mining and this is partly due to the fact that most students entering the first year of the courses are at least eighteen years of age and at the end of the course they have reached the required age for taking the examinations. During the last few years excellent progress has been made in the organisation of mining education, due to the grants made by the Miners' Welfare Fund, and it appears that in the future more boys of fourteen years of age will enter the mining classes. It will, therefore, be advantageous to increase the number of years in the courses in order that the student will have continuous instruction before he takes any of the examinations.

It is the writer's experience that no course intended to instruct mining students for the qualifications now demanded can be completed in less than seven years evening work. Shorter courses are only possible where the elementary instruction is curtailed, resulting in the whole scheme being weakened.

Subjects of Courses.

Junior Courses (First two years).

Two main differences are noticeable, viz.,

- (1). Junior Courses which include the subject of mining.
- (2). Junior Courses which exclude mining and concentrate on the subjects of English, Mathematics, Drawing and Science.

The Junior Courses in all the centres in Scotland, (Nos. 7, 8, 9, 10) are in the first arrangement and the reason for this is given in the following statement:-

"Right from the first year we introduce the subject of mining. We are so convinced of the necessity of creating and maintaining interest of the young students in their industry that we include the subject in these two years. We feel also that since attendance upon these classes is voluntary, some degree of catering to the subject that lies nearest to their interests has got to be done." X

All the other schemes exclude mining for at least the first two years. (In some centres, for example No. 1., Sunderland Technical College, No. 3, Staffordshire, and No. 12, South Wales, no attempt is made to give instruction in mining until the fifth years). In the Report of H.M. Inspectors of Mining Instruction reference is made to this principle as follows:-

"Mining technology, under modern conditions, is so obviously the practical application of scientific principles and methods to the many and varied problems of the mine, that little argument should be needed in support of the view that a scheme of mining education suited to the needs of the workers in the industry who hope to rise above the ranks of the average wage earner must be one which, in earlier years, concentrates upon scientific training rather than mining technology. This is necessary in order that, at a later stage, the study in mining technology may be approached along scientific lines, by students who possess the requisite knowledge and training." Ø

After consideration of these two statements one must agree that the second is more sound. While adopting a method of

X See following page.
Ø " " "

of/ scientific approach the mining interest can still be maintained if the principles of the subjects, wherever possible, are applied to simple mining practice. The teacher, however, must be careful to keep his subject intact. That is, if the subject of mathematics is being taught, the instruction should be on the principles and any work which would involve complicated mining technology should be avoided.

Courses Nos. 7 & 8 (Fig. 2, p 64) are illustrations of the over-application of mining in the Junior Courses. For example, in studying mathematics, the student has continually in his mind a mining problem and in all likelihood mathematical principles will become subsidiary to mining.

In the teaching of Junior classes two aims should be held in view., the first, that the student should acquire a thorough understanding of the particular subject, the second, that he should be led to realise that these studies are closely connected with his more advanced work. Further, most of the entrants to the Junior Courses are young and inexperienced in actual mining practice with the result that the teaching of mining has not the necessary "background".

In the syllabuses which include mining, where referring to the Junior years, these statements occur:-

"The mining class is largely a simple talkative course."
 "Instruction should be elementary and no complicated problems involved."
 "The simple principles of mining should only be taught."

X Communication from the Joint Committee on the Organisation of Classes in Science and Technology, Technical College, Glasgow. (23rd January, 1934).

Ø Report of H.M. Inspectors on the Provision of Instruction for Persons employed in the Coal Mining Industry in England and Wales (1932).

To efficiently teach mining principles to persons who have not had much experience underground is extremely difficult, and with no scientific foundation on which to build the instruction, the task becomes impossible. Again, since the subject has to be repeated in the latter years of the course much valuable time is wasted and subjects which would be of more value to the student are, of necessity, excluded.

With reference to scheme No.6. (Yorkshire) attention is drawn to the subject "Safety Principles" in the First Year. This class is included in the course for boys below eighteen years of age with the sole aim of teaching the safe use of appliances in the mine. There is no intention of making it a compulsory subject of the course except for young lads who are just entering the industry and no mining technology is included. ~~(A full description of Safety Classes is given in Chapter)~~.

It is now generally accepted that the inclusion of mining in the first years of the course, apart from its unsoundness, does not attract young persons engaged in the industry, nor does it act as an incentive to students to continue their studies further. In the writer's experience, only those students who have delayed their studies, have questioned the lack of Mining in the Junior Courses. With this exception, students usually show keenness in all the subjects of the Junior Course even where little reference is made to mining. The subjects taught in most of the centres are English, Mathematics, Drawing and Science (Chemistry and Physics) and for mining students this combination is the most suitable.

In observing the other subjects included in the schemes shown in Fig. 2, p. 64 examination requirements have to be considered. Generally, in the years following the Junior Courses the subjects taken collectively are similar in all districts but the sequence is not always identical. This is due to two reasons, viz.,

1. The subjects of the examination are diverse and, therefore, a scheme showing a complete sequence is impossible.
2. The examinations for First and Second Class Certificates of competency have to be taken in one sitting and the placing of subjects in any specific order is unnecessary.

The common aim in the scheme submitted is to carry the examination subjects to the last year of the course but this is impossible as six subjects would have to be included in the last session. For example, in Course 4, (Derbyshire), "Ventilation and Lighting", an examination subject, has been placed in the fourth year of a nine years' course.

In some of the courses subjects have been included which are not necessary for examination purposes and, while their value cannot be questioned, the course is already overloaded so that these subjects could be eliminated from the schemes. "Fuels", "Economics", and "Mineralogy", are subjects which come under this category and it is suggested that these subjects could be taught in a post-examination course. It is often found that students who qualify desire to continue their studies and it would, therefore, seem advisable that definite post-examination courses be arranged to include some allied subjects which would be of great assistance to a person who is ready to take an administrative position in the mine.

In 95% of the collieries in Britain alternating current has been adopted in preference to direct current practice. To the mining student, the subject of electricity presents the most difficulties and instruction on direct current could, therefore, be confined to principles without affecting in any way the value of the course on mining technique. This, however, cannot be achieved until the Board of Mining Examinations exclude questions on direct current practice from the examination papers.

The subject of Geology should form an important part of mining education but in the schemes shown four districts have omitted it from the course, viz., No.3, (Staffordshire), No.9. (East of Scotland), No.10 (Edinburgh) and No.11 (North Wales). These districts give some instruction on the subject in conjunction with mining or surveying and this meets the needs of the examination. Apart, however, from the utilitarian value in mining courses, geology develops the powers of observation and forms a co-ordinating subject of chemistry, physics and dynamics. It should, therefore, be given a definite place in any scheme of mining education.

Conclusion.

Under the present conditions of examination there are many unsurmountable obstacles encountered in the arranging of a scheme of mining education which will not only furnish persons employed in the industry with a good training in mining technique but will also give them the best and broadest education that is possible. The courses in Fig.2, p64 are, in most cases, identical in content and this agreement of thought illustrates to some extent that the schemes are as near perfect as may be possible. The educational plan in mining is, therefore, controlled by the statutory tests and until these are altered very little improvement can be made in mining education. If, however, examinations were set at intervals and the final test grouped (as suggested in the preceding chapter) all courses of mining education could be arranged along much broader lines.

The position is summarised by A.M. Carr-Saunders and P.A. Wilson as follows:-

"The situation is complicated by the very strong tradition in this industry of promotion from the ranks. This means that there is little opportunity for liberal education before technical studies begin. The legislation has been successful in that it has produced a high level of technical competence; it has failed in that it has neglected the broader aspects of professional competence."*

* "The Professions" by Carr-Saunders and Wilson.

A Modified Course on Mining Instruction to meet the suggested
Re-arrangements of Examination.

Mining education can be improved only when the examination conditions are altered. If the arrangement of examinations were made as suggested, viz., Preliminary, Intermediate, and Final (Grouped), instruction in mining could be developed in such a manner that it would give mining men a more liberal and comprehensive education along with the vocational instruction necessary under the present statutory rules.

The following scheme of instruction with examinations is submitted:-

Junior Course.

1st Year.	English. Mathematics. Safety Principles. Woodwork, etc.	
2nd Year.	English. Mathematics. Science. (Elem. Physics & Chemistry.)	<u>Adult Class</u> (One year only). English. Mathematics. Science. Drawing.

Examination: English, Mathematics, Science, Drawing.

Senior Course.

3rd Year.	English. Mathematics. Science (Physics).
4th Year.	English. Mathematics. Science (Chemistry).
5th Year,	English. Mechanics. Science (Electrotechnics).

Examination: English, Mathematics, Mechanics, Science (Chemistry
& Physics) Electrotechnics.

Advanced Course.

6th Year.	Geology. Electrical Engineering I. Mechanical Engineering I.	
7th Year.	Electrical Engineering II. Mechanical Engineering II. Mine Surveying I.	----- Examination: 1st Group (Machinery) -----
8th Year.	Mine Surveying II. Ventilation & Lighting. Winning & Working.	----- Examination: 2nd Group (Mine Surveying). -----
9th Year.	Explosions, Inundations, etc. Mining Legislation & Mine Management. Mining Tutorial.	

Examination: (Mining Group) Ventilation & Lighting.
Winning & Working.
Explosions, Inundations, etc.
Mining Legislation.

Post Examination Courses.

1st Year.	Fuels with Laboratory. Geology " "
2nd Year.	Economics. Layout of Mineral Properties.

General Observations on Above Scheme.

(1). In the First Year Safety Principles and Woodwork are grouped and may be taken without English and Mathematics. This is arranged to provide for the instruction of boys on Safety Principles (~~see Ch. _____~~). It is felt that where a lad enrolls in a class for Safety instruction he should not be compelled to take the whole First Year Course. If, however,

however/ he qualifies in Safety Principles and desires to continue his studies he will be required to take the first year course, excluding Safety Principles. Classes for boys about to be employed in mines should, in the future, form an important feeder for the full courses in mining but great care will have to be exercised in the methods adopted in order to encourage young lads to continue their studies. Woodwork is included in the course as a means to this end and also to give practice in manual dexterity, so necessary in working with appliances underground.

(2). The scheme includes provision for an adult class in the Preliminary Course to suit students who have delayed their studies and only one year is given to this class as it is found that adult students are in a position to advance to the third year after one year's instruction. In the third year senior and junior students can be combined with no disadvantage.

(3). The teaching of English is continued to the fifth year of the scheme. Much of the inferior quality of work in the advanced years is due, not so much to lack of knowledge of the particular subject, but to the students' difficulty of expression. Ability to report in a lucid manner on underground operations is essential to the potential holder of an official position. In the fifth year the subject, may with advantage, be confined to reports and discussions on mining matters.

(4). The other subjects in the Senior Course (Mathematics & Science) form a basis on which the pure mining subjects may be taught. Constant application of the subject matter to mining problems should be made throughout the senior course.

(5). In the Advanced Course, the subjects of Electrical Engineering, Mechanical Engineering and Mine Surveying have been allocated two sessions each. These subjects are generally the most difficult to mining students and it is, therefore, thought

thought/ expedient to allot extra time to them.

(6). Geology is placed in the Sixth Year in order that no year in the Advanced Course should be without a subject which is closely connected with the "getting" of minerals.

(7). The Eighth and Ninth Years concentrate on the examination subjects of the Mining Group. After the Seventh Year the student should have a good grasp of all the sciences and, therefore, concentrated study, coupled with his practical experience, should enable him to qualify. Under this arrangement the important subjects of the examination can be taken in the last two years.

(8). A mining tutorial class has been included in the last year of the Advanced Course in order to discuss and co-ordinate all the mining subjects. With senior students a class of this type has many real advantages. During discussion each student receives the benefit of the others' experiences and an opportunity of revision of all the work is afforded.

(9). Students who have completed a full course of mining and have qualified, generally desire to continue their studies. Post-examination courses for two years including four subjects are shown in the scheme. These subjects will be of real value to those anticipating an administrative appointment.

Courses for Firemens' & Shotfirers' Examinations.

The usual method of preparing candidates for the above examinations is by arranging a class for instruction on the particular matter of the test. These tests are described on Page and are of an elementary nature.

A course such as this is far from satisfactory as no orderly scheme of instruction is adopted and the knowledge acquired by the student is usually of little use to him in his daily work.

Under the proposed new examination arrangements it would be necessary to draw up a special course for firemen and shotfirers. The following course is suggested:-

(1). Preliminary Examination (1st Year's Instruction).

English, Mathematics, Drawing and Science,
as in Adult Class of the Junior Mining Course,
(See Page 59).

(2). Final Examination (2nd Year's Instruction).

Practical Problems which come within the experience
of Fireman and Shotfirer. [This would include the
subjects given under "Final Examination" (See Page)]

**TABLE - SHOWING - MINING - COURSES - ARRANGED - IN - THE - COAL
MINING - AREAS - OF - GREAT - BRITAIN**

Y E A R	E N G L A N D						S C O T L A N D					
	DURHAM. (SUNDERLAND TECH. COLLEGE)	WIGAN & DIST.	STAFFORDSHIRE.	DERBYS HIRE.	WARWICKSHIRE	YORKSHIRE.	WEST OF SCOTLAND	GLASGOW. (ROYAL TECHNICAL COLL.)	EAST OF SCOTLAND	EDINBURGH. (HERRIOT WATT COLL.)	NORTH WALES.	SOUTH WALES.
	1	2	3	4	5	6	7	8	9	10	11	12
1 ST .	ENGLISH. MATHEMATICS. DRAWING. SCIENCE.	ENGLISH. MATHEMATICS. MINING DRAWING. PHYSICS & CHEMISTRY.	ENGLISH. MATHEMATICS. DRAWING. SCIENCE.	ENGLISH. MATHEMATICS. CHEMISTRY. PHYSICS.	ENGLISH. MATHEMATICS. DRAWING. SCIENCE.	SAFETY PRINCIPLES. CALCULATIONS. OPTIONAL SUBJECT. (WOODWORK, METALWORK, PHYSICAL TRAINING, ENGLISH, ARTS, CRAFTS ETC.)	TECHNICAL ENGLISH. TECHNICAL MATHS. TECHNICAL SCIENCE. DRAWING & MATERIALS.	TECHNICAL ENGLISH. TECHNICAL MATHS. TECHNICAL SCIENCE. DRAWING & MATERIALS.	ENGLISH. MATHEMATICS. DRAWING. MINING.	ENGLISH. MATHEMATICS. DRAWING. MINING.	MATHEMATICS. DRAWING. SCIENCE.	ENGLISH. MATHEMATICS. DRAWING. SCIENCE.
2 ND .	ENGLISH. MATHEMATICS. DRAWING. SCIENCE.	MATHEMATICS. HEAT & MECHANICS. VENTILATION & LIGHTING. ELECTROTECHNICS.	ENGLISH. MATHEMATICS. DRAWING. SCIENCE.	MATHEMATICS. DRAWING. CHEMISTRY.	MATHEMATICS. MACHINE DRAWING. PHYSICS.	MATHEMATICS. DRAWING. SCIENCE. OPTIONAL SUBJECT. (AS IN 1 ST YEAR)	TECHNICAL ENGLISH. TECHNICAL MATHS. TECHNICAL SCIENCE. DRAWING & MATERIALS.	TECHNICAL ENGLISH. TECHNICAL MATHS. TECHNICAL SCIENCE. DRAWING & MATERIALS.	ENGLISH. MATHEMATICS. DRAWING. MINING.	MATHEMATICS. CHEMISTRY. MINING.	MATHEMATICS. DRAWING. SCIENCE.	ENGLISH. MATHEMATICS. DRAWING. SCIENCE.
3 RD .	MATHEMATICS. DRAWING. SCIENCE.	MATHEMATICS. MECHANICS & HEAT ENGINES. EXPLOSION, RESCUE ETC. ELECTROTECHNICS.	ENGLISH. MATHEMATICS. PHYSICS.	DRAWING. MECHANICS & HEAT ENGS. ELECTRICITY & MAGNETISM.	MATHEMATICS. CHEMISTRY. APP. MECHANICS.	ENGLISH. MATHEMATICS. DRAWING. SCIENCE (PHYSICS) SURVEYING *	MATHEMATICS. MINING & GEOLOGY. MINING SCIENCE.	MATHEMATICS. III. MATHEMATICS IV MECHANICS & LAB.	ENGLISH. MATHEMATICS. SCIENCE. MINING.	MATHEMATICS. PHYSICS. MINING.	MINING SCIENCE. ELECTRICAL ENG. MINING CHEMISTRY & FUELS.	ENGLISH. MATHEMATICS. DRAWING. PHYSICS & MECHANICS.
4 TH .	MATHS & MECHANICS MINING SCIENCE. GEOLOGY.	ELECTROTECHNICS. GEOLOGY (FUELS). SURVEYING. I. ENGINEERING. DRAWING.	ENGLISH. MATHEMATICS. PHYSICS.	MECHANICAL ENGINEERING VENTILATION & LIGHTING. ELECTRICAL ENG. (D.C)	MINING I. HEAT ENGINES. GEOLOGY (OR MATHS)	MATHEMATICS. DRAWING. SCIENCE (CHEMISTRY) LABORATORY WORK * (COAL ANALYSIS ETC.)	ENGINEERING DRAWING. MINING. ELECTRICAL ENG.	ENGINEERING DRAWING. INORGANIC CHEMISTRY. GEOLOGY.	MINING. MECHANICS. ELECTRICITY & MAGNETISM.	MINING. MECHANICAL ENG. ELECTRICAL ENG.	VENTILATION & LIGHTING. SURVEYING I. MINE MACHINERY. I.	ENGLISH. MATHEMATICS DRAWING. CHEMISTRY.
5 TH .	HEAT & HEAT ENGINES. ELECTRICAL ENG. I. SURVEYING I.	MINE WORKING. DEVELOPMENT OF MINERAL PROPERTIES MINE MACHINERY.	ENGINEERING DRAWING. MECHANICS & HEAT ENGINES. VENTILATION & LIGHTING.	MINE WORKING. SURVEYING I. ELECTRICAL ENG. (A.C)	MINING II. HEAT ENGINES. ELECTRICAL ENG.	MATHEMATICS. DRAWING. MECHANICS. FUELS. (ELEMENTARY) *	MINING. MECHANICAL ENG. MINING LABORATORY.	MATHEMATICS. V. PHYSICS & LAB. ELECTRICITY & MAGNETISM.	MINING. MECHANICAL ENG. ELECTRICAL ENG.	MINING. MECHANICAL ENG. ELECTRICAL ENG.	MINING. SURVEYING. II. MINE MACHINERY II.	MECHANICS & HEAT. ELECTROTECHNICS. SURVEYING. I.
6 TH .	MINING I. VENTILATION & LIGHTING. COLLIERY ENG. I.	MINING ELECTRICITY. SURVEYING. II.	MINING. ELECTRICITY. SURVEYING.	FUELS. SURVEYING II. GEOLOGY.	MINING III. SURVEYING. I. ELECTRICITY. (A.C)	MATHEMATICS. HEAT ENGINES. ELECTRICITY. SURVEYING. *	MINING. SURVEYING. MINING TUTORIAL.	MINING. I. MECHANICAL ENG. SURVEYING. I.		MINING. MINING LABORATORY.	EXPLOSIONS & FIRES. SURVEYING. III. MANAGEMENT & LEGISLATION (DEVELOPMENT OF MINERAL PROPERTIES.)	VENTILATION & LIGHTING. GEOLOGY. ENGINEERING. SCIENCE. SURVEYING. II. *
7 TH .	MINING II. ELECTRICAL ENG II. COLLIERY ENG. II. SURVEYING. II.	COLLIERY ORGANISATION MINING LAW. SURVEYING III.		MINING I. MINE MACHINERY. ENGINEERING MATERIALS & STRENGTH OF MATERIALS	MINING. IV. SURVEYING II. ELECTRICAL ENG. (OR ECONOMICS)	MINING. ELECTRICAL ENG. MECHANICAL ENG. PROPERTIES OF MATERIALS *		MINING. II. ELECTRICAL ENG. SURVEYING II. MINERALOGY & LAB.				MINING. I. ELECTRICITY. (TECHNICAL) MECHANICAL ENG. SURVEYING. III & GEOLOGY *
8 TH .				MINING II. MINE MANAGEMENT. ECONOMICS. MINE MACHINERY.		MINING. ELECTRICITY. SURVEYING. GEOLOGY. *						MINING II. ELECTRICAL ENG. SURVEYING IV.
9 TH .				REVISION AND SPECIAL CLASSES AS REQUIRED.		MINING. ELECTRICITY. MACHINERY. GEOLOGY. ECONOMICS & LEGISLATION						

NOTE - PRACTICAL CLASSES IN SCIENCE, ENGINEERING, GEOLOGY, AND SURVEYING ARE HELD IN MOST CENTRES THROUGHOUT THE SUMMER TERM - THOSE CLASSES ARE OPTIONAL - CLASSES MARKED WITH AN ASTERISK ARE HELD IN SUMMER AND ARE ESSENTIALLY INCLUDED IN THE COURSE.

C H A P T E R V

The Mining Student.

The writer does not claim to have composed this Chapter but has left it to the mining students to make their individual contributions. The reader will find at the beginning of the chapter reasons why the miner becomes student.

In a questionnaire submitted to eighty-six students answers are given which show the type of student attending classes in mining.

THE MINING STUDENT.

In the County of Durham there are approximately 110,000 persons employed in and about the mines and, of this number, less than 200, or $\cdot 2\%$, are attending evening courses in mining technology. During the session 1933/34 Classes on Safety Instruction were commenced in the County and 1,811 students qualified. (See Chapter "Safety Instruction to Boys"). In addition to these numbers, approximately 150 electrical and mechanical engineers in collieries attend continuation classes on their particular subjects. It is estimated that about 2% of the workers in mines of the County of Durham are given instruction on subjects pertaining to the industry.

This chapter is concerned with those who are attending a full course in mining technology, and who have as their aim the attainment of one or other of the statutory qualifications in mining. It was thought, however, that this might not be the only reason actuating the worker to become student and, in order to obtain definite information regarding this, it was decided to submit a questionnaire to all new students enrolling in the mining classes at the Sunderland Technical College for Session 1934/35.

The question asked of each student was as follows:-

"WHAT MADE YOU DECIDE TO TAKE A COURSE IN MINING?"

The students were instructed to give no name in their replies but full details of reasons for enrolling. The writer, instead of giving a general description of the replies received proposes to give the answers verbatim as follows:-

- (1). "For a number of years I have had a desire to join the mining classes but shifts and lack of information have up till the present made it a remote wish. The circumstances which eventually enabled me to join were seeing a bill advertising the classes in my employers' office. I wrote and received a prospectus, then, taking my under-manager's advice, I enrolled as a mining student. Eventually, if I pass my examinations, I will be in the position to take any opportunity which may come my way, which may better me both financially and socially".
- (2). "My father has worked as a miner from the age of twelve and has worked every type of laborious mine work from a trapper to a coal hewer. He has made the average amount of money for his work but hasn't been able to have any of his family placed in a better position than himself, therefore, with his example in mind, I intend to better my position in the mining trade as I know more about mining than anything else and the only way is to study mining. Another reason why I enrolled in these classes is I think (although I may be wrong) I should stand a better chance of obtaining work with a good knowledge of mining, than I would if I had only the practical experience. Then again, if more miners studied mining they would know more of the dangers that lie before them and how to act in case of emergency, and there would be fewer explosions as dangerous quantities of gas would be more carefully dealt with".
- (3). " When attending school, I used to delight in hearing my father and elder brothers talk about their daily routine in the mines and to argue as to the merits of their respective collieries. My young mind would thrill with admiration and I decided, when very young, that I was cut out to be the ideal miner. But, on leaving school, and having started my miner's life, I was a trifle disappointed to find myself working every day for a meagre pay. Too late to turn back and admit defeat to my friends, I decided that at least I would stick in and improve my status as a miner. I enquired here and there and was advised to take a course in mining and here I am, working and hoping for the best".
- (4). "I took a course in mining for one main object and that is to better my position down the mine, then ultimately it will give me a better position in life. The circumstances of the miner, what with his low wages and heavy work, makes one think very strongly for himself, and because I do not want to be just an ordinary miner that is why I hope I am successful in my courses."
- (5). "The reason I decided to take a course in mining was because I know if I did not try to learn something about the place in which I have to earn my living there would be nothing left for me but very hard work. I have tried every class of work in a mine from a trapper to a coal hewer and I now find that without education to help my practical knowledge I will not be able to rise to anything more than ordinary workman. With the above reason added to the good advice I have received from others I am trying to improve my social standard and, if my brain will allow me, I will not give up until I have attained one of the highest positions in my class of work."

- (6) "To enable me to qualify for a better job."
- (7). "Having had a college education and being undecided in my choice of a career, I was invited and given an opportunity of taking up mining engineering by one of our colliery officials. This, of course, necessitated a course in mining engineering."
- (8). "I decided to take a course in mining because I am greatly interested in the work I am doing in the mine. Having had a course in "Safety in Mines" and receiving a badge for the same, was another reason I decided to go on with mining classes. I want to learn as much as possible about mining, such as Ventilation, Air Measurements, Gases found in Mines, etc., also to try and better my position when I get older."
- (9). "Being young and having a good deal of time to spare, I used to ponder over young people being educated and being made efficient for the posts they occupied. It struck me-- "Why don't I equip myself when ever so many advantages were provided for students and maybe if I were to become an efficient person I would rise in position?" Not altogether the prospects of rising made me enrol but the thought of being able to do my work in the coal mine neatly and efficiently and to justify myself for the work I am pursuing."
- (10). "As I was working in a mine I thought that it would be very interesting to learn all about mines. Also, I would like to pass for the Certificates and, if possible, receive a better situation."
- (11). "On leaving school I started work at the colliery in the Surveying Office. The work was interesting and I knew I would have to study if I wanted my Surveyor's ticket so I took the mining classes to go through the stages till I was qualified to sit my Home Office examination."
- (12). "When I left school, liking machinery I immediately thought of engineering. I had a friend, a colliery manager, who advised me to take up mining for he told me that although trade was slack at the moment, he was certain it would soon pick up again since they had started building plant for making petrol from coal which would soon lead to more plant being built and then more coal would be needed in the country instead of having to rely on foreign trade. The mining classes can give you the same training as a 'Variety and at the same time allow you to carry on with your work and earn money."
13. "I am not envious but when I look around and see the advance of those with whom I went to school I realise what a fool I have been. That in itself was a spur which goaded me, plus the recommendation I heard from one who is a student. Again, I don't like the idea of having a back bent by years of service (or hard labour) and practically a slave to the god Coal. On the other hand, the classes open out a vista of a new life and we can only try and realise the possibilities which are placed before us."

- (14). "As a boy commencing work I had a desire to learn mining. Reading first one mining book and then another I found there was something more than the practical side of mining. This gave me an ambitious mind to improve my position. On the advice of the manager I started to study mining correspondence and soon found that I was building a house on sand, but not before I had spent a good deal of money on it. Upon farther advice from a certified colliery manager upon the system of mining classes I commenced them and in a lesson or two I proved to myself that there is nothing better than the teacher in front of you."
- (15). "I left school at the age of 14 thinking at that time, as most lads do, that my education was complete. After working at the colliery for two years, however, I began to realise how little I really did know. The majority of things I had learned at school I had almost forgotten and of the technical side of my occupation I was entirely ignorant. Knowing then that future promotion depended entirely on a full and complete knowledge of every subject concerned, and being encouraged by my officials to do so, I took the very wise step to obtain them."
- (16). "Working in the mine I wished to have a fuller understanding of the work I was doing, also that I might have a better job than coal hewing all the time."
- (17). (a) "To improve my education.
(b). To better my position.
(c). To have a better knowledge of the mine and its workings".
- (18). "As I wish to better myself in mining".

During session 1933-34 all mining students were asked to complete a questionnaire, a copy of which is given on p. 75. The answers given have been tabulated and are shown on figs. 3 to 5, ps. 76-78

The following is a résumé of the answers:-

Question No. 1. - Age.

From the age returns the following table is constructed:-

<u>Year.</u>	<u>Average age.</u>	<u>No. in class.</u>
Mining - Preliminary.	20. 0.	7.
" Third Year.	24. 0.	15.
" Fourth "	26. 5.	11.
" Fifth "	27. 1.	6.
" Sixth "	28. 7.	16.
" Seventh "	28. 1.	10.
Mining Surveying		
" Fifth "	19. 4.	3.
" Advanced "	23. 3.	18.

The age range is from 17 to 42.

Question No. 3. - Day School Attended.

Table showing number of students who have attended Elementary, Junior Technical and Secondary Schools.

	<u>Elementary.</u>	<u>J.T.S.</u>	<u>Sec'y.</u>	<u>Total.</u>
Mining Preliminary.	7.	-	-	7.
" Third Year	14.	1.	-	15.
" Fourth "	11.	-	-	11.
" Fifth "	4.	-	2.	6.
" Sixth "	15.	-	1.	16.
" Seventh "	<u>4.</u>	<u>-</u>	<u>6.</u>	<u>10.</u>
	55.	1.	9.	65.
	84.7%	1.5%	13.8%	100%
Mine Surveying				
" Fifth Year.	-	-	3.	3.
" Advanced.	<u>9.</u>	<u>-</u>	<u>9.</u>	<u>18.</u>
	9.	-	12.	21.
	42.9%		57.1%	100%

From the above table it would appear that boys who were at school ten or twelve years ago and are now following mining frequently came from the secondary schools (vide- Seventh Year Mining). This, however, does not hold at the present time. The writer is of the opinion that the mining industry would absorb more students from Junior Technical and Secondary Schools if statutory examinations were graded. Students would then immediately on leaving the day school, be required to enter a course of instruction in order to obtain a preliminary

preliminary/ mining qualification.

Probably the real reason for the lack of boys from Secondary Schools is that the mining industry demands a very severe and long "apprenticeship" before any person is allowed to hold a position of responsibility.

Question No.5. No. of hours away from home per week when attending mining classes.

The column of hours away from home is included to show that travelling from home to class or from mine to class may take up even more time than is devoted to instruction. Of the 86 students, 14 spent more time in travelling than at instruction.

Question No.6. No. of miles travelled per week from home to class.

The number of miles travelled illustrates how a mining community is scattered over a large area. It will be noted that students nos. 78 and 81 travel 92 miles per week. This is noteworthy in connection with the arguments put forward regarding the advantage of reducing the number of evenings arranged per week in a mining course. (See p.92,1)

Question No. 8. Occupation in Mine.

This column indicates that a percentage of all types of mine workers are interested in mining education.

The following table summarises the facts:-

<u>Occupation.</u>	<u>No. of Students.</u>
Overmen.	6.
Deputies(Firemen).	16.
Shift Workers.	12.
Miners(Coal Hewers).	10.
Putters (Pony Drivers).	8.
Haulage Attendants.	5.
Mining Apprentices.	3.
Apprentice Surveyors.	17.
Linesmen.	9.

Question No.9. Interests.

Six students wrote "none" and six wrote "classes". A number answered "sport" but on enquiry it was found that this meant simply "football spectator" and the reading of sports papers.

Of the 50 students who included "football" as an interest it was found that only a few took an active interest in the game. Again, "football spectator" should have been the answer. Most interests were centred in summer games and mention should be made here that this is due to the excellent facilities now available to the working miner by the funds set aside for recreation by the Miners' Welfare Committee.

Question No.10. Preference of Subjects in Curriculum.

The following table shows the subjects with placings made by the students in the first three years of the mining course:-

English.....	1.	(One year instruction).
Mathematics....	4.	
Science.....	17.	
Drawing.....	6.	
Geology.....	1.	(One year instruction).

Science is the most popular subject and this is undoubtedly due to the practical work involved and to the suitability of the subject to mining application from the beginning.

In the advanced years no subject showed any striking preference.

Question No.11. Reasons for entering the mining industry.

1. In the majority of cases mining was the only work available.
2. When the boy had left school the mines offered more wages than any other industry.
3. Another reason is shown as follows:-
 - (a). "Father was a miner".
 - (b). "Belonged to a mining family, therefore mining was inevitable".
 - (c). "Father is an official at a colliery."
4. Three students out of eighty-six stated that it was their own choice.

From the foregoing it will be seen that circumstances rather than choice determines that the boy shall be a miner.

Question No.12. Aim in taking mining classes.

In all cases the reason stated was to obtain one or other of the statutory certificates and so procure a better position in the mine. Additional answers were as follows:-

- (a). To obtain a fuller education.
- (b). To gain general knowledge.
- (c). To try and improve general knowledge.
- (d). To keep the mind occupied.
- (e). To improve the intellect.
- (f). To broaden general knowledge.

Whereas the majority of the students are taking classes in order to improve their financial standing and industrial status, a few are anxious to improve their general knowledge. This is of great encouragement to the writer who sees such cultural possibilities in mining education.

Question No.13. Books read for recreation.

Out of 86 students, 20 answered "none", and 12 read only mining books. Most of the students read books of adventure and other light matter. Although "none" is recorded by many students all are interested in newspapers of various types.

Question No.14. Preference of times of class meetings.

This question was included in order to find out whether the student preferred to attend a class before or after a shift in the mine. There was, however, no definite information obtained regarding the point. On enquiry it was found, contrary to expectations, that quite a number of students preferred to attend a class after a shift.

In stating preference for the evening the following additional answers were given:-

- (a). "More discussion and various views from other students". (Evening classes are larger.)
- (b). "Like a large class".
- (c). "More time for homework". (This refers to having the other evenings at home instead of working in the mine).

Additional answers given by those students preferring morning classes were as follows:-

- (a). "Evening more suitable for recreation."
- (b). "More rested".
- (c). " Only one subject at a time". (Under the three hour evening class system the duplicate classes held in the morning were of 2 hours' duration, meeting on three mornings of the week. Three students gave this reason.)

QUESTIONNAIRE.

- 1. Name. Age.
- 2. Married or Single
- 3. What standard of education did you reach before taking
mining classes?
- 4. Number of hours per week attending mining classes.....
- 5. Number of hours away from home when attending classes.....
- 6. Number of miles travelled to and from classes.....
- 7. Number of shifts per week (state whether alternate shifts
are worked.
.
- 8. Class of work at the colliery (state in detail)
.
- 9. What are your interests? (sports, hobbies, church, etc.)
.
- 10. Which subjects do you prefer? (state in order of preference
and give reasons)..
.
.
.
- 11. What made you decide to enter the mining industry?.
.
.
- 12. What is your aim in taking mining classes?.
.
.
- 13. What books do you read for recreation?.
.
- 14. If you attend both morning and evening classes state which
you prefer and why.
.
.

- TABULATED ANSWERS TO QUESTIONNAIRE SUBMITTED TO MINING STUDENTS. -

- Session 1933-34. -

COURSE	STUDENT	AGE.	MARRIED (M) SINGLE (S)	DAY SCHOOL ATTENDED	NO. OF HOURS AT EVENING CLASSES (PER WEEK)	NO. OF HOURS AWAY FROM HOME PER WEEK.	NO. OF MILES TRAVELLED PER WEEK.	NO. OF SHIFTS PER WEEK.	OCCUPATION	INTERESTS	PREFERENCE OF SUBJECTS	REASONS FOR	AIM IN	BOOKS	PREFERENCE	INTELLIGENCE MARK MAXIMUM 100	
												ENTERING THE MINING INDUSTRY	TAKING MINING CLASSES	READ AS RECREATION	OF CLASS MEETINGS, [MORNING OR EVENING]		
PRELIMINARY (COMBINED 1ST AND 2ND YEARS)	1	J.D	22	S	ELEM.	3	4	3	4	SHIFT WORKER	WIRELESS CHURCH	NO SPECIAL PREFERENCE	NO ALTERNATIVE	TO GET ON IN LIFE.	ALL CLASSES	EVENING (MOST SUITABLE)	59
	2	J.F	20	S	"	3	3½	12	4	PUTTER	SPORTS AMBULANCE CHURCH	SCIENCE DRAWING	NO ALTERNATIVE	TO TRY AND BETTER MYSELF	ANY BOOKS	MORNING [MORE ABLE TO STUDY]	54
	3	T.J.	20	S	"	3	4	10	5	"	CLASSES	DRAWING SCIENCE MATHS	ONLY INDUSTRY IN THE DISTRICT	TO TRY TO GO HIGHER THAN REMAIN IN THE LOWER GRADE OF WORK	AN OCCASIONAL LIBRARY BOOK.	MORNING [EVENING MORE SUITED FOR RECREATION]	60
	4	J.R	24	S	"	3	4	12	6	SHIFT WORKER	FOOTBALL CHURCH	MATHS. DRAWING	ONLY JOB AVAILABLE	SO THAT I MIGHT OBTAIN A BETTER POSITION	LITTLE READING	MORNING (MORE RESTED)	47
	5	T.R.	19	S	"	3	5	12	4	PUTTER.	CLASSES	SCIENCE DRAWING MATHS	NO ALTERNATIVE	TO BETTER MYSELF.	NONE	MORNING [MORE ABLE TO STUDY]	57
	6	W.S.	17	S	"	3	4	3	4	ENGINEMAN	CYCLING CHURCH	SCIENCE DRAWING	NO ALTERNATIVE	TO TRY AND BETTER MYSELF.	NO READING.	EVENING	60
	7	W.W.	17	S	"	3	4	3	5	HAULAGE LAD.	FOOTBALL CRICKET.	DRAWING MATHS	NO OTHER CHANCE FOR OTHER WORK	IN ORDER TO OBTAIN A BETTER POSITION	OCCASIONALLY A NOVEL	EVENING (MORE SUITABLE)	58
YEAR T H I R D	8	R.B.	27	S	"	6	8	12	5	MINER	CLASSES	SCIENCE MATHS DRAWING	ONLY JOB AVAILABLE	IN ORDER TO OBTAIN 2ND CLASS CERTIFICATE	VERY LITTLE READING	EVENING	52
	9	J.F.	37	M	"	6	7	3	6	DEPUTY.	CLASSES	ENGLISH MATHS	HAD TO EARN MY LIVING ON LEAVING SCHOOL.	TO OBTAIN PROMOTION IN THE MINE.	MINING BOOKS	NO PREFERENCE.	47
	10	W.F.	17	S	"	6	9	15	5	HAULAGE LAD.	FOOTBALL BOXING SWIMMING	DRAWING MATHS. SCIENCE	NO OTHER PLACE WHERE I COULD GET WORK.	TO TRY AND GET A BETTER JOB AND ALSO A FULLER EDUCATION	DETECTIVE STORIES	MORNING (MORE ABLE TO STUDY)	57
	11	W.H.	29	M	"	6	10	48	6	DEPUTY.	FOOTBALL BOXING SWIMMING	DRAWING. SCIENCE MATHS.	NO OPTION	TO BETTER MY POSITION IN LIFE	FICTION—FAVOUR- ITES! A.G. HALES TUTTLE JEFFREY FENOL	EVENING	63
	12	G.H	18	S	"	6	8	12	5	LINESMAN	FOOTBALL	SCIENCE DRAWING MATHS.	[No ANSWER]	TO SECURE A HIGHER POSITION	NONE.	EVENING.	45
	13	W.H.	17	S	J.T.S.	6	7½	4½	5	LINESMAN	FOOTBALL	SCIENCE MATHS DRAWING	NO ALTERNATIVE	TO SECURE A "SURVEYING" TICKET	HUMOROUS STORIES.	EVENING	77
	14	A.J.	25	S	ELEM.	6	10	35	5	MINER.	NONE	DRAWING SCIENCE MATHS	ONLY JOB OPEN.	TO MAKE PROGRESS	VERY LITTLE READING IN WINTER.	EVENING	48
	15	W.M.	34	M	"	6	10½	42	6	DEPUTY.	CYCLING BOWLS.	SCIENCE MATHS. DRAWING	NO ALTERNATIVE	TO IMPROVE POSITION AT WORK	EDGAR WALLACE AND ADVENTURE STORIES	EVENING [FEEL READER FOR STUDY]	53
	16	J.P.	24	S	"	6	10	56	5	PUTTER	FOOTBALL TENNIS CHURCH	MATHS DRAWING SCIENCE	ONLY JOB AVAILABLE.	TO OBTAIN PROMOTION	NONE	EVENING	51
	17	J.R.	18	S	"	6	8	12	5	HAULAGE LAD.	SPORT CLASSES	SCIENCE DRAWING MATHS.	FAMILY IN MINES AND HOLDING OFFICIAL POSITIONS.	TO ADVANCE AS FAR AS POSSIBLE IN THE KNOWLEDGE OF MINING	TRAVEL LIGHT FICTION.	EVENING.	50
	18	R.R.	18	S	"	6	9	28	6	MINING STUDENT	RUGBY FOOTBALL	SCIENCE DRAWING MATHS	LIKED THE WORK.	TO HOLD THE POSITION OF COLLIERY MANAGER	HOMEWORK AND MINING BOOKS	EVENINGS [ALWAYS ON DAY SHIFT]	50
	19	W.R.	20	S	"	6	8	8	5	HAULAGE LAD.	CYCLING	MATHS SCIENCE DRAWING	REGULAR WORK TO BE OBTAINED.	TO IMPROVE POSITION AT WORK.	FICTION ZONE GREY.	EVENING.	64
	20	T.S.	24	S	"	6	9	48	5	MINER.	TENNIS CHURCH	SCIENCE MATHS DRAWING	NO OTHER CHOICE	TO IMPROVE MY POSITION	DETECTIVE STORIES.	EVENING [IN BETTER COND- ITION]	74
	21	H.S	35	M.	"	6	9	7	7	DEPUTY.	SPORTS	MATHS. DRAWING SCIENCE	VERY LITTLE ELSE FROM WHICH TO CHOOSE.	INCREASE MY KNOW- LEDGE OF MINING WHICH MAY LEAD TO A BETTER POSITION	NONE IN WINTER.	EVENING [ALWAYS ON DAY SHIFT]	48
22	J.W.	17	S	"	6	9	28	6	DEPUTY'S ASSISTANT	FOOTBALL CHURCH	DRAWING SCIENCE MATHS.	NECESSITY OF OBTAINING EMPLOYMENT.	TO SEEK BETTER WORK	NONE.	EVENING.	53	
4TH YEAR	23	J.A.	25	S	"	6	8	12	5	MINER	NONE	SCIENCE MATHS, GEOLOGY	INTERESTED IN MINING ALSO ONLY WORK AVAILABLE.	TO GAIN GENERAL KNOWLEDGE ALSO TO TAKE A BETTER POSITION SHOULD THE OPPORTUNITY OCCUR	EDGAR WALLACE TYPE.	NO SPECIAL PREFERENCE	68
	24	A.H.	24	M	"	6	10	5	5	MINER (COAL CUTTING)	SPORTS CHURCH	SCIENCE GEOLOGY MATHS.	WISHED TO SEE WHAT A MINE WAS LIKE.	TO BETTER MYSELF	VERY LITTLE READING	MORNING [ONLY ONE SUB- JECT AT A TIME]	55
	25	W.L.	20	S	"	6	10½	8	5	PUTTER.	RAMBLING CYCLING STUDYING.	SCIENCE GEOLOGY MATHS.	[No ANSWER]	TO SECURE "TICKETS" IN ORDER TO BECOME A COLLIERY OFFICIAL	NONE	EVENING.	63

[illegible]

FIG. 4.

COURSE	STUDENT		AGE	MARRIED (M) SINGLE (S)	DAY SCHOOL ATTENDED	No. of Hours at		No. of Miles Travelled [per week]	No. of Shifts per week.	OCCUPATION	INTERESTS	PREFERENCE OF SUBJECTS	REASONS FOR	AIM IN	BOOKS	PREFERENCE	INTELLIGENCE MARK. MAXIMUM 100
						EVENING CLASSES [per week]	NO. OF HOURS AWAY FROM HOME [per week]						ENTERING THE	TAKING MINING	READ AS	OF CLASS	
FOURTH YEAR	26	A.M.	38	M.	ELEM.	6	10	24	5	DEPUTY.	NO INTERESTS NO TIME	SCIENCE DRAWING	WAGES PAID ATTRACTED ME TO THE INDUSTRY	TO FURTHER MY KNOWLEDGE AND IF POSSIBLE TO OAIN AN UNDERMAN'S CERTIFICATE	READ NEWSPAPERS	EVENING	48
	27	W.M.	19	S	"	6	10½	40	5	MINER.	TENNIS FOOTBALL	No PREFERENCE	NO OTHER WORK OBTAINABLE	ENDEAVOUR TO BETTER MYSELF	NOVELS	No PREFERENCE	67
	28	J.M.	30	M.	"	6	10	40	4	SURVEYOR / LINESMAN.	NO TIME FOR ANY INTERESTS OUTSIDE CLASSES	FIND ENJOYMENT IN ALL CLASSES. PREFER GEOLOGY	FIRST WORK ON OFFER.	TO GAIN MINING KNOWLEDGE AND MISS THE ROUGH WORK	READ TEXT BOOKS.	EVENING	52
	29	W.M.	25	M.	"	6	10	24	7	PUTTER.	CHESS	SCIENCE MATHS	FINANCIAL REASONS.	TO TRY AND IMPROVE MY EDUC- ATION & OBTAIN A CERTIFICATE	BOOKS ON SCIENCE	MORNING [EASIER TO ATTEND]	53
	30	W.O.	18	S.	"	6	8	4	3	LINESMAN.	CHURCH SWIMMING CYCLING.	SCIENCE GEOLOGY MECHANICS	POSITION AT THE MINE VACANT. ADVISED BY MY PARENTS TO ACCEPT	TO GAIN KNOW- LEDGE AND BE- COME A SURVEYOR.	BOOKS ON SPORT AND ADVENTURE	No PREFERENCE	38
	31	E.T	31	M.	"	6	10	24	3	MINER.		SCIENCE DRAWING	GOOD WAGES DURING THE WAR	TO OBTAIN A 2ND CLASS CERTIFICATE	MINING BOOKS.	MORNING [ONLY ONE SUB. EACH MORNING]	59
	32	S.W.	26	M.	"	6	8	4	5	DEPUTY		SCIENCE DRAWING MATHS.	WAGES ATTRACTED ME TO THE INDUSTRY	TO OBTAIN THE MANAGER'S CERTIFICATE	NEWSPAPERS AND PERIODICALS	MORNING.	48
	33	J.W.	34	M	"	6	10	28	6	DEPUTY.	WIRELESS CHURCH	SCIENCE MECHANICS GEOLOGY	ATTRACTED BY THE MYSTERY OF THE MINE	TO BETTER MY POSITION. TO BE MORE CONFID- ENT I COMPETENT	MINING BOOKS	SATURDAY AFTERNOONS	52
FIFTH YEAR	34	P.D.	21	S.	ELEM.	6	9	28	6	PUTTER.	TENNIS WIRELESS CHURCH	SCIENCE MECHANICS GEOLOGY	THOUGHT I WOULD LIKE TO BE A MINER	TO BECOME A MANAGER OF A COLLIERY	FICTION MYSTERY NOVELS	MORNING [FEEL MORE ABLE]	79
	35	R.F.	28	S.	SECONDARY	6	8	4	6	SHIFT WORKER.	FOOTBALL (STREET) SCOUTS CHURCH	ELECTRICITY MECHANICAL ENG.	FINANCIAL REASONS. MINING OFFERED BETTER WAGES WHEN I LEFT SCHOOL.	TO IMPROVE MY POSITION.	NONE (NO TIME)	EVENINGS. DIFFICULT TO CON- CENTRATE IN THE MORNING AFTER A SHIFT.	63
	36	R.H.	31	M.	ELEM.	6	8	4	6	DEPUTY.	CHURCH. GARDENING WOODWORK PAINTING.	No PREFERENCE	MOST REMUNERATIVE WHEN I LEFT SCHOOL.	TO BETTER MY POSITION	DETECTIVE AND ADVENTURE STORIES	EVENING CLASSES [MORE TIME FOR HOME WORK]	68
	37	W.S.	32	M.	"	6	8	24	6	MINER	TAKE A PASSING INTEREST IN ALL SPORT BUT NOTHING SERIOUS.	HEAT ENGINES ELECTRICITY GEOLOGY SCIENCE	FINANCIAL REASONS AND ONLY INDUSTRY IN DISTRICT.	TO BETTER MY POSITION FINANCIALLY AND SOCIALLY. KEEP MY MIND OCCUP- IED	VERY LITTLE IN WINTER. READ BOOKS BY WELLS, DICKENS, GILCHRIST.	EVENING [MIND MORE ALERT]	40
	38	J.T.	25	S.	"	6	8	6	6	MINER	FOOTBALL DRAUGHTS CHURCH	HEAT ENGINES ELECTRICITY SURVEYING DRAWING	IT WAS THE ONLY INDUSTRY WHICH OFFERED REGULAR WORK.	TO ENDEAVOUR TO OBTAIN AN OFFICIAL POSITION	DETECTIVE NOVELS	[BETTER SUITED FOR TAKING AN INTEREST IN THE WORK]	61
	39	J.T.	26	S.	"	6	9½	28	6	SHIFT WORKER.	CRICKET TENNIS FOOTBALL CHURCH	MECHANICAL ENG. ELECTRICITY SURVEYING GEOLOGY	NO ALTERNATIVE AT THE TIME.	TO IMPROVE MY POSITION.	DETECTIVE AND DRAMA	MORNING. ONE SUBJECT IS GIVEN AT EACH CLASS	48
SIXTH YEAR	40	J.C	24	S	"	6	9	20	5	PUTTER	WIRELESS FOOTBALL	MINING ELECTRICITY	FANCIED MINING. FATHER IS A MINER.	TO BETTER MYSELF.	FICTION	MORNING [FEWER STUDENTS IN CLASS]	48
	41	R.C.	24	S	"	6	8	24	6	SHIFT WORKER.	CYCLING	[No Answer]	No OPTION	TO SECURE A BETTER POSITION IN THE MINE	SOME READING WHEN TIME. MINING BOOKS	EVENING.	65
	42	T.C.	21	S	SECONDARY	6	12½	48	5	APP SURVEYOR.	NONE	MINING	[No Answer]	TO BETTER MYSELF	MINING BOOKS AND MAGAZINES	EVENING.	63
	43	R.F	42	M	ELEM.	6	9	12	7	MASTER WASTEMAN	VERY LITTLE SPORT. A LITTLE SWIMMING AND READING	DRAWING MINING	ONLY VACANCY AVAILABLE AT THE TIME	TO BECOME QUALI- FIED - BETTER WORK AND WAGES.	FICTION: H.G. WELLS.	EVENING.	49
	44	J.C.	21	S	"	6	8	6	5	SHIFT WORKER.	A LITTLE SPORT.	VENTILATION MINE WORKING	MY FATHER WAS A MINER.	TO GAIN QUALIFICATIONS.	DETECTIVE STORIES WORKS ON POLITICS	EVENING.	46
	45	A.C.	24	S.	"	6	10	18	6	LINESMAN	SPECTATOR.	ELECTRICITY SURVEYING	THERE WAS A VACANCY AT THE COLLIERY	TO OBTAIN A 1ST CLASS CERTIFICATE	MANY NOVELS. ALL KINDS.	EVENING [LIKE A LARGE CLASS]	58
	46	J.G.	32	S.	"	9	12	12	6	SHIFT WORKER.	FOOTBALL WIRELESS PHOTOGRAPHY	MINING SURVEYING ELECTRICITY ENGINEERING	WAR WAGES WERE AN ATTRAC- TION.	IMPROVING THE INTER- LECT. TO OBTAIN PROMOTION.	SCOTT, DICKENS. SABATINE.	EVENING.	63
	47	A.H.	32	M	"	9	13½	42	6	OVERMAN	AMBULANCE	MINING VENTILATION SURVEYING	ONLY OPENING.	TO INCREASE MY EFFICIENCY	A LITTLE READING AS A RELAXATION FROM MINING SUBJECTS	MORNING [AS MY SHIFT FOLLOWS THE CLASS]	50
	48	C.M.	32	M.	"	6	9	6	6	DEPUTY.	NONE - NO TIME	MINING SURVEYING	GOOD WAGES OFFERED WHEN YOUNG	TO BETTER MYSELF SOCIALLY AND FINANCIALLY	NOVELS, A FEW	EVENING [FEEL GENERALLY FITTER]	77
	49	F.R.	23	S	"	6	9	20	5	SHIFT WORKER	SPORT. SPECTATOR.	MATHEMATICS MINING GEOLOGY	COULD NOT GET ANYTHING BETTER.	TO TAKE AN INTEREST IN MY WORK, AND PERHAPS BETTER MY POSITION	A FEW NOVELS. MINING LITERATURE	EVENING [PREFERABLE TO SATURDAY FORENOON]	45
	50	W.S.	39	M.	"	6	9	12	7	MASTER SHIFTER.	No PREFERENCE.	TO HELP TO SUPPORT THE FAMILY	TO HELP TO SUPPORT THE FAMILY. THE PIT WAS THE EASIEST WAY.	TO GAIN KNOWLEDGE AND OBTAIN PROMOTION	MINING LITERATURE	MORNING [MORE FIT TO STUDY]	75
	51	A.T.	34	M	"	6	9	36	6	DEPUTY.	GARDENING	MATHEMATICS SCIENCE MINING.	BELONGED TO A MINING FAMILY. MINING WAS THEREFORE INEVITABLE	TO INCREASE OF THE INDUSTRY (1) BETTER SOCIAL STATUS (2) INCREASE WAGES.	ONLY BOOKS APPERTAINING TO MINING.	NO SPECIAL PREFERENCE (HAVE ALWAYS A TUSH TO GET TO CLASS)	48
	52	W.T.	28	M	"	6	9	26	6	SHIFT WORKER	A FEW SPORTS. (TAKE NOTHING SERIOUS- LY)	DRAWING MACHINERY.	ONLY VACANCY AVAILABLE	TO BECOME QUALIFIED - HARD REFINED WORK - BETTER WAGES.	FICTION DEALING WITH UNUSUAL SUBJECTS. eg. H.G. WELLS ETC.	EVENING.	69
	53	W.W.	22	S.	"	6	10	60	5	MINER.	A FEW SPORTS. SWIMMING	DRAWING MACHINERY	ONLY VACANCY AVAILABLE.	TO QUALIFY, MORE REFINED WORK, BETTER WAGES.	FICTION: H.G. WELLS.	EVENING.	62
	54	N.W.	35	M.	"	6	8	10	7	OVERMAN.	RUNNING RUGBY CHURCH.	No PREFERENCE	No OTHER CHOICE.	TO OBTAIN A HIGHER POSITION. TO BROADEN MY GENERAL KNOWLEDGE	NOVELS ON TRAVEL.	EVENING [MORE DISCUSSION AND VARIOUS VIEWS FROM OTHER STUDENTS.]	72
	55	L.B.	27	S.	SECONDARY	6	13	65	7	OVERMAN.	SWIMMING MOTOR CYCLE	No SPECIAL PREFERENCE	MY OWN CHOICE	TO OBTAIN A 1ST CLASS CERTIFICATE	NOVELS. ALL SORTS.	No SPECIAL PREFERENCE	75

COURSE	SEVENTH YEAR																INTELLIGENCE MARK MAXIMUM 100
	STUDENT.	AGE	MARRIED (M) SINGLE (S)	DAY SCHOOL ATTENDED	NO OF HOURS AT EVENING CLASSES [PER WEEK]	NO OF HOURS AWAY FROM HOME [PER WEEK]	NO. OF MILES TRAVELLED [PER WEEK]	NO. OF SHIFTS PER WEEK.	OCCUPATION	INTERESTS	PREFERENCE OF SUBJECTS	REASONS FOR ENTERING THE MINING INDUSTRY	AIM IN TAKING MINING CLASSES	BOOKS READ AS RECREATION	PREFERENCE OF CLASS MEETINGS [MORNING OR EVENING]		
5 TH YEAR MINE SURVEYING	56	E.A.	35	M	ELEM.	6	9	28	7	DEPUTY	NONE DURING WINTER. CRICKET IN SUMMER	MINING SURVEYING ELECT. ENGINEERING	AN ORPHAN AND THEREFORE NO ADVICE AVAILABLE.	TO GAIN KNOWLEDGE AND EVENTUALLY IMPROVE MY POSITION	NONE. NO TIME.	EITHER MORNING OR EVENING	36
	57	D.D.	25	S	SECONDARY	6	10	72	6	OVERMAN	GOLF RUGBY FOOTBALL MOTORING.	MECHANICAL ENGINEERING SURVEYING ELECTRICAL ENGINEERING	CAME INTO CONTACT WITH MINING DURING STRIKE (1926)	TO OBTAIN MANAGER'S CERTIFICATE	NOVELS W.J. LOCKE MINING LITERATURE.	EVENING.	72
	58	E.H.	34	M	ELEM.	6	8	18	7	DEPUTY	FOOTBALL CRICKET BOWLS. WIRELESS.	MINING ELECT. ENGINEERING SURVEYING	PRELIMINARY INTERESTS.	TO INCREASE MY EFFICIENCY. TO BETTER MY POS- ITION.	TRAVEL STORES.	EVENING [LIKE A LARGE CLASS]	68
	59	A.M.	27	M	SECONDARY	6	8½	36	6	OVERMAN	FOOTBALL TENNIS MUSIC	MINING ELECT. ENGINEERING SURVEYING	MY OWN CHOICE	TO OBTAIN A MANAGER'S POSITION	NOVELS BY EDGAR WALLACE.	EVENING.	70
	60	J.M.	24	S	"	6	8	16	5	SHIFT WORKER.	FOOTBALL DANCING CAMPING.	SURVEYING. MINING ELECT. ENGINEERING	INTENDED TO BE TEMPORARY WHEN 16 YEARS OF AGE. FAMILY REASONS MADE IT PER- MANENT.	TO BETTER MY- SELF. CONSIDER IT A HOBBY	MYSTERY NOVELS.	MORNING [GENERALLY TIRED AT NIGHT AFTER COMPLETING A SHIFT]	80
	61	G.O.	26	S	"	6	8	6	6	MINING STUDENT	MOTORING RUGBY	SURVEYING. MINING ELECT. ENG.	MY OWN CHOICE	TO OBTAIN THE MANAGER'S CERTIFICATE	READ MANY NOVELS (ALL KINDS)	EVENING [PREFER A LARGE CLASS]	77
	62	J.R.	26	S	ELEM.	6	10	48	6	DEPUTY	FOOTBALL CRICKET	MINING SURVEYING ENGINEERING	ONLY INDUSTRY IN THE DISTRICT	TO QUALIFY AS A MINE MANAGER.	VERY FEW. (NO TIME)	EVENING [NOT SO FRESH IN A MORNING CLASS]	53
	63	K.R.	21	S	SECONDARY	6	9	44	6	MINING STUDENT	PIGEON FLYING. TENNIS	MINING ELECT. ENGINEERING COLLIERY ENGINEERING SURVEYING	INTEREST IN MINING DUE TO MINING SURROUNDINGS	TO OBTAIN A GOOD POSITION IN THE INDUSTRY	NOVELS BY GALSWORDTHY AND RAYMOND.	EVENING [MORNING IS NOT SUITABLE AFTER A NIGHT SHIFT]	75
	64	G.T.	28	M	"	6	12	68	6	DEPUTY	FOOTBALL CRICKET SWIMMING MUSIC	MINING SURVEYING ENGINEERING	FORCE OF CIRCUMSTANCES.	AN ATTEMPT TO MAKE A BAD JOB INTO A DECENT ONE	NONE. SINCE STUD- YING MINING DO NOT FEEL INCINED TO READ NOVELS.	EVENING OR MORNING.	60
	65	W.L.	33	M	ELEM.	6	10	24	6	SHIFT WORKER.	NONE AT PRESENT. INTERESTED IN GARDENING.	NO PREFERENCE.	FORCE OF CIRCUMSTANCES.	PROMOTION OF PRIMARY IMPORTANCE ALSO A DESIRE TO IMPROVE MY KNOWLEDGE.	NONE AT PRESENT.	MORNING [FIND I CAN DO MORE IN THE MORNING]	48
6 TH YEAR MINE SURVEYING	66	M.L.	19	S	SECONDARY	6	10	25	6	APP. SURVEYOR	CYCLING DANCING.	SURVEYING GEOLOGY (OTHER SUBJECTS DRY)	FATHER IS AN OFFICIAL AT THE COLLIERY.	TO BECOME A CERTIFIED MINE SURVEYOR.	BOOKS FROM THE COUNTY COUNCIL LIBRARY.	EVENING. [MORNING CLASSES ARRANGED FOR THOSE ON NIGHT SHIFT]	51
	67	W.R.	19	S	"	6	8	8	6	LINESMAN	SCOUTS.	SURVEYING ELECTRICITY GEOLOGY.	THE FIRST JOB WHICH CAME ALONG	TO QUALIFY AS A SURVEYOR	DETECTIVE AND ADVENTURE STORIES (WHENTIME)	EVENING.	52
	68	D.L.	20	S	"	6	13	80	6	APP. SURVEYOR.	CYCLING FOOTBALL DECORATIVE WORK.	GEOLOGY SURVEYING MINING.	THE COLLIERY WAS THE LOCAL SOURCE OF EMPLOYMENT.	TO QUALIFY AND ENSURE MYSELF OF A RESPECTABLY PAID POST.	WEEKLY PERIODICALS. A BOOK NOW AND AGAIN	EVENING.	70
	69	J.B.	23	S	ELEM.	4½	6½	24	6	LINESMAN	DANCING CLASSES	SURVEYING.	A GOOD JOB WAS OFFERED IN THE SURVEYING DEPT.	TO BECOME A MINE SURVEYOR	NOVELS BY EDGAR WALLACE	ONLY EVENING	71
	70	G.B.	24	M	SECONDARY	4½	6	28	6	APP. SURVEYOR	FOOTBALL SWIMMING.	SURVEYING	JOB VACANT ON LEAVING SCHOOL.	MINE SURVEYOR'S CERTIFICATE	LIGHT FICTION		71
	71	R.B.	23	S	"	4½	8	26	6	APP. SURVEYOR	BOY SCOUTS. WALKING	SURVEYING	THE BEST OPPORTUNITY WHICH WAS OFFERED	TO OBTAIN THE A CERTIFICATE AND SO INCREASE WAGE	GALSWORDTHY DUMAS.		80
	72	J.B.	19	S	ELEM.	4½	7	6	6	LINESMAN	CLASSES	SURVEYING	THE ONLY JOB WHICH WAS OFFERED	TO GAIN A SURVEYOR'S CERTIFICATE	NONE		61
	73	N.G.	30	M	"	4½	9	24	6	APP. SURVEYOR.	CLASSES A FEW SPORTS.	SURVEYING	A VACANCY OCCURED	TO GAIN A SURVEYOR'S CERTIFICATE	MYSTERY NOVELS.		64
	74	T.H.	21	S	SECONDARY	4½	10	54	6	APP. SURVEYOR	CRICKET. RUGBY.	SURVEYING	?	TO BECOME A QUALIFIED SURVEYOR.	NONE. NO TIME.		46
	75	L.H.	22	S	"	4½	8	32	6	APP. SURVEYOR.	CYCLING TENNIS RIFLE SHOOTING	SURVEYING	I TOOK THE FIRST JOB WHICH TURNED UP.	TO QUALIFY AND IMPROVE MY POSITION.	HARDY AND DICKENS.		73
76	P.K.	18	S	"	4½	6½	7	6	APP. SURVEYOR	FOOTBALL	SURVEYING	INTENDED TO TAKE OXFORD COURSE. IN RETURN FROM ONE SCHOOL FOUND I WAS TOO FAR BEHIND.	TO OBTAIN THE SURVEYOR'S AND MANAGER'S CERTIFICATES	A FEW NOVELS.	82		
77	A.K.	22	S	"	4½	6	28	6	APP. SURVEYOR	A LITTLE SPORT SPECTATOR	SURVEYING	REALISED THAT OPPORTUNITIES ONLY OCCUR IN ONE STUDIES.	TO MAKE MYSELF THOROUGHLY CONVERSANT WITH THE SUBJECT	BOOKS ON TRAVEL.	70		
78	E.L.	30	M	ELEM.	4½	12	92	6	APP. SURVEYOR	FOOTBALL WIRELESS.	SURVEYING	AS A BOY I WISHED TO ENTER THE INDUSTRY.	TO OBTAIN A SURVEYOR'S CERTIFICATE	A FEW NOVELS.	52		
79	E.M.	30	M	"	4½	6	6	6	APP. SURVEYOR.	CREATIC WORK.	SURVEYING	ONLY VACANCY WHEN I LEFT SCHOOL.	TO ATTAIN THE POSITION OF MINE SURVEYOR	VERY LITTLE TIME FOR READING.	71		
80	T.R.	20	M	"	4½	6	4	6	LINESMAN	FOOTBALL.	SURVEYING.	THE MINE OFFERED REGULAR EMPLOYMENT.	TO OBTAIN THE MINE SURVEYOR'S CERTIFICATE	NONE.	51		
81	J.T.	20	S	SECONDARY	4½	11	92	6	APP. SURVEYOR	FOOTBALL CRICKET PIANO	SURVEYING	ONLY OCCUPATION WITHIN REASONABLE DISTANCE FROM HOME.	TO QUALIFY AS A MINE SURVEYOR.	SPORTING JOURNALS JACOBS & WOODHOUSE.	ONLY EVENING	81	
82	T.T.	22	S	"	4½	7	10	6	APP. SURVEYOR	SWIMMING FOOTBALL TENNIS.	SURVEYING	FORCE OF CIRCUMSTANCES	TO QUALIFY AS A MINE SURVEYOR.	RIDER HAGGARD CARLYLE.		80	
83	L.W.	27	S	"	4½	10	78	6	APP. SURVEYOR	SPORTS. A LITTLE IN SUMMER.	SURVEYING	A VACANCY OCCURRED	TO OBTAIN GOOD POSITION	NONE		57	
84	N.W.	25	S	ELEM.	4½	10	18	6	APP. SURVEYOR	CRICKET.	SURVEYING	INTERESTED IN THE INDUSTRY.	TO OBTAIN THE SURVEYOR'S CERTIFICATE.	A FEW NOVELS.		40	
85	R.Y.	22	S	"	4½	8½	28	6	APP. SURVEYOR	CHURCH	SURVEYING	THE ONLY VACANCY ON LEAVING SCHOOL.	TO BECOME A QUALIFIED SURVEYOR	NONE NO TIME.		69	
86	J.S.	26	M	"	4½	10	64	6	APP. SURVEYOR	SLIGHTLY INTERESTED IN SPORT.	SURVEYING	?	TO OBTAIN A SURVEYOR'S CERTIFICATE.	NONE.		65	

CHAPTER VI

Arrangement of Hours of Instruction to Working Miners. -----

The Mining Industry differs from all others in that a special shift system has to be introduced in order that the mining of coal may be carried out methodically and economically. A mine worker may, therefore, be called upon to commence work at any time during the twenty-four hours of the day. Mining education, if it is to attain its aim, must be open to all workers in mines and, in order to effect this, special arrangements must be made regarding instruction. In this chapter the writer has shown in detail the various shifts worked in the County of Durham and the corresponding arrangements made to give all mine workers technical instruction, if they so desire. He has also studied in detail the fatigue during class hours and has made definite findings regarding length of class instruction, the allocation of times to the various subjects and the introduction of rest periods.

Arrangement of Hours of Instruction to Working Miners.

In arranging suitable times of instruction in mining, classes must be made to suit the shift system of the particular coalfield. It is, therefore, necessary before time tables of classes are drawn up, to obtain information regarding the conditions of work prevailing in the district allotted to the educational centre. To illustrate the importance of this, details of all shifts worked in a large colliery in Durham were obtained and graphed as shown in Fig.12 page 95. The working shifts are shown thereon in heavy black lines, the downward arrow showing the commencement of the shift and the upward arrow the end of the shift. Apart from horsekeepers, the mining students at Sunderland Technical College are drawn from all workmen detailed on the table.

Particulars of the various shifts worked at eight other collieries in the County of Durham were obtained and these are illustrated by a table on Fig.13, p.96. The times of these shifts were combined and are shown on Fig.14 p.97. Shift systems in the Lancashire, Yorkshire and Scottish Coalfields are also included for comparison.

It is obvious from the last table that mining education in the County of Durham is beset with difficulties and if classes are held only in the evenings many working miners are prevented from attending. It should also be mentioned that most miners are not permanently on the one shift but over a period of three weeks work on three different shifts. The following is one example of the times of work over a period of three weeks:-

1st week.7 a.m. to 2.30 p.m.
2nd "4 p.m. to 11.30 p.m.
3rd "10.30 p.m. to 6 a.m.

This shift system makes the formulation of a scheme of instruction still more difficult. If evening classes alone are held many students can only attend every third week. In other coal

coal/ fields this difficulty does not arise to the same extent and hours of instruction can be arranged to suit all working miners without having recourse to any elaborate scheme of class meetings.

To meet these conditions of work and to ensure that instruction will be continuous three schemes may be formulated, viz:-

- (1). Part-Time Day Classes. The student is relieved of his duties by the Colliery Company in order to attend the Instruction Centre on one whole day per week.
- (2). Classes arranged to suit all shifts.
 Morning Classes 9.30 a.m. to 12 noon.
 Evening Classes 7, p.m. to 9.30 p.m.
 Saturday Morning Classes 9 a.m. to 12 noon.
 During each week the same instruction is given in the morning, evening and Saturday morning classes.
- (3). Saturday Afternoon Classes. 2 p.m. to 6 p.m.
 No colliery work, unless of urgent necessity, is carried out on Saturday afternoon, so that all students could, if they cared, attend mining classes arranged for this time.

Observations.

(1). Part-Time Day Classes.

The advantages of this scheme are obvious. The student is in a better mental and physical condition than he is when attending a class during an interval between his shifts and, further, for one day his environment is completely and pleasantly altered. Again, if attending an Advanced Centre he can enter College life to some extent and, by meeting students of other departments, add to his education that which is impossible when attending continuation classes. More progress can be made in six hours day instruction than in the same number of hours evening instruction and the student is required to make only one journey per week against two, and possibly three, when attending in the evening. From an educational standpoint Part-Time Day Classes are ideal but, at the same time the demands of the industry have to be considered.

Many students attending mining classes hold official appointments at collieries and, therefore, permission to have a day's absence per week from duties could not, in most cases, be allowed.

With regard to the working miner, whilst no objection would be made about his absence from work, he could not afford to lose a day's wage thereby. It is certainly asking much of the industry to allow students to attend day classes during the whole mining course which may extend to as many as eight years. It is suggested, however, that in the last two years instruction should be given in Part-Time Day courses as during these years the subjects call for much laboratory work which is not possible in an Evening Course.

(2) "Shift" Classes.

In this scheme classes are arranged so that all students obtain tuition no matter what shift they are working. A time table of this arrangement is shown on fig. 6 p. 84. Instruction on Saturday mornings covers three hours against five in the other classes so that a student attending alternative classes receives only thirteen hours' instruction out of a possible of fifteen. This is the only disadvantage in the scheme but an extension of hours on Saturday morning is not to be advised, three hours continuous instruction being a maximum. The scheme has been adopted in Sunderland Technical College and has proved very satisfactory. The teaching in all sections is kept identical for each week so that a student can attend class in the morning or evening, whichever is most suitable to his work. The scheme can only be carried out where full-time lecturers are employed.

(3). Saturday Afternoon Classes.

Since it is the general rule that no work is done at collieries on Saturday afternoon it would appear that this time would be ideal for giving mining instruction. In former years many centres held classes on Saturday afternoon but these are gradually being dropped as it is found that when a miner has completed a week's strenuous manual labour he has no inclination to study on an afternoon which is generally devoted to recreation. Where miners are on the back shift, that is on the shift starting from 11 a.m. onwards, there is no other time for relaxation. Again, in order to cover a mining course students must attend for four and possibly five consecutive hours of instruction. (In the questionnaire submitted to 86 students

students/ attending mining classes at the Sunderland Technical College only one gave a preference for these classes.)

Saturday afternoon classes, however, can only be discontinued if full-time Mining Lecturers are available to give instruction in Part-Time Day Classes or Shift Classes. It seems, therefore, inevitable that in a coalfield with a shift system as in the County of Durham and where the instruction centres are spread over the County, Saturday Afternoon Classes must continue for elementary instruction at least. In the Advanced centres, where full-time Lecturers are appointed, the practice certainly should be avoided.

Duration of Class Instruction.

In order to cover a Mining Course it is found necessary to have three subjects in each session. As most of the subjects are combined with laboratory practice and drawing, two hours are allocated to each subject, making a six-hour attendance weekly.

In arranging the number of class meetings, two alternatives are suggested:-

- (1). Three evenings per week (two hours each).
- (2). Two " " " (three " ") X

The advantages in scheme No.1 are as follows:-

- (a). Each evening is devoted to one subject, resulting in better assimilation by the student.
- (b). No time is lost in class changing.
- (c). Fatigue is less than in a three-hour class.
- (d). More students are able to attend since a two-hour class does not overlap the same number of shifts as a three-hour class.

The advantages in Scheme No. 2 are:-

- (a). Only two evenings per week, leaving more time for home study and recreation.
- (b). Less time is spent in travelling with a corresponding decrease in expense.

X This, the writer contends, may with no disadvantage be reduced to $2\frac{1}{2}$ hours (see p. 92)

TIME · TABLE · OF · MINING · CLASSES · ARRANGED · TO
SUIT · SHIFT · SYSTEM · OF · THE · DURHAM · COAL · FIELD

· EVENING CLASSES ·

CLASS.	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
3 rd yr.	MATHS 7 p.m. - 8 p.m. DRAWING 8 p.m. - 9.30 p.m.	MATHS 7 p.m. - 8 p.m. SCIENCE 8 p.m. - 9.30 p.m.				
4 th yr.	GEOLOGY 6.30 p.m. - 8 p.m. MATHS. 8 p.m. - 9 p.m.	SCIENCE 6.30 p.m. - 8 p.m. MATHS. 8 p.m. - 9 p.m.				
5 th yr.	HEAT. 7 p.m. - 8 p.m. ELECTRICAL ENG. I 8 p.m. - 9.30 p.m.			HEAT. 6.30 p.m. - 7.30 p.m. SURVEYING I 7.30 p.m. - 9 p.m.		
6 th yr.			MINING 6.30 p.m. - 7.30 p.m. VENTILATION 7.30 p.m. - 9 p.m.	MINING 6.30 p.m. - 7.30 p.m. COLLIERY ENG. I 7.30 p.m. - 9 p.m.		
7 th yr.	MINE WORKING 6.30 p.m. - 8 p.m. COLLIERY ENG. II 8 p.m. - 9.30 p.m.	ELECT. ENG. II. 6.30 p.m. - 8 p.m. SURVEYING II. 8 p.m. - 9.30 p.m.				

· MORNING CLASSES ·

3 rd yr.	MATHS. 9.30 a.m. - 10.30 a.m. DRAWING 10.30 a.m. - 12 noon.	MATHS. 9.30 a.m. - 10.30 a.m. SCIENCE 10.30 a.m. - 12 noon.				ALL CLASSES MEET ON SATURDAY MORNINGS. 9 a.m. - 12 noon.
4 th yr.		MATHS. 9.30 a.m. - 10.30 a.m. GEOLOGY. 10.30 a.m. - 12 noon.			MATHS. 9.30 a.m. - 10.30 a.m. SCIENCE 10.30 a.m. - 12 noon.	
5 th yr.	HEAT 9.30 a.m. - 10.30 a.m. ELECT. ENG. I. 10.30 a.m. - 12 noon.	HEAT. 9.30 a.m. - 10.30 a.m. SURVEYING I. 10.30 a.m. - 12 noon.				
6 th yr.	MINING. 9.30 a.m. - 10.30 a.m. COLLIERY ENG. I 10.30 a.m. - 12 noon.	MINING. 9.30 a.m. - 10.30 a.m. VENTILATION. 10.30 a.m. - 12 noon.				
7 th yr.				SURVEYING II. 9.30 a.m. - 11 a.m. ELECT. ENG. II. 11 a.m. - 12.30 p.m.	COLLIERY ENG. II. 9.30 a.m. - 11 a.m. MINE WORKING 11 a.m. - 12.30 p.m.	

Of the foregoing two schemes undoubtedly the first is the better from an educational standpoint but, in formulating a scheme, it is found that the fact of the mining community being scattered over a wide area necessitates the reduction of the number of class meetings to a minimum of two evenings per week.

The following are the hours of the Mining Classes held at the Sunderland Technical College from 1929 to 1934:-

Session 1929 / 1930.....	Three evenings of 2 hours.
Sessions	
1930 / 1934.....	Two " " 3 "

After the adoption of the two-evening per week scheme, various psychological tests were carried through in order to obtain information as to fatigue which might result from three hours' instruction, and from these tests to decide as to whether it would be possible to reduce the length of class meetings without affecting the quality or quantity of the class work.

FIRST TEST.

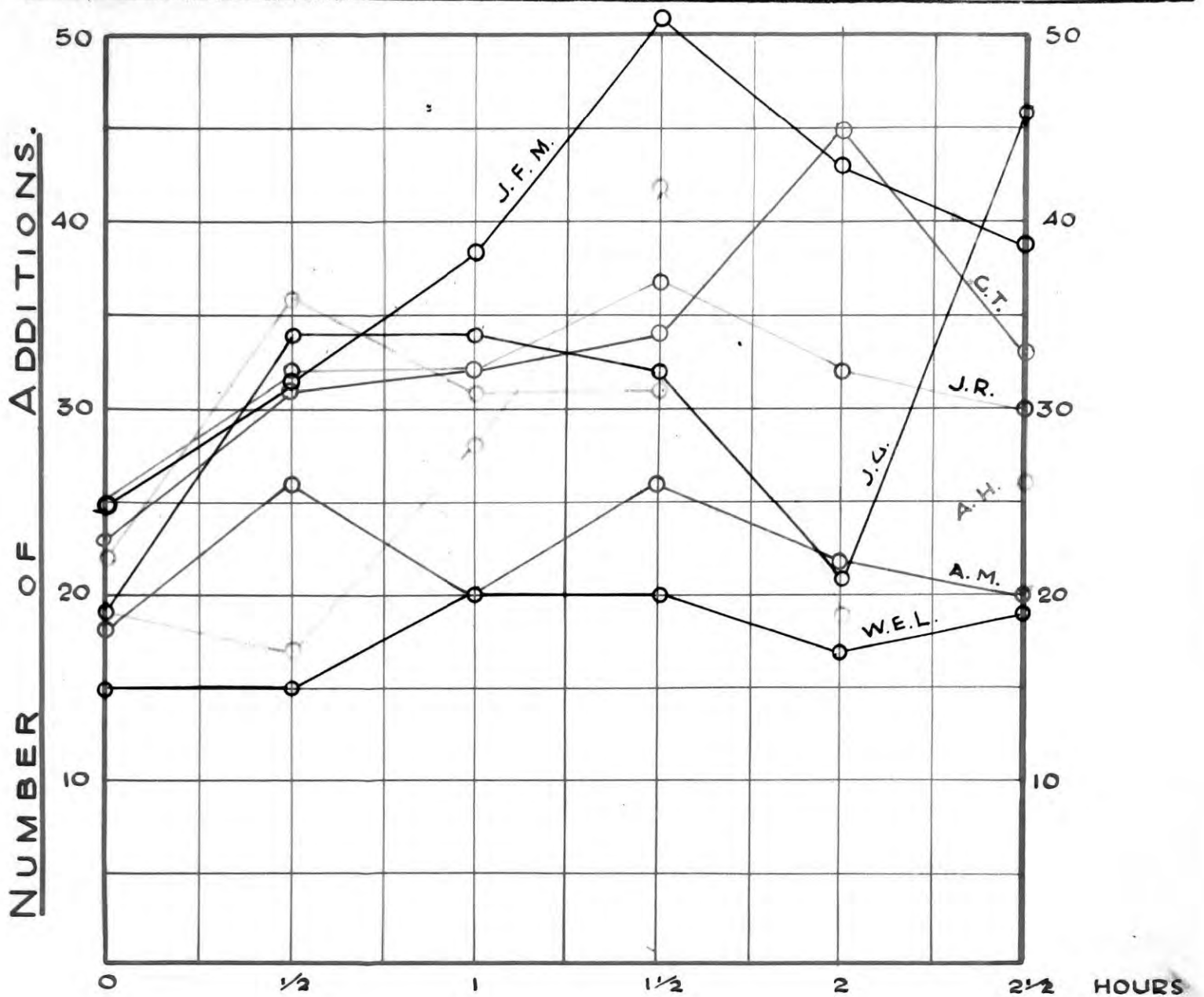
The method of continual addition, as used by Kraepelin, was adopted. This type of test takes the form of adding one-place numbers printed in a vertical column. In an attempt to reduce practice to a minimum, the writer introduced fractions in addition to the one place numbers. (See Appendix No. 1.)

Report of Test.

Class..... 7th Year Mining.
 No. in Class.. 10.
 Ages..... 35, 34, 33, 28, 27, 26, 25, 24, 21, 27.
 Duration of Lecture.....2½ hours(continuous).
 Subject..... Electrical Engineering. (Approximately 95% of the subject matter was theory requiring close attention by the students.)
 Time of Tests. 1st....6.30 p.m. Last....9 p.m. Given at half-hour intervals.
 Duration of Tests.....1 minute each.

Students were instructed to add as many figures as possible and, at the end of each test, to show the result. It was found that only in one case was a mistake made in addition. It was, therefore, decided to take the number of additions completed in each test as a value of fatigue, Fig 7 p.86 gives the graphed results. Individual results are shown and also a graph giving average additions.

MENTAL FATIGUE - TEST NO 1
CONTINUAL ADDITION OF ONE-PLACE NUMBERS WITH FRACTIONS.



GRAPH SHOWING AVERAGE NUMBER
OF ADDITIONS EVERY 1/2 HOUR.

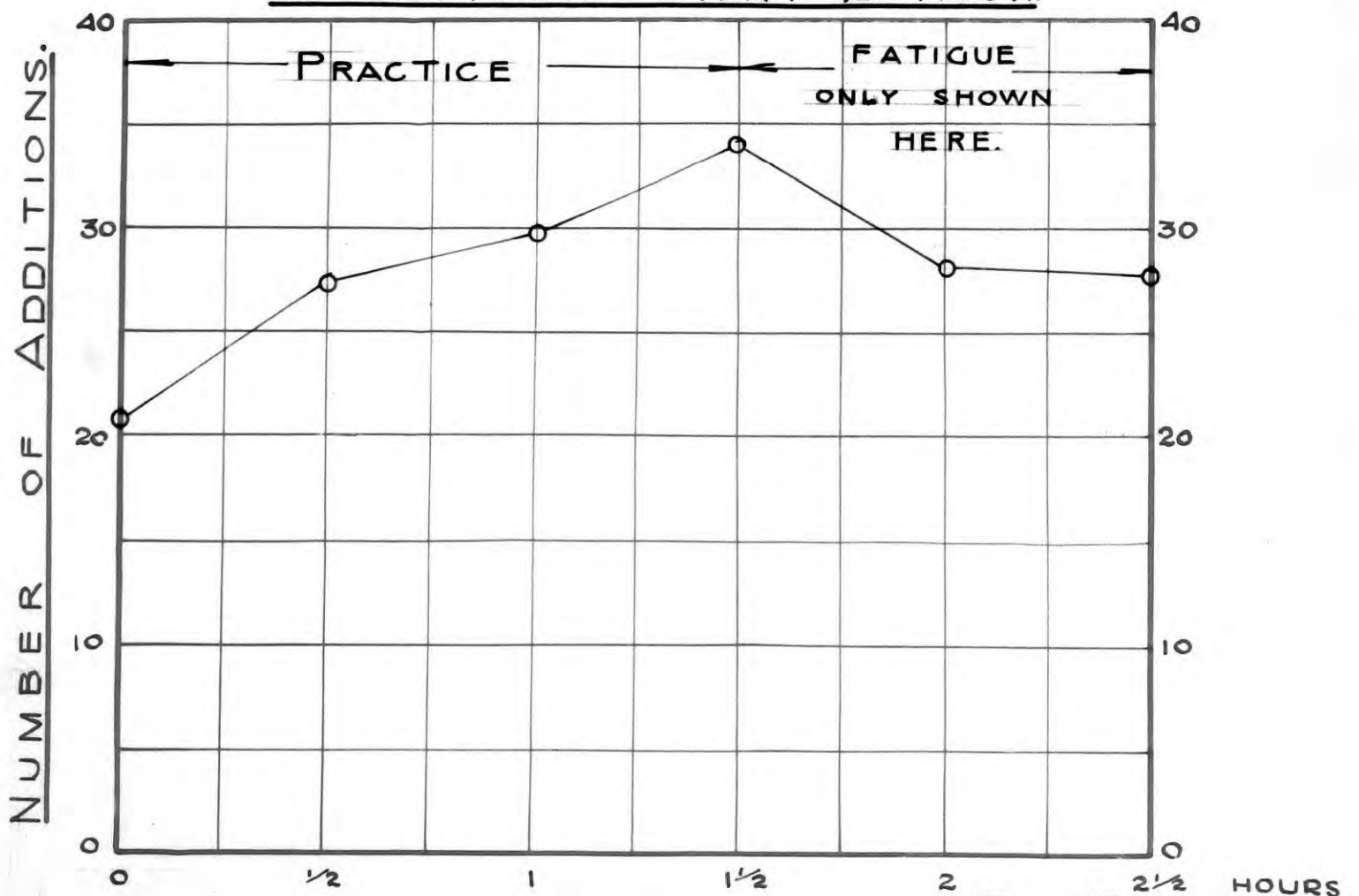


FIG. 7.

Observations.

The inclusion of fractions did not reduce "practice" to any extent. The student usually showed annoyance in adding fractions and the writer is of the opinion that only place numbers should be used. The average graph shows a rise in work done until the fourth test, that is, after one-and-a-half hours' instruction, followed by a definite drop. The positive gradient illustrates practice but after one-and-a-half hours' instruction fatigue tips the scales against "practice", as shown by the negative gradient. This test, therefore, indicates that after that length of time fatigue is definitely present.

SECOND TEST. Time Estimation. X

A duration of one-and-a-half minutes was filled by rapid metronome beats and this was done at intervals of half-an-hour during instruction. The number of beats was varied at each test. The errors were calculated as percentages of the true estimations and were plotted as shown in Fig. 8 p. 88.†

Report of Test.

Class.....6th Year Mining.
 No. in Class...9.
 Ages.....42,39,34,32,24,24,21,20,19.
 Duration of Lecture.....3 hours (continuous).
 Subjects.....Mine Ventilation--1½ hours.
 Colliery Engineering--1½ hours.
 Time of Tests.....First...6.30 p.m. Last....9.30 p.m.
 Given at half-hour intervals.

The time estimation of the students varied widely and all showed a reduction in error until the third test, all except one showing an increase in error at the fourth test, after one-and-a-half hours' instruction.

Observations.

Practice does not enter into this test and this is illustrated by the wide variations in the first two. It is, however, shown by the increase in error after the third test that fatigue definitely occurs after one-and-a-half hours' instruction.

X From "Mental Fatigue" by Max Offner.

*By "practice" is meant the effect of practice the test itself gives.

† Sample of student's estimations given in Appendix No. 2.

— MENTAL FATIGUE - TEST N^o 2 —

TEST BY TIME ESTIMATION.

GRAPH N^o 1 SHOWS AVERAGE PERCENTAGE ERROR EVERY HALF HOUR DURING THREE HOURS CONTINUOUS INSTRUCTION.

GRAPH N^o 2 SHOWS AVERAGE PERCENTAGE ERROR EVERY HALF HOUR DURING 2 $\frac{3}{4}$ HOURS INSTRUCTION WITH A 10-MINUTE REST PERIOD.

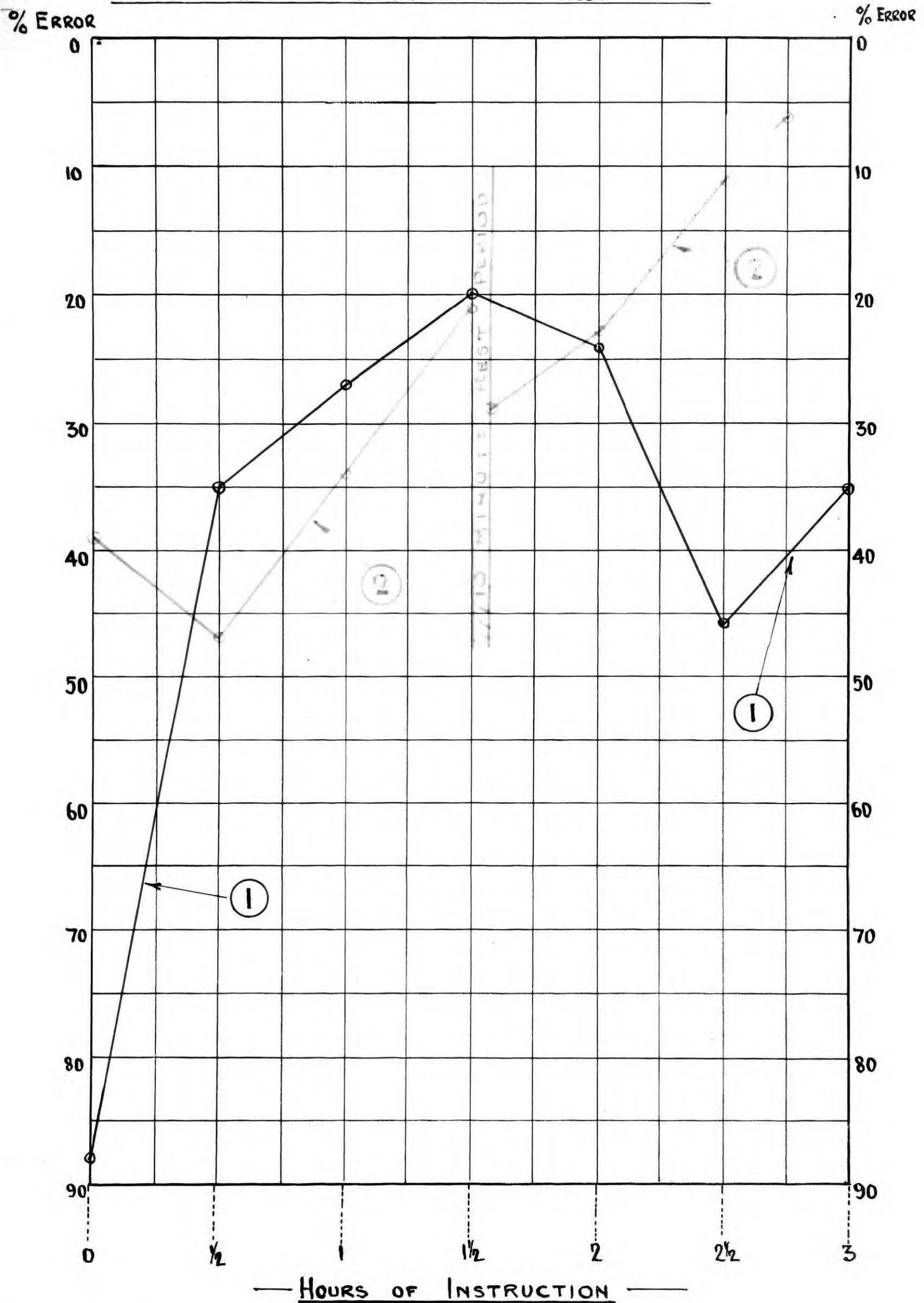


FIG. 8.

THIRD TEST. Cancellation of Letters. Ø

Test Sheets (see Appendix No. 3). were supplied to students and they were instructed to score out letters A and F. Each test lasted one minute and was repeated at half-hour intervals during instruction. The number of letters cancelled and the number of errors made by each student were graphed as shown in Fig. 9 p. 90. The average work and error curves are also shown.

Report of Test.

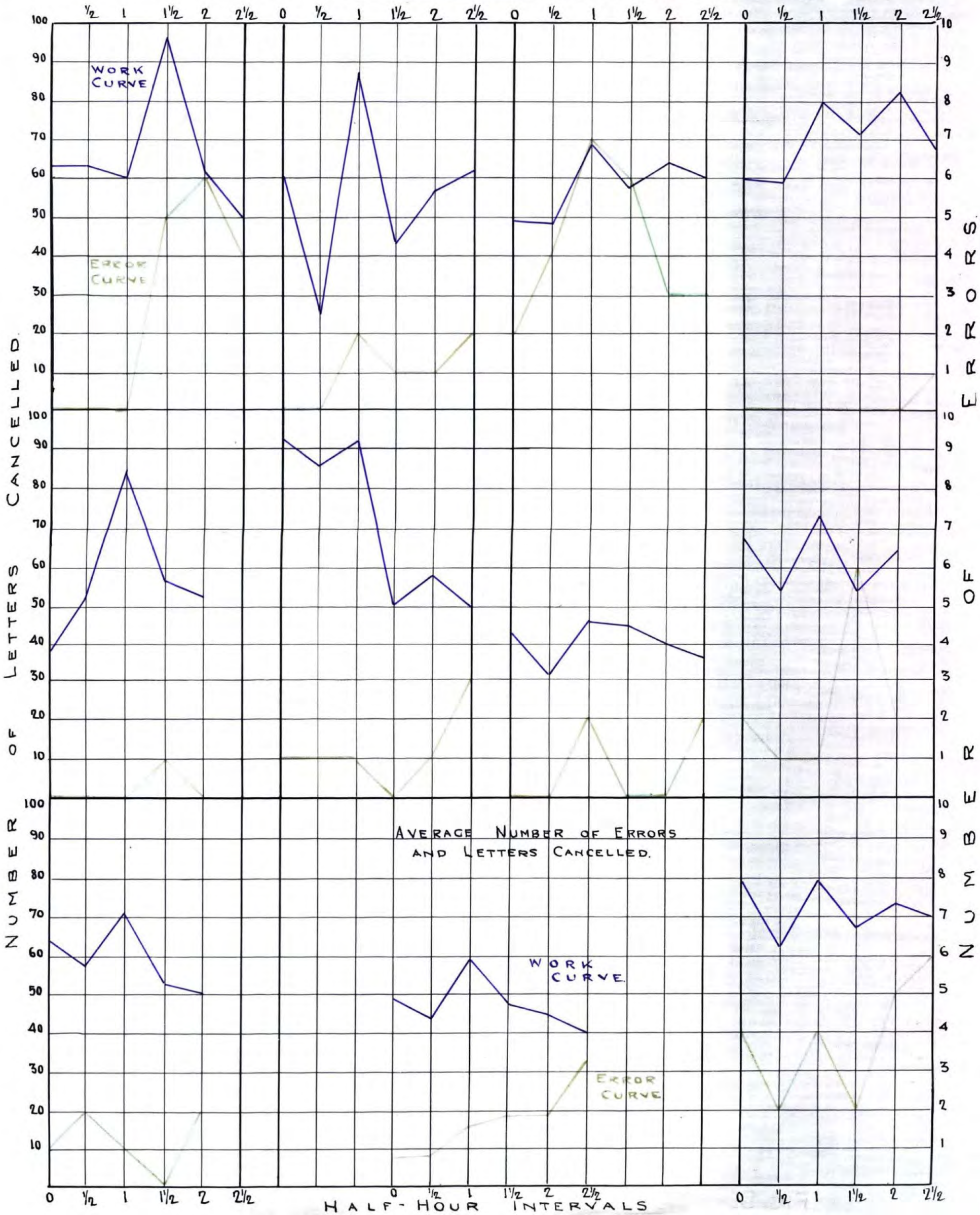
Class.....	7th Year Mining.
No. in Class..	10.
Ages.....	42, 35, 32, 32, 28, 28, 28, 28, 24, 22.
Duration of Work.....	1½ hours' lecture, 1 hour calculations (continuous).
Subjects.	Electrical Engineering 1½ hours. Surveying Calculations 1 hour.
Time of Tests.....	1st 6.45 p.m. Last 9.15 p.m. Tests were made at half-hour intervals.

Observations.

This test was commenced after instruction had been given for fifteen minutes as it had been found in the previous experiments that the describing of the method of procedure at the beginning of the meeting usually unsettled the class. The individual graphs show that with all students, except one, the number of cancellations decrease after the second test, that is, after one-and-a quarter hours' instruction. The average error curve shows a general increase in errors throughout the test but a decided rise at the last test.

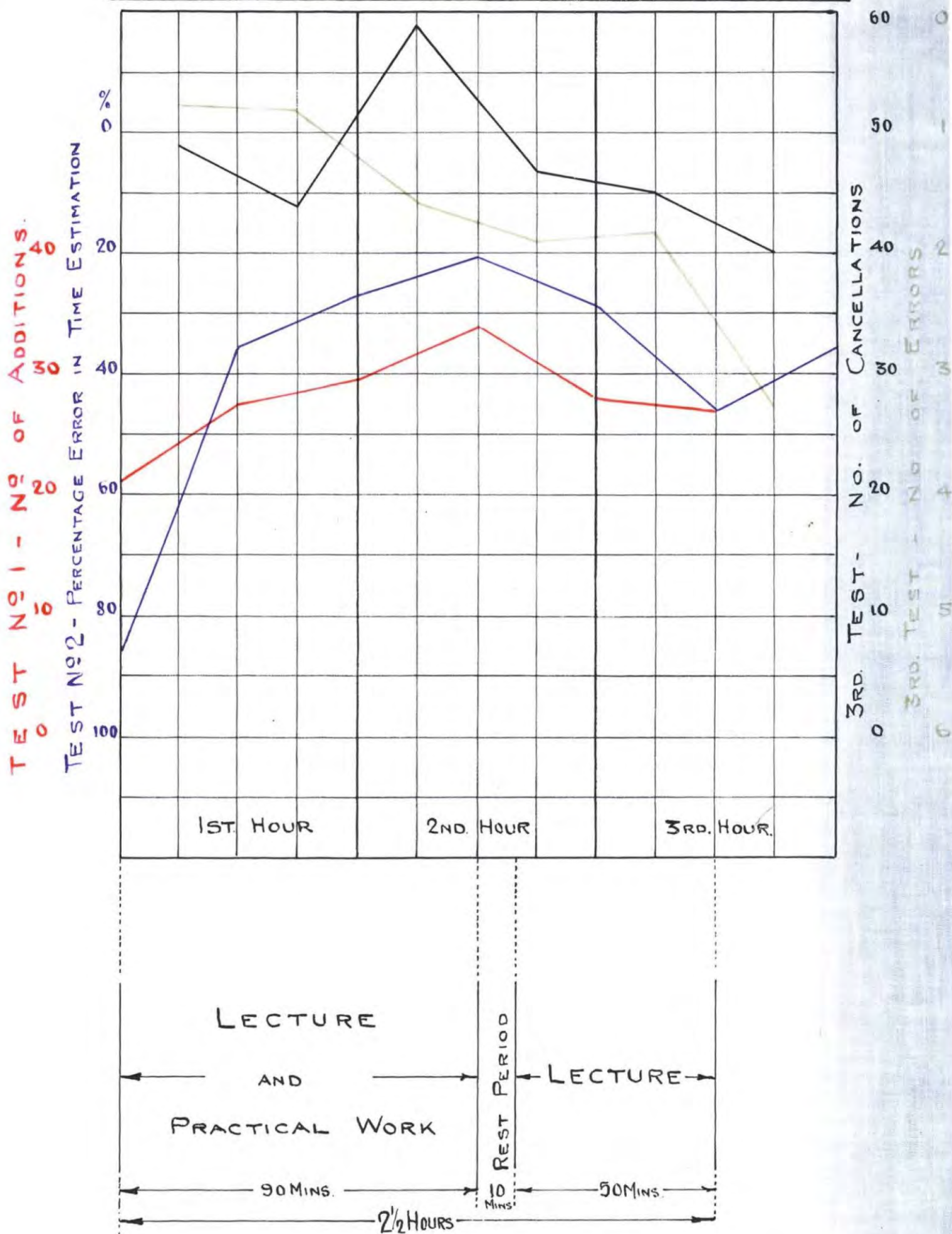
Rest Periods. The benefit of rest periods has already been referred to by many psychologists and the writer does not wish to make any observations thereon. A test of the same nature as No. 2. ^{but with a rest period embodied} was, however, carried out with the same class and the results are shown as a graph in Fig. 8 p. 88

MENTAL FATIGUE TEST BY CANCELLATION OF LETTERS.



— FATIGUE TESTS. —

GRAPHS SHOWING THE AVERAGE RESULTS OF EACH
TEST WITH A SUGGESTED ALLOCATION OF TIME
FOR A CLASS OF TWO AND A HALF HOURS DURATION



01.017

CONCLUSIONS.

- (1). In most mining courses three subjects have to be taken each year and the general practice is to arrange instruction for three evenings per week of two hours' duration or two evenings of three hours. An objection to the first is that students, living at a distance, spend an excessive time in travelling. The fatigue tests (see Fig.10 p.94) show that three hours continuous instruction are excessive. The writer claims that by arranging classes of two and a half hours' duration, including a rest period, the number of meetings can be reduced to two without affecting the quality or the quantity of the work done.

The information obtained from the fatigue tests indicates where the fatigue is greatest and, acting upon these results, the writer has inserted a rest period at the "critical" time. The results of all the tests with the suggested allocation of time during two and a half hours' instruction are shown on Fig.10 p.94

The success of the rest period has more than justified its introduction and members of the class have emphatically expressed opinions which further support the claims made; also, during the present session (1934-35) when classes are arranged as suggested the quantity of the work covered is the same as with a three hours' class.

- (2). In following the "shift" system of instruction classes held during the day can be taken only by full-time lecturers and this usually makes it necessary to have two classes under one lecturer. On Saturday mornings, when students from each course may attend, a real difficulty arises if numbers are high. By introducing a shorter class meeting more students are in a position to

to/ attend evening classes and the attendances on Saturday mornings are correspondingly decreased. Fig. 11 p. 94 shows the proportion of students attending the various combinations of shift classes. By comparing the figures when a three hours' class was held with the figures for the present session it is seen that the number attending evening classes has increased while the number attending combinations which include Saturday mornings has considerably decreased.

- (3). Under the three hours' evening class system and where a student attends evening, morning and Saturday morning classes, over three weeks he receives only fifteen hours instruction out of a possible of eighteen hours* (83% of the possible). Under the two and a half hour system the student now receives thirteen out of a possible of fifteen hours instruction† (87% of the possible).

* Three-hour class meetings -- 2 meetings per week.

A student taking a combination of classes to suit shifts attends as follows:-

1st Week	-----Evening-----	6 hours instruction.
2nd "	-----Morning-----	6 " "
3rd "	-----Saty. "-----	3 " "

Over a period of three weeks the number of hours instruction is fifteen.

The total hours of instruction given to a student attending evening and morning classes only is eighteen.

† Two-and-a-half hour class meetings -- 2 meetings per week.

A student taking a combination of classes to suit shifts attends as follows:-

1st Week	-----Evening-----	5 hours instruction.
2nd "	-----Morning-----	5 " "
3rd "	-----Saty. "-----	3 " "

Over a period of three weeks the number of hours instruction is thirteen.

The total hours of instruction given to a student attending evening and morning classes only is fifteen.

TABLE SHOWING PROPORTION OF MINING STUDENTS ATTENDING THE VARIOUS COMBINATIONS OF SHIFT CLASSES DURING SESSIONS 1931-32, 32-33, AND 33-34 (3 HOURS INSTRUCTION EACH EVENING) AND DURING SESSION 1934-35 (2½ HOURS INSTRUCTION EACH EVENING)

SESSION	YEAR OF COURSE	Nº OF STUDENTS	EVENING CLASSES ONLY	MORNING CLASSES ONLY	SATURDAY CLASSES ONLY	EVENING AND MORNING CLASSES	EVENING AND SAT. CLASSES.	MORNING AND SAT. CLASSES	EVENING, MORNING, & SATURDAY CLASSES	
SESSION 1931-32	PRELIM.	18	3	-	-	1	-	3	11	3 HOURS
	3RD.	16	3	-	-	7	-	-	6	
	4TH.	14	3	-	-	5	-	1	5	
	5TH.	19	8	1	-	5	-	4	1	
	6TH.	10	3	-	-	4	1	1	1	
		77	20	1	-	22	1	9	24	
		100%	26.2%	1.2%	-	28.6%	1.2%	11.6%	31.2%	
SESSION 1932-33	PRELIM.	15	3	-	-	10	-	-	2	3 HOURS
	3RD.	14	-	-	-	8	-	-	6	
	4TH.	19	13	-	-	5	-	-	1	
	5TH.	13	2	-	-	2	-	4	5	
	6TH.	10	1	-	-	9	-	-	-	
		71	19	-	-	34	-	4	14	
		100%	26.8%	-	-	47.8%	-	5.7%	19.7%	
SESSION 1933-34	3RD.	15	5	-	-	-	-	3	7	3 HOURS
	4TH.	12	3	-	-	6	-	-	3	
	5TH.	6	-	-	-	1	-	-	5	
	6TH.	16	7	-	-	4	-	3	2	
	7TH.	10	4	1	-	4	-	-	1	
		59	19	1	-	15	-	6	18	
		100%	32.2%	1.7%	-	25.4%	-	10.2%	30.5%	
SESSION 1934-35	3RD.	27	6	1	-	15	-	2	3	MEETINGS-2½ HOURS
	4TH.	13	7	-	-	1	-	1	4	
	5TH.	7	3	-	-	3	-	-	1	
	6TH.	15	6	2	-	3	-	1	3	
	7TH.	15	9	1	-	2	-	2	1	
		77	31	4	-	24	-	6	12	
		100%	40.2%	5.2%	-	31.2%	-	7.8%	15.6%	

FIG. 11.

TABLE SHOWING WORKMEN'S SHIFTS IN A
— MODERN DURHAM COLLIERY. —

DISTRICTS	CLASS OF WORK	SHAFT	MORNING	NOON	AFTERNOON
			12 1 2 3 4 5 6 7	8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12	
No 1	HEWERS AND DEPUTIES				
	TRANSIT				
	STONEMEN AND EXAMINERS				
	ONSETTERS AND SHAFT LADS.				
	HORSEKEEPERS				
	WASTEMEN				
No 2	HEWERS	No 2			
	TRANSIT AND DEPUTIES				
	STONEMEN AND EXAMINERS				
No 3	HEWERS				
	TRANSIT AND DEPUTIES				
	FILLERS AND TRANSIT S.W. SECTION				
	CUTTERS				
	SHIFTERS AND EXAMINERS				
No 4	HEWERS				
	TRANSIT AND DEPUTIES				
	STONE MEN, SHIFTERS, EXAMINERS				
No 5	HEWERS				
	TRANSIT, DEPUTIES	No 1			
	FILLERS, CONVEYORS, TRANSIT.				
	CUTTERS				
	SHIFTERS, EXAMINERS				
PIT BOTTOM	ONSETTERS, SHAFTMEN.				
	HORSEKEEPERS				
	WASTEMEN				
SURFACE.					

TABLE SHOWING DURATION OF SHIFTS WORKED
IN EIGHT MODERN COLLIERIES IN DURHAM.

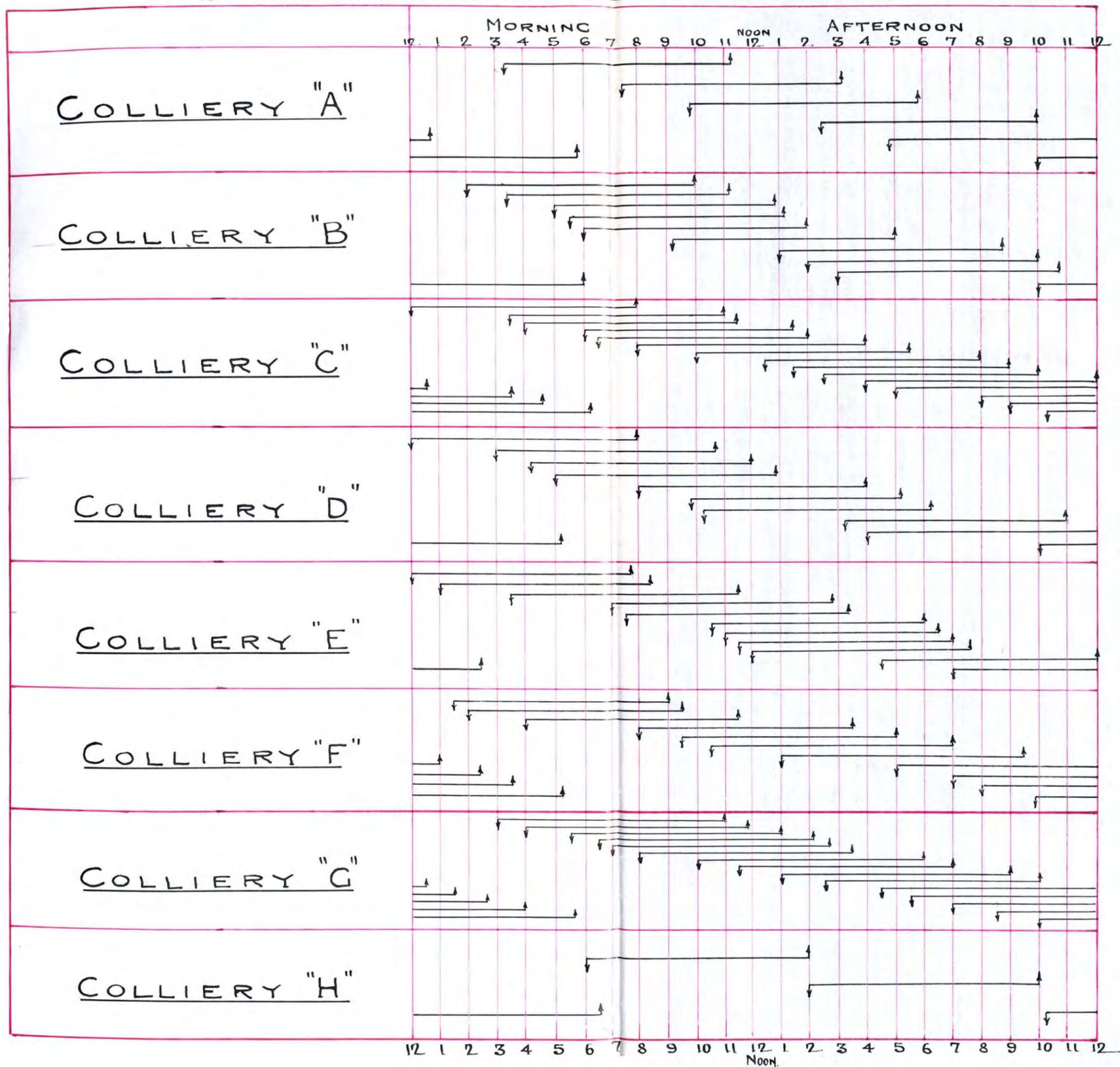
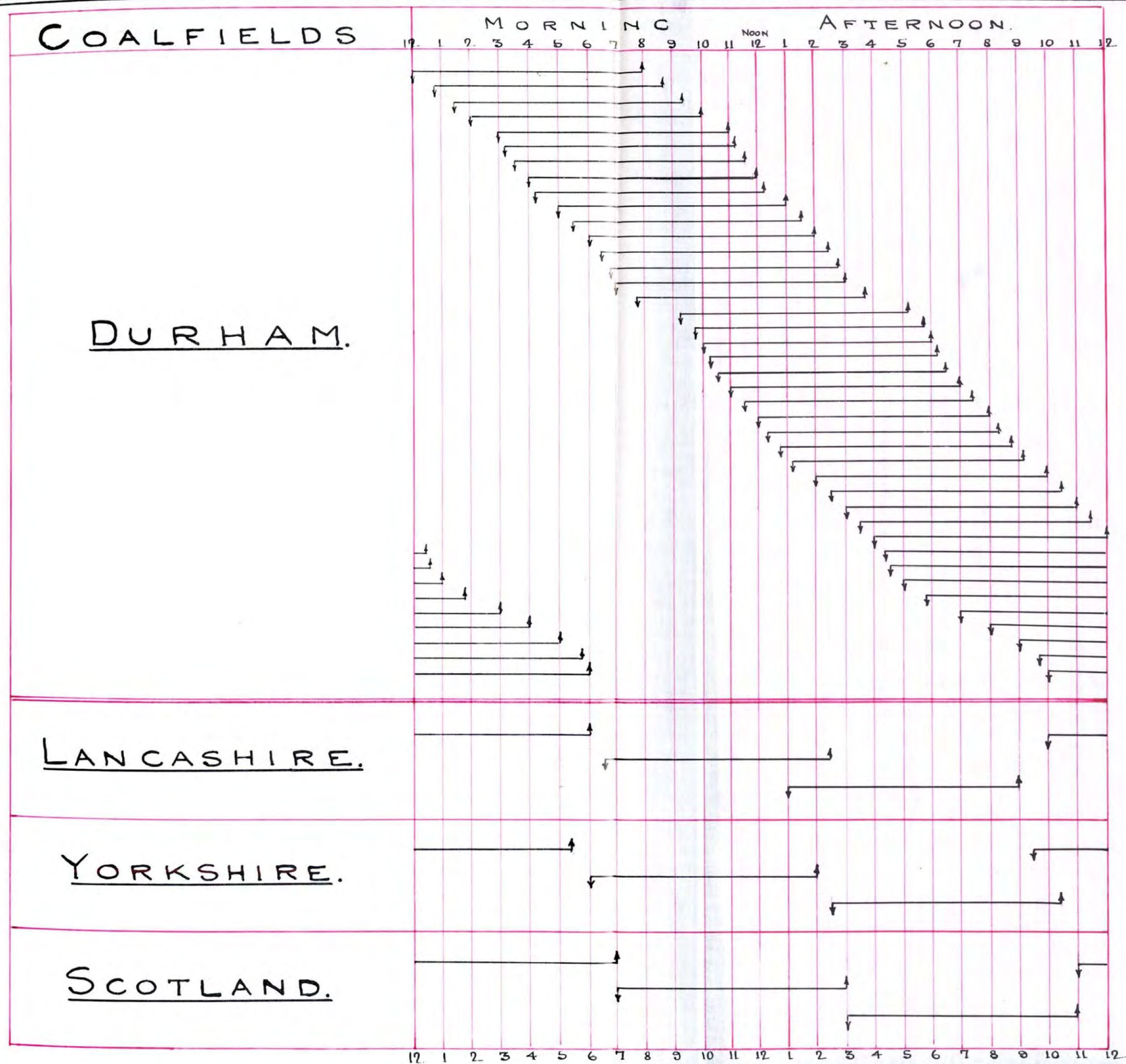


FIG. 14.

TABLE SHOWING THE MULTIPLE SHIFT SYSTEM IN THE DURHAM COALFIELD AND THE "STRAIGHT" SYSTEM EMPLOYED IN OTHER DISTRICTS



C H A P T E R VII

The Demands of the Mining Industry on the Worker
and their Effects on the Receptivity of the
Mining Student.

In this Chapter the writer has described a method which he suggests will give a truer value of individual class results than the usual system of examination marks. Certain conclusions have been drawn regarding the industry's effect on the receptivity of the student.

THE DEMANDS of the MINING INDUSTRY on the WORKER
and their EFFECTS on the RECEPTIVITY of the
MINING STUDENT.

Introduction.

Details of the conditions under which the miner works and of the standard of education demanded have already been given in preceding chapters. The writer has attempted to convey to the reader a true perspective of mining education and it is hoped that opinions will have been framed as to the difficulties which face a working miner who has decided to qualify for an official position. This chapter is included in order to connect working conditions and instruction and to place on record specific cases of these difficulties. A scheme is also put forward which, the writer maintains, will enable mining instructors to value more correctly the standard of class work. Since the placing of the student is made quite evident the teacher can enquire as to the reason for a student having low achievement results. The writer proposes to illustrate the usefulness of the scheme from results obtained during his research work.

Intelligence Tests.

During Session 1933-34, 86 students attending the mining classes at Sunderland Technical College were given an intelligence test -- Group Test No.34,* issued by the Institute of Industrial Psychology who have adopted it as the standard for elementary schools. As approximately 85% of these students have had only elementary education it was decided that a test of this kind would be suitable. Owing to the age range, 17 to 42, it was not possible to estimate intelligence quotient and only the percentage scoring was calculated. The results are shown graphically on Fig.15 p.107.

*Sample of Test Sheet given in Appendix No 4.

Method of Testing.

The tests were carried through by the writer at the beginning of each class meeting. They were given in spacious rooms with excellent lighting and the booklets were not distributed until the atmosphere and conditions were entirely suitable. The students were made fully aware of the type of test the timing of which was registered by means of a stop watch as follows:-

Writing Name, etc. and Reading general instructions - 2 mins.

Test I.	Reading Instructions.	1 min.
	Test.	3 mins.
" II.	"	4 "
" III.	Reading Instructions.	1 "
	Test.	1½ "
" IV.	"	7½ "
" V.	Reading Instructions.	1 "
	Test.	2 "
" VI.	Reading Instructions.	1 "
	Test.	2 "
" VII.	"	6 "
" VIII.	"	3 "
" IX.	"	9 "
Total		45 mins.

No intervals were allowed between any of the tests.

Report of Test.

The students considered the test as a competition and much keenness was shown. This attitude of mind did, no doubt, produce reliable results. Many of the candidates requested their scorings and these were granted. It had, of course, been made quite clear that the test was not compulsory and that the results therefrom had no connection with class examinations. The course of the graph (Fig.5 p.107) is

is/ similar to that obtained in all intelligence tests and the writer feels entitled to accept the results as reliable . It will be noted, however, that five students obtained over 80%. All of these have had a secondary education and, therefore, the test was unsuitable for them. Of the seventeen who obtained over 70%, 8 have had a secondary education, 8 elementary, and 1 has attended a Junior Technical School. Another reason for results above average is probably that student miners are, naturally, of a higher intelligence than those who are indifferent to education.

Gradation Marks.

It was the intention of the writer to calculate the correlation between intelligence and achievement marks but owing to the small numbers this was relinquished.

The scheme mentioned in the Introduction which, it is suggested, will enable mining instructors to value more correctly the standard of class work is now described and reasons shown for low achievement results.

The student's class position in each subject was tabulated alongside his intelligence position and the differences calculated. The average of these differences was obtained and these figures, the writer suggests, be called "Gradation Marks".

The procedure is illustrated as follows:-

<u>Class.</u>	<u>Student.</u>	<u>Order of Merit.</u>			
		Maths.	Drawing.	Science.	Intelligence.
B.	1.	2.	2.	3.	1.
		Diff. (Int.-Maths)	Diff. (Int.-Dwg.)	Diff. (Int.-Sc.)	
		-1.	-1.	-2.	
		Average Difference (Gradation Mark)			
		$\frac{-4}{3} = -1.3.$			

Complete tables of Gradation Marks are shown on Figs 16, 17 pgs 108, 109

While the writer admits that this method is only approximate he has found it very useful in class. It is, for example, particularly striking that certain students have, over three sessions, a large negative while others have a high positive gradation mark. It was thought at first that the reason for the continued negative results might be due to the strenuous work underground. It was found, however, that not the heaviness of the work but rather the type was the cause. The average gradation marks of the various classes of underground workers are as follows:-

<u>Workers.</u>	<u>Aver. Grad. Mark.</u>	<u>No. of Candidates.</u>
Overmen.	-1.2.	10.
Deputies.	+0.6.	29.
Linesmen.	-1.0.	11.
Miners.	+1.0.	18.
Shiftmen.	-0.1.	22.
Pony Drivers.	+0.2.	13.
Haulagemen.	-1.3.	6.

Although the number of students is small the following observations may be made:-

Negative Gradation Marks.

Overmen.

The average mark for Overmen is -1.2 and this, at first glance, may create a certain amount of suspicion regarding the reliability of the result. Overmen are the highest grade of workmen in the mine and may be classed with foremen in engineering shops. The writer, however, believes that the negative result is due to the fact that the overman, unlike the foreman in the workshop, has to be in attendance at the mine at times other than the actual shifts so that his mind is continually occupied with his underground responsibilities. Most of the overmen attending mining classes have to return to the mine after leaving class in order to consult with the other officials.

Linesmen and Haulagemen.

The gradation marks of the above workers, -1.0 and -1.3 respectively, illustrate the theory that the receptivity of the student is not so much affected by his strenuous work underground as by the type of work. A linesman, to whom is entrusted the keeping of underground roadways in the correct directions, is engaged in repetition work which does not further original thinking. The same is the case with the haulageman, who, for a spell of seven hours may be in charge of a machine the manipulation of which is the same for every journey of the tubs. If employed in the roadways the same physical movements are gone through again and again. This is illustrated on Fig. 16 p. 108 During Session 1931-32 Student B.1. was a haulageman and his gradation mark was -1.3. In the following year when he changed his occupation to pony-driving his gradation mark was zero. In that year, 1932-33, he was first in order of merit in all his subjects. Again the writer reminds the reader that the number of haulagemen is small and the findings may therefore be questioned. Coupled with experience, however, the writer considers the point important and worthy of further research.

Shiftmen.

The gradation mark of the above worker, -0.1., is so near an average that no definite conclusion may be made. Of all the workers in mines the shiftmen probably experience most variety. Their standard may, therefore, be said to be satisfactory.

Positive Gradation Marks.

Miners. (Coal Hewers).

The result obtained here is striking. It is the highest positive mark and during three sessions only three negative gradation marks were registered by students who were employed at the coal face. These were -1.7, -0.3 and -1.7.

The coal hewer is called upon to exercise his mind more than any other worker during his whole shift. He is usually on the "payment by results" system and, therefore, in order to work remuneratively he has to plan operations carefully from the beginning to the end of his shift. His employment is the working of virgin ground and he must take the greatest care in order to ensure safety to himself and to those in the vicinity. The writer does not hesitate to classify the coal hewer's job as a highly skilled one, calling forth all the ingenuity of the worker and, although the work is also strenuous, the results again illustrate the point that assimilating powers are not impaired by heavy physical labour if that is accompanied by variety of work and thought.

Deputies and Pony Drivers.

The average gradation marks of these workmen are +0.6 and +0.2 respectively. The mark for deputies is high and again illustrates the point of the preceding paragraph. The deputy's duties underground are solely in the interests of safety and if these duties are carried out conscientiously he must call upon all his experience and ingenuity in order to make his "district" as safe as possible.

As regards Pony Drivers (gradation mark +0.2), their result may be classed as an average and, therefore, no definite finding can be made. The work of a pony driver is very strenuous and the mark is indicative that work underground resulting in physical exhaustion is not the only contributory factor to low evening class results.

The Maintenance of Gradation Marks throughout Sessions.

It was noticed that throughout the three sessions about 50% of the students had gradation marks which were nearly constant. Special notice was taken of those students who having low results and enquiry was made into the cause of this continued low standard.

The following four students were considered:-

<u>Class.</u>	<u>Student.</u>	<u>1931-32.</u>	<u>1932-33.</u>	<u>1933-34.</u>
A.	No.3.	-2.5	-5.0	-5.3
B.	2.	-0.8	-1.0	-2.2
C.	1.	-1.7	-0.3	-1.7
D.	2.	-3.0	-2.3	-3.7

Student A.3. was an example of a misfit. He stated quite definitely that he did not like his occupation and had made many attempts to get out of it. It should be noticed that the students' class marks were average and not until gradation marks were introduced in the mining classes was there any suspicion that this lad was not making progress. The writer ventures to put forward this case alone as illustrating the advantage of the scheme.

Students B.2, C1, D.2. These students, from their class results, would be rated average. All attended regularly and evinced much interest in the class work. Their homework was always completed and generally they would be considered very satisfactory students. The writer was able to collect the following information which was common to all three:-

They had been attending mining classes for many years, on an average about ten. There had been no organised mining course in the district and they were forced to obtain instruction wherever possible. Their instruction has been top-heavy, since it has been purely mining and has not provided a good grounding in first principles. It is evident that these students will not make any progress until they take a course on such subjects as English, Mathematics, Science and Drawing.

Conclusions.

(1). The use of intelligence tests in Continuation Classes has been very limited and it is suggested that they could here be used with great advantage.

(2). In using gradation marks the teacher, after one session, is in possession of figures which give a truer value of class

class/ results than do examination percentages.

(3). Workmen attending evening classes do so of their own accord. It appears, therefore, inconceivable that poor results are due to indifference. We must search for the cause by enquiring into conditions of the industry in which they are employed. Teachers of evening students only succeed when they have a sympathetic understanding of the difficulties with which their students are confronted.

INTELLIGENCE TEST.

GRAPH SHOWING PERCENTAGE SCORES
OF 86 MINING STUDENTS.

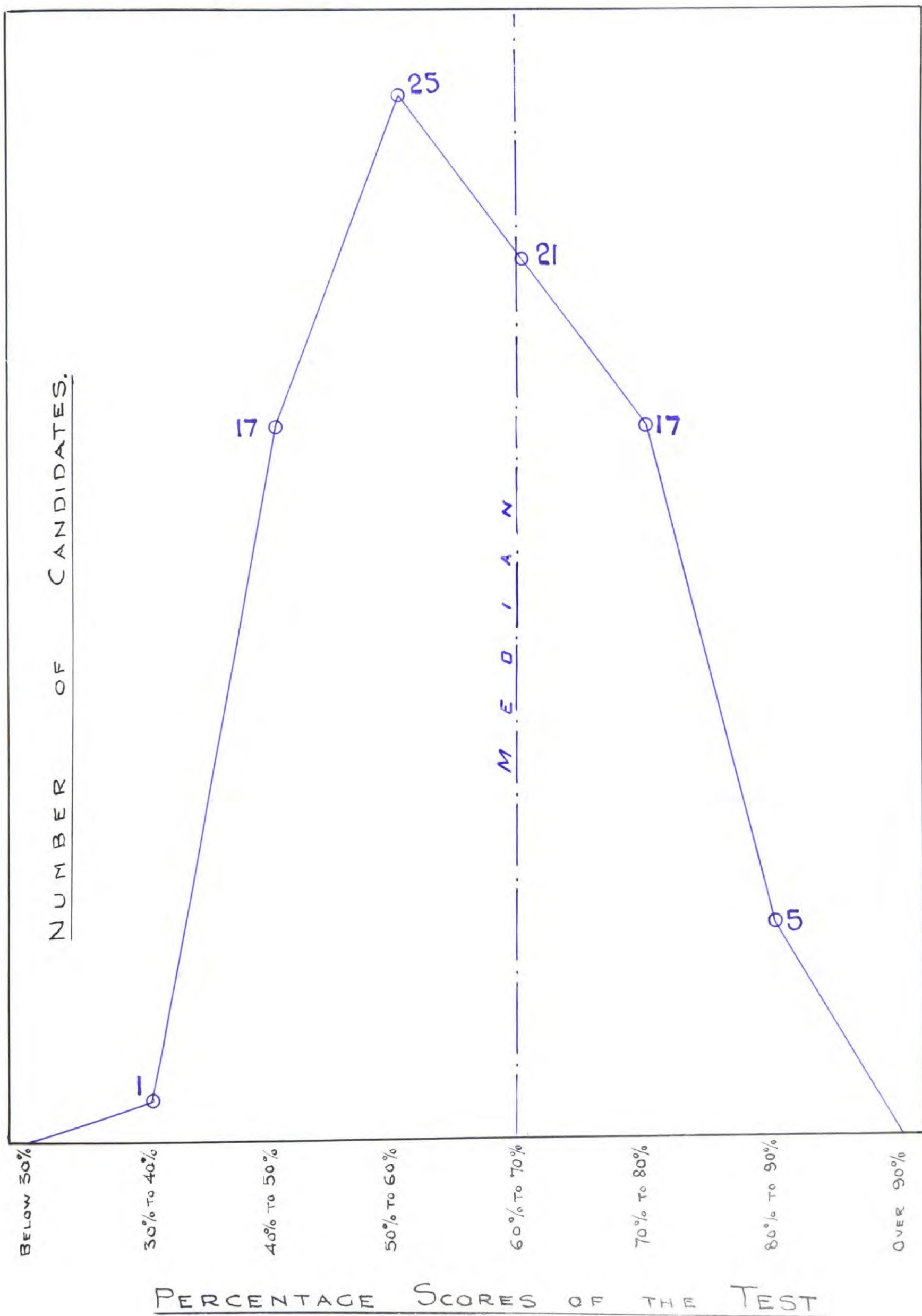


FIG. 15.

**TABLE SHOWING STUDENTS' ORDER OF MERIT IN EXAMINATIONS AND INTELLIGENCE,
ALSO METHOD OF CALCULATING INDIVIDUAL GRADATION MARKS.**

	STUDENT	FOURTH YEAR MINING (SESSION 1931-32)								FIFTH YEAR MINING (SESSION 1932-33)								SIXTH YEAR MINING (SESSION 1933-34)								OCCUPATION IN MINE
		MATHS.	GEOLOGY	SCIENCE	INTELLIGENCE	d _{I-M}	d _{I-G}	d _{I-SC}	AVERAGE d	HEAT	ELECTRICITY	SURVEYING	INTELLIGENCE	d _{I-H}	d _{I-E}	d _{I-S}	AVERAGE d	MINING	COLLIERY ENGINEERING	VENTILATION	INTELLIGENCE	d _{I-M}	d _{I-C}	d _{I-V}	AVERAGE d	
CLASS "A"	1									11	4	10½	9½	-1½	+5½	-1	+1.0	12	11½	8½	11½	-½	0	3	+0.8	PUTTER
	2									9	8	10½	3	-6	-5	-7½	-6.2	8	10	10	4	-4	-6	-6	-5.3	SHIFT WORKER
	3	5	5	5	2½	-2½	-2½	-2½	-2.5	10	11	7½	4½	-5½	-6½	-3	-5.0	9	11½	12	5½	-3½	-6	-6½	-5.3	LINESMAN
	4	4	4	3	4	0	0	+1	+0.3	5	6	9	8	+3	+2	-1	+1.3	4	8½	3	10	+6	+1½	+7	+4.8	DEPUTY
	5									6	9½	7½	11	+5	+1½	+3½	+3.3	14	14	14	13	-1	-1	-1	-1.0	SHIFT WORKER
	6									7	12	3	6	-1	-6	+3	-1.3	13	3½	8½	8	-5	+4½	-½	-0.3	LINESMAN
	7	1	2	1	2½	+1½	+½	+1½	+1.2	3	3	1	4½	+1½	+1½	+3½	+2.3	2½	2	1	5½	+3	+3½	+4½	+3.7	SHIFT WORKER
	8									2	1	2	7	+5	+6	+5	+5.3	5½	5	4	9	+3½	+4	+5	+4.2	OVERMAN
	9									4	7	4	12	+8	+5	+8	+7.0	10	8½	11	14	+4	+5½	+3	+4.2	SHIFT WORKER
	10	2	3	4	1	-1	-2	-3	-2.0	-	-	-	-	-	-	-	-	7	13	13	1	-6	-12	-12	-10.0	OVERMAN
	11	3	1	2	5	+2	+4	+3	+3.0	12	9½	12	9½	-2½	0	-2½	-1.7	5½	6	5	11½	+6	+5½	+6½	+6.0	DEPUTY
	12									1	5	5	2	+1	-3	-3	-1.7	11	7	7	3	-8	-4	-4	-5.3	SHIFT WORKER
	13									-	-	-	-	-	-	-	-	2½	3½	6	7	+4½	+3½	+1	+3.0	MINER
	14									8	2	6	1	-7	-1	-5	-4.3	1	1	2	2	+1	+1	0	+0.7	OVERMAN
CLASS "B"	1	2	2	3	1	-1	-1	-2	-1.3	1	1	1	1	0	0	0	0	2	1	2	1	-1	0	-1	-0.7	PUTTER
	2	4	3	4½	3	-1	0	-1½	-0.8	3	5	4	3	0	-2	-1	-1.0	5	6	4½	3	-2	-3	-1½	-2.2	SHIFT WORKER
	3	1	4	1	2	+1	-2	+1	0	2	6	5	2	0	-4	-3	-2.3	4	2	1	2	-2	0	+1	-0.3	DEPUTY
	4	6	5	4½	6	0	+1	+1½	+0.8	6	2	2	6	0	+4	+4	+2.7	3	4	4½	6	+3	+2	+1½	+2.2	MINER
	5	5	1	2	4	-1	+3	+2	+1.3	5	3	3	4	-1	+1	+1	+0.3	1	5	3	4	+3	-1	+1	+1.0	MINER
	6	3	6	6	5	+2	-1	-1	0	4	4	6	5	+1	+1	-1	+0.3	6	3	5	5	-1	+3	0	+0.7	SHIFT WORKER
CLASS "C"	1	3	2	1	1	-2	-1	-2	-1.7	1	2	1	1	0	-1	0	-0.3	2	5	1	1	-1	-4	0	-1.7	MINER
	2	1½	1	1	2	+½	+1	+½	+0.7	7	3	2½	2	-5	-1	-½	-2.2	3	4	3	2	-1	-2	-1	-1.3	PUTTER
	3	5	5	4	4	-1	-1	0	-0.7	2	6	5	6	+4	0	+1	+1.7	4	3	7	6	+2	+3	-1	+1.3	DEPUTY
	4	1½	4	5	5	+3½	+1	0	+1.5	4	4	2½	4	0	0	+1½	+0.5	5	2	5½	4	-1	+2	-1½	-0.2	PUTTER
	5	4	3	1½	3	-1	0	+1½	+0.2	6	5	7	7	+1	+2	0	+1.0	7	7	5½	7	0	0	+1½	+0.5	LINESMAN
	6	-	-	-	-	-	-	-	-	3	1	4	3	0	+2	-1	+0.3	1	1	2	3	+2	+2	+1	+1.7	MINER
	7	-	-	-	-	-	-	-	-	5	7	6	5	0	-2	-1	+1.0	6	6	4	5	-1	-1	+1	-0.3	DEPUTY

TABLE SHOWING STUDENTS' ORDER OF MERIT IN EXAMINATIONS AND INTELLIGENCE,
ALSO METHOD OF CALCULATING INDIVIDUAL GRADATION MARKS.

CLASS "D"	STUDENT	FIFTH YEAR MINING (SESSION 1931-32)								SIXTH YEAR MINING (SESSION 1932-33)								SEVENTH YEAR MINING (SESSION 1933-34)								OCCUPATION IN MINE
		MINING	COLLIERY ENGINEERING	SURVEYING	INTELLIGENCE	d _{I-M}	d _{I-C}	d _{I-S}	AVERAGE d	MINING	COLLIERY ENGINEERING	VENTILATION	INTELLIGENCE	d _{I-M}	d _{I-C}	d _{I-V}	AVERAGE d	COLLIERY ENGINEERING	ELECTRICITY	SURVEYING	INTELLIGENCE	d _{I-C}	d _{I-E}	d _{I-S}	AVERAGE d	
	1	2	1	3	4	+2	+3	+1	+2.0	5	2½	3	5	0	+2½	+2	+1.5	4	2	4	6	+2	+4	+2	+2.7	DEPUTY
	2	4	4	4	1	-3	-3	-3	-3.0	4	5	4	2	-2	-3	-2	-2.3	6	6	5	2	-4	-4	-3	-3.7	OVERMAN
	3	3	2	1	3	0	+1	+2	+1.0	3	4	5	3	0	-1	-2	-1.0	2	3	6	4	+2	+1	-2	+0.3	DEPUTY
	4	1	3	2	2	+1	-2	0	0									1	1	3	3	+2	+2	0	+1.3	OVERMAN
	5									1	1	2	1	0	0	-1	-0.3	3	4½	1	1	-2	-3½	0	-1.8	SHIFT WORKER
	6									2	2½	1	4	2	2½	1	+2.2	5	4½	2	5	0	+½	+3	+1.2	DEPUTY.

CLASS "E"	STUDENT	PRELIMINARY MINING COURSE (SESSION 1932-33)								THIRD YEAR MINING (SESSION 1933-34)								OCCUPATION IN MINE	
		MATHS.	DRAWING	SCIENCE	INTELLIGENCE	d _{I-M}	d _{I-D}	d _{I-SC}	AVERAGE d	MATHS.	DRAWING	SCIENCE	INTELLIGENCE	d _{I-M}	d _{I-D}	d _{I-SC}	AVERAGE d		
	1	6	1½	4	5	-1	+3½	+1	+1.2	4	10	5	8	+4	-2	+3	+1.7	MINER	
	2	3	4½	5	3	0	-1½	-2	-1.2	6	11	4	5	-1	-6	+1	-2.0	HAULAGE HAND	
	3	5	4½	3	2	-3	-2½	-1	-2.2	11	4	7	3	-8	-1	-4	-4.3	DEPUTY	
	4									7	5	10	11	+4	+6	+1	+3.7	LINESMAN	
	5									5	3	1½	1	-4	-2	-½	-2.2	LINESMAN	
	6	9	9	6½	8½	-½	-½	+2	+0.3									MINER	
	7	7	7½	2	4	-3	-3½	+2	-1.5	2½	8½	6	6½	+4	-2	+½	+0.8	DEPUTY	
	8	4	7½	8	6	+2	-1½	-2	-0.5									PUTTER	
	9									9	8½	9	9½	+½	+1	+½	+0.7	HAULAGE HAND	
	10	8	6	9	7	-1	+1	-2	-0.7	10	6	11	9½	-½	+3½	-1½	+0.5	LINESMAN	
	11									8	7	8	4	-4	-3	-4	-3.7	HAULAGE HAND	
	12	1	1½	1	1	0	-½	0	-0.2	1	2	1½	2	+1	0	+½	+0.5	MINER.	
	13	2	3	6½	8½	+6½	+5½	+2	+4.7									DEPUTY	
	14									2½	1	3	6½	+4	+5½	+3½	+4.3	MINER.	

CLASS "F"	STUDENT	PRELIMINARY MINING COURSE (SESSION 1933-34)								OCCUPATION IN MINE
		MATHS.	DRAWING	SCIENCE	INTELLIGENCE	d _{I-M}	d _{I-D}	d _{I-SC}	AVERAGE d	
	1	3	5	3	2	-1	-2	-1	-1.3	SHIFT WORKER
	2	4	2	2	4	0	+2	+2	+1.3	PUTTER
	3	2	3	4	5	+3	+2	+1	+2.0	SHIFT WORKER
	4	5	4	5	1	-4	-3	-4	-3.7	HAULAGE HAND
	5	1	1	1	3	+2	+2	+2	+2.0	HAULAGE HAND

FIG. 17.



CHAPTER VIII

The Teaching of English.

This Chapter has been included in order to show that no course of Technical Education is complete without having embodied in the curriculum the subject of English; also, the subject should be taught during the greater part of any technical course. The writer has described schemes of English teaching in various mining centres and has discussed the merits of each. He has also made suggestions as to the type of course that should be adopted, from an industrialist's point of view, but leaves the details of its teaching to those who have the requisite experience in that subject.

THE TEACHING OF ENGLISH.

The importance of including English in a technical course cannot be overestimated and no course in the subject of mining is complete without having embodied a definite class for the instruction of this subject which is the vehicle of expression in speech and writing and, therefore, essential to all from the mine worker to the highest official in the mining industry.

The mine is not conducive to the speaking of good English, and technical education, if carried along the narrow lines of the accumulation of facts pertaining to a particular study, does not give the wide knowledge of the English language so necessary for those who desire an education which will be of assistance to them not only in their profession but in every walk of life.

Most technical courses are already overloaded with subjects which are essential to the particular vocation and it has been stated that to introduce a subject, such as English, is unnecessary, if not impossible, with the result that the subject has been completely eliminated from most technical courses. If, however, English is given a specific place in the curriculum the other subjects would, without any doubt, be more easily assimilated by the students. The disadvantage of overloading the course would result in an advantage as the instruction in other subjects would be easier. The appreciation of an author largely depends on whether we can observe as closely as he and, therefore, if students are trained to appreciate good literature they will be more successful in understanding the instruction given by the teacher and in the accumulation of technical knowledge from books. A good grounding in English will ease the training in vocational subjects resulting in satisfactory progress to the mining student who is working under so many disadvantages.

The inclusion of English in a technical course at once invites criticism. To the student, especially in the junior classes, the subject appears unnecessary as it has no vocational appeal. Further, it is often immediately unpopular, due probably to recollections of boredom in the day school. While the correction of sentences, formal grammar, and the study of literature, both poetry and prose, provide a certain amount of training in our language, the interest which should exist in the study of English is often thereby destroyed. The success of English teaching in continuation schools therefore lies, to a great extent, in the hands of the elementary and secondary school teachers. If the subject is made popular in the day schools there should be no difficulty in fostering the interest in the continuation classes.

Having decided that English is essential in any technical course, should a specific place be given to the subject in the junior, senior and advanced courses? Or, should it be included only in the junior course and in the others the vocational subjects used as a medium for its teaching? The subject is quite as necessary in the upper courses as in the lower since the senior students will in all likelihood hold positions of responsibility in the industry and, therefore, a good command of the English language is imperative.

While the vocational subjects can be used with success in cultivating clear and effective expression of thought, they are of necessity confined along their own lines and fail to promote powers of expression on general matters.

The teaching of English may be directed along two different paths. The first we may term "localised" English and the second "comprehensive" English. Let us consider the first. The subject of mining is taken as the basis and upon this English is taught. A limited vocabulary results and knowledge is localised. Throughout the whole mining course the student is called upon to express his thoughts on a particular technical subject and, therefore,

therefore/ further training by means of a special subject on "vocational" English is superfluous^u. One of the arguments put forward for the use of this "applied" English is that in order to hold the interest of the younger student industrial bias in the subject is essential. There is some truth in this but the introduction of this type of English, while showing a realisation of the necessity ~~of~~^{for} the subject, does not obviate the difficulty but rather adds to the already overcrowded curriculum without advantageous results.

As an example of this type of English teaching, the following is a syllabus arranged in a mining centre and is classed under the title "Technical English":-

1st and 2nd Years.

The treatment of this subject should be essentially non-formal; the exercises undertaken would be in the main oral and (to a lesser extent from time restrictions) written composition, the matter whereof being continuously related to the industry in which the lads are engaged. The following syllabus suggests subjects suitable for such oral and written exercises. A short written composition might be given as a home exercise each week, or at other frequent intervals.

Written Composition.

- (a) Practice in writing from dictation.
- (b) Short concise reports of accidents to workman in a section or at the screening and washing plant or other work.
- (c) Concise statement of a grievance or dispute in a mine.
- (d) Short essays on such topics as "My day's work", "A day in the Life of a Colliery Fireman", etc. This series of exercises would give the teacher an opportunity of pointing out the parts of the Coal Mines' Act and Regulations which should be observed in the various duties described.
- (e) Written authorizations such as an Official in a Mine might give to a worker to carry out certain duties.
- (f) Reports of Firemen, Inspectors, and other Officials.
- (g) Various aspects of Welfare Schemes (see Oral Discussions).
- (h) Subject matter dealt with in the Mining Lectures.
- (i) Any of the topics mentioned under "Oral Discussions".

Oral Discussion.

The teacher should initiate a discussion on the following topics and similar or cognate subjects, so as to encourage students to take part. These discussions will give them confidence to express their opinions and will give the teacher the opportunity to correct defects in speech.

To get the greatest good from these discussions it is suggested that the teacher might give out the subject to be discussed a week before the meeting, with the instructions that each student must think over the subject in the interval and be prepared to take part in the meeting.

- (a). Welfare Schemes: Local. Sport and Recreation.
County. Pit head baths. Rest houses for miners and their dependents.
Homes for aged miners.
National. Education in the Industry.
Provision of Welfare Scholarships.
Research Board and its work.
Finance of Welfare Schemes.
- (b). Ambulance training of Miners.
- (c). Safety first Movement.
- (d). Various safety provisions of the Mines' Act.
- (e). Rescue Work.
- (f). Local happenings in Mining districts.
- (g). Short lecture by the teacher followed by oral or written exercises on such subjects as:-
Importance of Mining Industry to the Community.
Limitations in the practice of the Industry--Mines' Acts and Regulations.
Brief historical resume of industrial conditions in former times leading to the passing of Acts regulating work in Mines.
The necessity for safety regulations--Accident incidence from various causes.

General.

It is recommended to the teachers that they should encourage the students to read books. The type of book will vary with types of students but good general literature should form the basis of the reading. It may be possible to use such books and reading as the subject of a written composition or an oral discussion.

It is interesting to note the above General Comments.

In the Report by the Board of Education on the "Teaching of English in England", this statement occurs--"There are those... who think that the easiest approach to the interest of the particular type of student with whom the Continuation Classes have to deal lies in taking the locality or even the industry with which he is familiar and making this the starting point by the gradual widening study of the past....these teachers who start from the pupil's vocation will be very careful not to confuse the starting point with the goal. What we want is ^{to} give the children their share of the whole of the splendid literary and historic heritage of humanity."

In order to arrange a scheme it is necessary to study the reasons for including English in a technical course. The aims may be stated as follows:-

1. To extend the vocabulary of the student and to train him to use and to appreciate the exact meaning of words and phrases.

2. To strengthen the student's ability to express himself in a simple and accurate manner.
3. To foster in him a love of good literature.

If these aims are attained not only will the student possess something which will be an asset to him in his profession but he will have obtained a wider knowledge of many subjects outside his own. An English course suitable for evening students must be carefully considered and while it is to be deplored that the subject may be taught "technically", at the same time the scheme should be arranged along popular and attractive lines. It should be comprehensive but not too academic. The following illustrates an academic and, therefore, unpopular scheme which has been arranged in a mining centre:-

ENGLISH.

1. Industrial and Social Conditions.
Introduction. Brief discussion on "Life in Saxon and Norman England."
 (a). The Manors and the Feudal System. Parochial, Municipal and National Life. The Black Death and Peasants' Revolt. Decay of villeinage.
 (b). Manors and Towns.
 (c). The Guilds(Gilds). Guilds; Merchant and Craft Guilds. General sketch up to reign of Henry VIII. Trades Unions.
 (d). Beginnings of National Economic Life, e.g. in reigns of Edward I,III.,Richard II.
2. Intellectual Development.
 (a). The Renaissance--characteristic features.
 (b). Intellectual development since the Renaissance.
3. Growth of Religious Liberty.
 (a). Mediaeval Times.
 (b). Reformation. Some reference to Huss, Wycliffe,Luther.
 (c). Religious struggle in 17th century.
 (d). Removal of Religious disabilities; rise of the Methodists.
4. Growth of Political Liberty.
 (a). Middle Ages.
 (b). Tudor Period.
 (c). Republican Experiment.
 (d). Revolution in 1688-9.
5. Commerce.
 (a) Municipal and National Regulation.
 (b). Perils of the Sea--Pirates--the Elizabethan "sea-dogs."
 (c). The New World, and Routes to the East. The East India Company.
6. External Expansion.
 Maritime, Commercial and Colonial Expansion.
 Development of Science of navigation.--Henry the Navigator, Columbus, Cabots, Magellan, Elizabethan

Elizabethan/ Explorers.

Commercial Expansion--East India Co.

Navigation Laws.

Present status of Australia, Canada, etc. in the Empire.

A technical student will not be attracted by a course of this nature. While it covers a good field of reading it is too historical to appeal to him. Set books are recommended for reading and that also condemns it. A course in English is not merely the reading of so many given books. The subject is limitless and a rigid syllabus only restricts the activities of the class. A better method would be, by means of a class library, to allow the student to make his own selection from the treasures of English literature, thereby leading him to regard the reading of good authors as a suitable and enjoyable occupation of his leisure.

The library must definitely be in class and contain several copies of each book in order that discussion can take place between the students themselves as well as with the teacher. The book collection need not be extensive but should include all classes of good literature which will attract the adolescent and the older student.

There can be no objection to the inclusion in the course of a little "technical" English which may be carried through by essays and reports on various mining subjects. This, however, can only be successfully applied in the senior classes where the students have already a good knowledge of mining. "Technical" English in the Junior Courses has no value whatever.

Practice in the construction of notes from information supplied and the expansion of these notes into a fuller description, also precis work, would enhance the value of the course and make the subject more varied and attractive.

Further, to effectively teach English the right type of instructor must be secured. He is, primarily, one with a knowledge of the miner, his work and his environment and will, therefore, have a sympathetic interest in the educational needs of his students.

To sum up, if English had a definitely assigned place in all technical courses a higher standard of work would inevitably follow as, without doubt, many poor results are due simply to the student's inability to comprehend what he has heard and read, coupled with his own difficulty of expression.

C H A P T E R I X

The Text Book in Mining Schools, with Special Reference
to its use in class as a means of
"Auto-Instruction."

In this Chapter the writer has placed on record the various attempts which were made in order to stimulate the study of class text-books. The first methods described are those in which home-work was relied upon as a means of increasing text-book study, but the method finally adopted took the form of auto-instruction from the text-book, in class.

The Text Book in Mining Schools with Special Reference
to its use in Class as a means of "Auto-Instruction."

It has been said that if a subject is efficiently taught there is no need for a text book as the student's class notes should form a book of reference for the particular subject. This comment is open to severe criticism as it is generally found that the student's class notes are not of a sufficiently high standard to take the place of a good text book. The student, if he wishes to make progress, should possess a text book for each subject.

The main advantage of the text book lies in the fact that the matter is presented from a second point of view and this, therefore, gives a clearer understanding of the subject. Points which the student may not have understood in class may, after perusal, be made quite apparent to him. Another advantage is that the student can study at his own rate and thus fix more definitely ideas and impressions.

It is impossible to cover any subject adequately in class but if the right type of book is chosen the teacher can concentrate on the principles of the subject, leaving the student to form the intermediate links between one principle and another. Much valuable time in class can be saved if reference is made to diagrams and illustrations in the text book. While the drawing of diagrams on the black board in class does probably fix ideas it is usually found that the student's copy is inaccurate and, therefore, unreliable. This is particularly the case if an attempt is made to illustrate on the board mechanical or electrical machinery. The most successful method of memorising the intricacies of part of a machine is to draw it down on paper. This should be done from the class book ~~with~~ ^{with} probably/ instructions on the black board on the general lines to be followed.

In order to stimulate the reading of the text book constant reference should be made by the teacher with regard to

to/ the particular portion in the book which pertains to the lecture matter.

The failure of the text book to receive its correct place in continuation classes is due primarily to the fact that it is generally too much in detail and too advanced for the particular class, as in order to obtain a book covering the course one must be chosen which goes more deeply into the subject than is necessary. The student is, therefore, not attracted by the contents as on a casual glance mastery of the matter seems impossible. A technical book written by a teacher of the subject rather than by a specialist is always more acceptable for class work as the matter is presented in a more teachable order and appeals more to the student.

Without a doubt, the use of text books in continuation classes has been curbed by the prohibitive prices which at present exist. It is essential that this matter receive primary consideration when deciding upon the type of text book to be adopted in class.

Again, a text book ought to be attractive in appearance from the outside. It has been observed that when a number of books are laid casually on a class room table the student invariably picks up the newest and brightest coloured ones first. A text book cover should make its appeal in the same way as packings and wrappers are designed to do in commerce.

Study of the Text Book.

It is the experience of most mining teachers that although a text book is purchased it is seldom studied or even used as reference. The student generally shows a keenness in possession but it is remarkable how little is known regarding the contents. He relies implicitly on lectures and other class work to give him all the knowledge he requires and serious study of the class book is unknown to him. It is, therefore, necessary to teach the student how to study and find information for himself.

In an attempt to achieve this aim the following methods were adopted in the mining classes in Sunderland Technical College:-

- (1). A portion was set for reading and a summary handed in for home work.
- (2). A portion which pertained to the matter of the following lecture was given out for reading.
- (3). Students were asked to hand in notes on any part of the text book which they had read. Marks were assigned for these notes.
- (4). Questions were set for home work which could only be answered with the aid of the text book.

The following are the general criticisms of these methods:-

- (1). Students usually wrote their summary with the book beside them. Whole sentences were copied and the home-work submitted usually took the form of disjointed facts with too much concentration on certain points. The work improved with practice and it was latterly considered to be quite a successful method of encouraging home study.
- (2). More progress could be made with the lecture. The students who had read the portion benefited but it was thought that those who had not prepared did not receive as much benefit as would have resulted if no preparation had been required. By having a few well-prepared students a false class attitude was created.
- (3). The notes handed in by the students were entirely voluntary. The method was instituted in order to form a rough estimate of the amount of home reading done apart from that required for home work. Only two students, out of twelve, submitted work for correction.
- (4). The adoption of this method was intended to give the student practice in finding information without assistance. No indication was given regarding the portion of the text book where the information would be found. Questions were made as simple as possible. Few students were successful in giving good quality work. Very often the answers given showed an entirely wrong conception of the matter. The danger of this was early recognised and the method discontinued.

While the methods described gave fairly satisfactory results, it was thought that more progress in home study would be made if the text book was used in class as a means of auto-instruction. In order to obtain information regarding the suitability of this method a subject was chosen from the Mining Course and the following is a description of the work done:-

- (1). Subject---Geology.
- (2). Class-----Fourth Year Evening Course in Mining.

Particulars of Students in Class. (Obtained from questionnaire completed by each student.)

<u>Student.</u>	<u>Age.</u>	<u>Day School attended.</u>	<u>Occupation</u>	<u>Leisure Reading.</u>
J.A.	25	Elementary.	Miner.	Edgar Wallace.
A.H.	24	"	Coal Cutting.	?
T.J.	19	"	App. Surveyor.	Newspapers.
W.L.	20.	"	Miner.	?
A.M.	38	"	Deputy.	Newspapers.
W.M.	19	"	Coal Cutting.	None.
J.M.	30	"	App. Surveyor.	Text Books.
W.M.	25	"	Miner	Text Books.
W.O.	18	"	App. Surveyor.	Adventure.
E.T.	31	"	Miner	None
S.W.	26	"	Coal Cutting.	Fiction.
J.W.	34	"	Deputy.	Fiction.

(3). Text Book-"Geology for Beginners" by W.W. Watts.

Reference also made to the following books:-

"Mineralogy" by Rutley.

"Geology" by Geikie.

(4). Meeting of class was held for two hours every second week. During the other week instruction in Geological Drawing was given.

The subject of geology was chosen since none of the students had received any previous instruction and also because practical work could be interwoven with reading throughout the course. No lectures were given but instruction sheets (see Appendix^{Nº5}) were issued to each student at the beginning of the class meeting.

Description of Instruction Sheets.

Typewritten sheets, eighteen in number, covering the course made up in book form. Each page is divided into sections and approximately every third section refers to practical work. The other sections detail the reading that has to be covered and include instructions regarding notes which have to be entered into the class note book. These notes may be in the form of a summary of the matter read. In other sections the important points only need be noted. Students are instructed, when writing summaries, to read the passage two or three times and then proceed without reference to the text book. Finally, the work must be checked and any omissions inserted and underlined.

When the study of one section of the subject is completed a test is set, of which the following is an example:-

TEST.

Note:- The questions should be answered without reference to notes. You should, however, revise all your work before answering the questions. Leave about six lines between each answer. After the test has been completed reference should be made to notes and points, which have been omitted, added. Additional work should be underlined.

Test should be marked in the following manner:-

Ten marks are given for each question and one mark deducted for each point taken from notes. Show the total marks for the test. This method should be adopted in all the tests in the course.

1. What is meant by the term "Geology"?
2. Describe the "in situ" theory of the origin of coal.
3. What is anthracite and how has it been formed?
4. Distinguish between clarain and durain by comparing their structures, constituents, etc.
5. State the procedure followed in finding the moisture, volatile matter and ash content of coal.
6. Draw, to a suitable scale, a section of a coal seam as follows:-

Roof.	
Coal	8"
Dirt	2"
Coal	22"
Dirt	3"
Coal	18"
Floor.	

To bring home to the mining student that geology is very closely connected with his work the subject was introduced with the study of coal. While it was realised that geology is usually taught from "origin", it was deemed advisable, in connection with mining students at least, to commence the course with the study of material which they are handling every day.

General Observations.

1. The class showed as much keenness in the reading and writing sections as in the practical work. This was not expected. It suggests that other subjects in conjunction with which no practical work could be done might be successfully taught in this manner.
2. The class was industrious and took a keen interest in the new method.
3. The discipline of the class was excellent. It is admitted, however, that this class was composed of older students and that the same might not result in a more elementary class.

4. The satisfaction shown by the student when he had obtained information for himself was very evident.
5. No difficulty was experienced when the work of the students got out of step. This was rather an advantage as the varied work being carried out created a more interesting class atmosphere.
6. The quicker students acted as an incentive to the slower. It was noted that as the session continued the slower students' lag behind the others decreased considerably.
7. It is an advantage to divide the work into small sections as the student usually judges his progress by the number of sections he has completed. Stress should be made on this point as long instructions delay progress. On an average the number of lines in each section does not exceed six.
8. Constant checking by the teacher must be made as usually the student, in his eagerness to progress, commences another section before the previous one has been completed. Quality of work submitted for checking improved considerably after a few weeks and at the end of the session the class notes were of a very high standard.*
9. A few students asked for assistance with parts of the text book which were not included in the instruction sheets. This showed that the aim of this method of teaching was being achieved to some extent.
10. The home work showed a wider conception of the subject as a result of more reading. The method of layout had also improved.
11. The final examinations improved in quality and the amount of written matter increased. Candidates showed that they had a more comprehensive knowledge of the subject. Examination scripts showed more detail than when the course was given in lecture form.

Students were asked at the end of the session for their opinions regarding the new method. The following are some of the statements made:-

* Samples of Student's Class Notes are given in Appendix No. 6.

1. "I did not think that a text book was so interesting."
2. "It makes you work".
3. "I did not like it at first but am very interested in it now."
4. "I have a good knowledge of most parts of the text book."
5. "I like the practical work better than the reading".
6. "I liked the summaries and found that latterly I could write a summary on a page of the text book without missing many points out."
7. "I liked the method but would have preferred a few lectures with it".
8. "The main advantage I found in it was that if I was off any time due to awkward shifts I could start where I had left off."

The above comments are taken as the genuine opinion of the students as they were instructed to give their unbiased criticism and being of a mature age it is not likely that they would hesitate to be perfectly frank.

The chief advantages claimed for this method of instruction are as follows:-

1. Lectures are replaced by individual instruction and practical work.
2. The method is new in Continuation classes and, therefore, acceptable to the student.
3. The student is finding information for himself and so learning to study.
4. The mind is trained in memory work.
5. It illustrates the usefulness of the text book to the student.
6. Each student is "striving" and "achieving" all the time and each at his own rate. Neither the slow nor the fast worker suffers.
7. In continuation schools students, particularly mining, may be prevented from attending class through work. This method of instruction does not penalise absent members as is the case in a lecture course.
8. The method constitutes a good training in the use of English.

The main disadvantage was that the same amount of work could not be covered as in a course of lectures only. Most students completed 75% only of the course as given in the instruction sheets and in order to complete the prescribed syllabus four lectures were delivered at the end of the session. This was not satisfactory and a new plan was drawn up for the following session.

The reconstructed scheme is shown in Fig. 18 p. 128. Five lectures were arranged in the order shown and the reasons for including these are as follows:-

Lecture No.1. This lecture gives a "start" to the course as in the first method there seemed to be a lack of concentration on the work due, doubtless, to the subject being new. The lecture was made as interesting as possible and mainly devoted to geological phenomena illustrated by lantern slides.

Lectures Nos. 2 & 3. This part of the subject offers scope for lecturing with the aid of lantern slides. Much ground was covered in two one-hour lectures in contrast with four or five hours taken by the students in the first method. These lectures were fixed in position in order to assist the general scheme of study at this stage but were not absolutely essential to the course. The subject of the lectures was covered in the reading but in a very concise form.

Lecture No.4. Included solely to ease the study of this part of the subject which students generally found difficult. Previously five to six hours had been spent at this stage and it was thought advisable, in order to save time, to include this lecture.

Lecture No.5. Metamorphism. Included to ease the study from text book as in lecture No.4. The subject could, with advantage, be illustrated by lantern slides.

In the first course the class on Geological Drawing was not in any way arranged to assist the study from the text book but this was rectified in the reconstructed scheme.

Fig. 18 p. 128 shows the order of instruction. Various sections are grouped in different colours and the arrows indicate how the course has been arranged in order that the lectures and the class in geological drawing assist the auto-instruction.

At the end of the second session no extra lectures were required to complete the course and it was decided that the alterations had allowed the scheme of teaching to proceed satisfactorily, and the aim to be achieved.

CONCLUSION.

In recording this scheme of teaching the writer does not suggest that all subjects could be successfully taught in this manner. In mining the method could only be employed satisfactorily in the junior courses, i.e., 1st to 4th year. Beyond that stage the classes concentrate on the essentials of technology

technology/ and since this demands practical knowledge on the part of the teacher, it is necessary to employ the lecture method. Again, the method aims at showing the student how to make full use of the text-book and he must, therefore, recognise its value at the beginning of a course in order that he will use it to the greatest advantage in the senior work where its assistance becomes imperative.

From the success attained through auto-instruction in geology the writer has no doubt that the method could be employed with good results in any subject of the junior mining courses.

FIG. 18.

**TABLE SHOWING RECONSTRUCTED COURSE IN GEOLOGY
INVOLVING AUTO-INSTRUCTION FROM TEXT BOOK**

GEOLOGY AUTO-INSTRUCTION		COURSE LECTURE	GEOLOGICAL DRAWING	WEEK
THE STUDY OF COAL		INTRODUCTION - THE EARTH (BARYSPHERE, LITHOSPHERE ETC.)	2 HOURS	1ST.
2 HOURS			PLAN AND SECTION LEVELS AND CONTOURS	2ND.
THE STUDY OF COAL				3RD.
			PLOTTING SECTION FROM PLAN (NO GEOLOGICAL FEATURES)	4TH.
THE STUDY OF COAL				5TH.
			SIMPLE GEOLOGICAL SECTIONS (LEVEL SURFACES, INCLINED STRATA)	6TH.
THE STUDY OF COAL ORIGIN OF COAL		THE AGENTS OF DENUDATION AND TRANSPORTATION.		7TH.
			GEOLOGICAL SECTIONS (LEVEL SURFACES, FOLDED STRATA)	8TH.
MECHANICALLY FORMED ROCKS		THE AGENTS OF SEDIMENTATION AND HARDENING		9TH.
			GEOLOGICAL SECTIONS (LEVEL SURFACES, FAULTED STRATA)	10TH.
CHEMICALLY AND ORGANIC- ALLY FORMED ROCKS.				11TH.
			GEOLOGICAL SECTIONS (IRREGULAR SURFACES, LEVEL & INCLINED STRATA)	12TH.
CHEMICALLY AND ORGANIC- ALLY FORMED ROCKS.				13TH.
			GEOLOGICAL SECTIONS (IRREGULAR SURFACES, FOLDED STRATA)	14TH.
STRATA. (LEVEL AND INCLINED)				15TH.
			GEOLOGICAL SECTIONS (IRREGULAR SURFACE, FAULTED STRATA)	16TH.
STRATA (FOLDING AND FAULTING OF ROCKS)				17TH.
			GEOLOGICAL SECTIONS. (IGNEOUS INTRUSION, METAMORPHISM)	18TH.
STRATA (FOLDING AND FAULTING OF ROCKS)		PRINCIPAL ROCK FORMING MINERALS.		19TH.
			GEOLOGICAL SECTIONS (IGNEOUS INTRUSION, METAMORPHISM)	20TH.
PRINCIPAL ROCK FORMING MINERALS.				21ST.
			MISCELLANEOUS PROBLEMS IN GEOLOGICAL DRAWING.	22ND.
MINERALS IGNEOUS ROCKS.				23RD.
			PLANS AND SECTIONS OF THE COAL FIELDS OF GT. BRITAIN.	24TH.
IGNEOUS ROCKS.		METAMORPHISM - METAMORPHIC ROCKS.		25TH.
METAMORPHIC ROCKS				26TH.

C H A P T E R X.

Class Notes and Note Books.

The writer has included this chapter as he claims that training in methodical note-taking forms an important part of technical education. The following pages detail the advantages of orderly-made class notes and also describes the method of note-taking adopted by the mining students under his charge.

CLASS NOTES AND NOTE BOOKS.

In technical teaching it is usually found that those students who show progress in their class work have a certain amount of pride in their note books. On the other hand, the less progressive do not give much thought to class notes and the matter contained therein is usually not in sequence and very often illegible.

The importance of efficient notes cannot be overestimated since they are the student's own textbook and should, therefore form a book of reference at all times. If they are compiled carelessly, and perhaps erroneously, class notes are a potential danger to the student in that entirely wrong ideas may be conveyed. The taking of notes by the student is a responsive reaction to new impressions and if a note is taken down correctly it shows that the new idea has been fixed in the mind. Again, notes are necessary in order that the student may be in a position to weigh and examine the new idea in his mind and, if the notes are correct and in sequence, he has an orderly and recoverable system of impressions at his hand. This is important in order that the student may have a correct perspective of the whole subject and not a collection of disjointed facts. The latter will certainly result if order is not practised throughout note-taking.

The value of note-taking should be emphasized in the junior classes and the student should be led to realise the necessity of taking down the class matter carefully. Success can only be gauged by the examination of the student's notes and the correction of same periodically. If this procedure is adopted during the first session it is usually found that students' class notes and also home work are methodical throughout the whole course. It is imperative that, in the first session, only high class work be accepted by the teacher and, in fact, in junior courses, it is advisable to aim at having

having/ a proportion of the subject well-assimilated and intelligently noted rather than attempt to cram the whole subject with consequent incomprehensible notes.

The next question which arises is, "Who should formulate the notes? The student or the teacher?" Note-taking is a two-fold process. There is a mental and a physical action and these two actions must be co-ordinated with ease by the student if note-taking is to prove worth while. It has been the experience of the writer that to most students, especially in continuation classes, this creates the real difficulty, owing to the fact that the student has already completed a day's work in the factory or in the mine, resulting in fatigue of his physical powers. Co-ordination, therefore, of the mental and physical becomes extremely difficult. On the average, the student cannot exercise the energy which is necessary to secure requisite notes. Other points which arise are the capacity of the student to select notes and his ability to put down his notes in a succinct form. Practice, however, can put these matters right but incorrect and careless notes caused by the student's fatigue cannot be overcome.

There is no doubt that students should be encouraged to take their own notes but in order to obviate wrong impressions of the subject matter it is desirable also that notes should be dictated by the teacher. In class work, instruction should employ a maximum part of the time and note-taking a minimum. Teaching should be done first, followed by dictation of notes which should be compact and should be a spontaneous effort on the part of the teacher. By following out this process the teaching is repeated in a second verbal form and this helps to correct false impressions which may have been ^{created} ~~taken~~ during instruction. Another advantage which can be claimed for this method is that mental concentration on the part of the student is relieved for a time and the physical powers are brought into action.

In teaching advanced classes it is certainly necessary to augment the students' notes by dictated matter.

Two forms of keeping notes may be adopted. They may either be taken down into a rough note-book and re-copied or written directly into a permanent note-book. The student should be allowed to decide which method he prefers. If the notes are carefully taken down in class there should be no need to recopy. The continuation class student would be better employed in home study than in copying notes.

Although students should be encouraged to supplement the class notes from their reading of text-books, this is seldom done voluntarily. It is advisable then to set a chapter or part of a chapter in the standard text-book to be written in precis at home.

NOTE BOOKS.

While the method of taking down notes is important, the type of note-book used is equally so. It is common knowledge among teachers of continuation classes that the note-books of students are of a very varied collection. It is usual to find that notes pertaining to two or more subjects are inserted in the one note-book. Generally when a student is asked to produce a particular note much time is wasted in finding the required section. By its very disorderliness, the student's own note-book does not encourage him to read his notes. Others take notes on loose sheets and one often has doubts as regards their ultimate destiny.

In order to encourage students to adopt a good method in note-taking, loose-leaf note-books were introduced to the mining students during the session 1933/34. With each note-book three separate storage covers were supplied. Notes are easily transferable to the storage

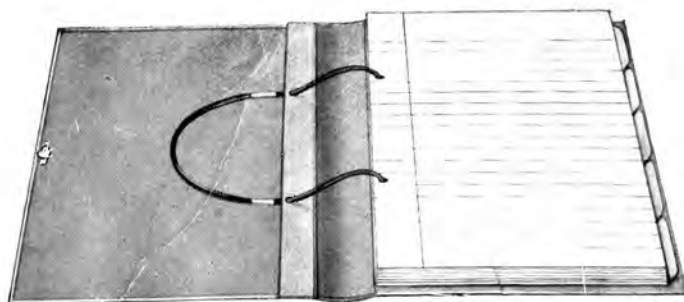
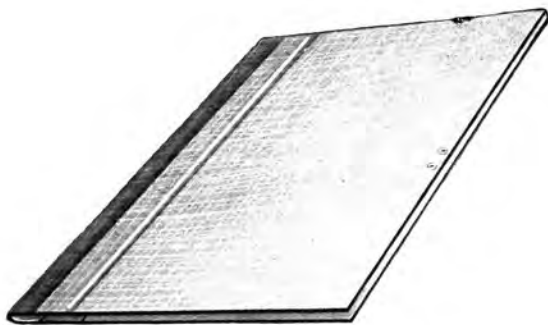
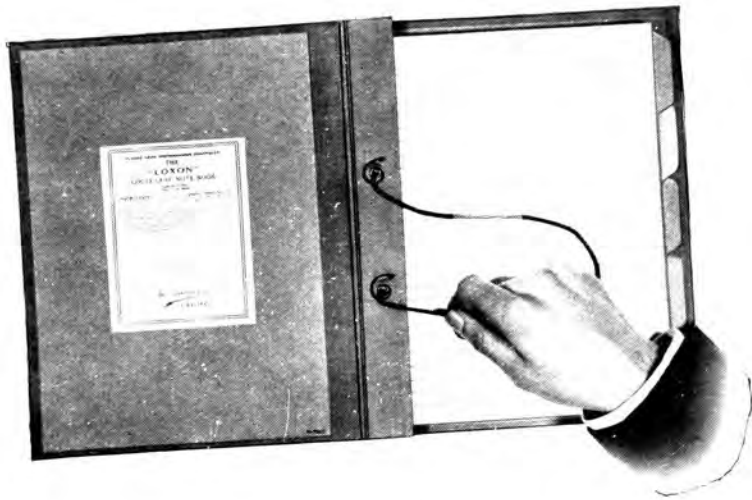
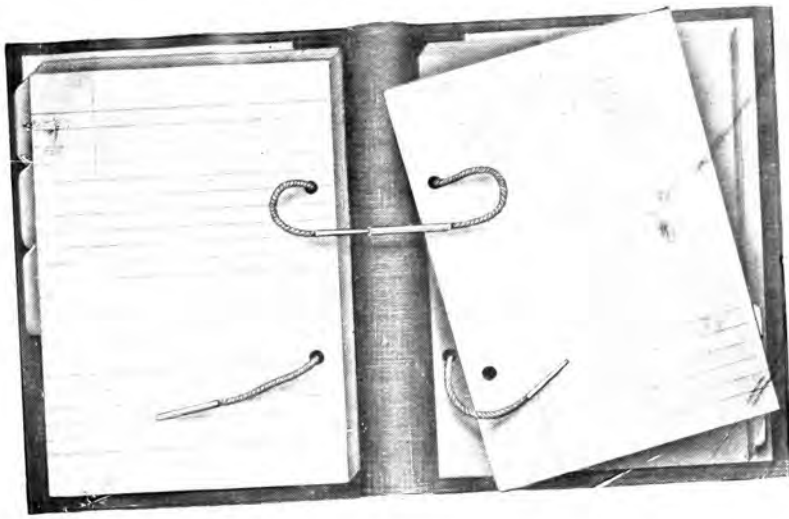
storage/cover, one of which is kept for each subject.

Simply to advise the student to purchase a certain type of note-book met with no success and in order to standardise the class book purchase of a quantity was made through the department. Whilst it could not be made compulsory, it is encouraging to find that ~~already~~ approximately 80% of the mining students are now using loose-leaf note-books, the type adopted being the "Loxon", photographs of which ~~are~~ ^{are} ~~accom-~~ ^{appended} ~~pany~~. The advantages of this loose-leaf book are as follows:-

- (1). The student, by having an attractive note-book is encouraged to keep his notes more methodically than before.
- (2). One book only is required for all subjects.
- (3). Revision of work is straightforward since each storage cover contains the notes on one subject in sequence.
- (4). Work done can easily be rearranged or new passages inserted. Augmentation of notes is, therefore, possible.
- (5). It is more economical.

Since these books have been introduced the standard of note-taking has risen very considerably and it is found that students are giving more time to completing their notes at home. Some statements made by students are of this order-- "I can now find my notes" (a decided advantage when the interval between work and class is so short). "I am taking more interest in my notes now". etc.

The writer is convinced that progress can readily be made by introducing these loose-leaf note-books. Apart from the many advantages claimed, their originality tends to turn the student's attention to the importance and accompanying benefits of accurate class note-taking.



For the convenience of the Examiners the conclusions arrived at in this thesis are here collected and set forth:-

1. The Mining Examinations, under the present conditions of the Coal Mines Act, do not allow of a sound educational course being taken by the student.
2. The Examinations are too comprehensive and, therefore, the student is prevented from carrying the study of all six subjects to the final year of the course. Instruction in at least three of the subjects has to be terminated in one or other of the previous years.
3. In order to make mining education cultural as well as vocational the students should advance to the final test by stages which are marked by examinations at specific points.
4. A mining community is, of necessity, scattered over a wide area and it is, therefore, essential that the number of class meetings should be reduced to a minimum, say, two per week.
5. A class meeting should not exceed two-and-a half hours and should include a rest period of ten minutes after one and a half hour's instruction.
6. The use of intelligence tests in Continuation Classes has been very limited and it is suggested that they here could be used with great advantage.
7. By combining the order of merit of achievement and of intelligence and forming "gradation marks" for each student, the mining teacher is in possession of figures which give a truer value of class results than do examination percentages.
8. From the use of "gradation marks" it is found that the type rather than the arduous nature of labour is the cause of low class results.
9. English should have a definitely assigned place in all technical courses.
10. The text-book should be given a more important position in technical education than it is to-day. In the junior courses it could be used in class as a means of instruction. The student should be taught how to study at the beginning of the course.
11. Training in methodical note-taking forms an important part of technical education. More time should, therefore, be spent in the beginning of the course in order to give the student training in efficient note-taking.