

FOUR DAYS IN JUNE

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INDEX

	<u>Page</u>
Synopsis.	1
Introduction.	2
A Brief Geological Description of the Wankie Coalfield.	3
No. 2 Colliery. A Description of Mining Methods.	3
Layout of No. 2 Colliery.	4
"High Extraction" Panels.	5
Wankie Colliery and the Law.	6
The Explosion.	6
The Inquiry into the Disaster and the Appointment of a Commission.	7
The Conduct of the Inquiry.	8
The First Recorded Ignition at Wankie.	8
The Second Ignition.	11
Previous Ignitions.	12
Possible Causes of the Explosion.	14
Recommendations of the Commission.	19

FOUR DAYS IN JUNE

THE WANKIE DISASTER AND THE AFTERMATH

Synopsis

The history of coal mining in Wankie up until the time of the disaster at the No. 2 Colliery is briefly described. The layout of the mine and mining methods are discussed, and possible causes of the coal dust explosion are speculated upon.

The author re-examines the evidence presented to the Commission of Inquiry by a number of witnesses. He also introduces certain new evidence relating to previous coal dust explosions in Wankie.

INTRODUCTION

The history of coal mining in Wankie began in 1893, when a young German prospector named Albert Giese heard tales from Africans of "black stones that burn". Intrigued by the stories, he made his way through the inhospitable bush country of North Western Rhodesia to an area about seventy miles from Victoria Falls.

Here, in the dry bed of the Kamandama river he came across a shale outcrop. (Interestingly this very place was later to form the "box cut" of an opencast pit). In the same vicinity he obtained samples of coal which proved to be of good quality.

The mineral rights were owned by the British South Africa Company who gave concession rights over a very large area in the Wankie district to the Mashonaland Agency Limited. In 1897, three years after having acquired the rights, the Mashonaland Agency engaged Giese to peg the Concession, which extended over 400 square miles.

Exploratory work commenced in 1900. In 1901 the Wankie (Rhodesia) Coal, Railway and Exploration Company Limited purchased the rights from the Mashonaland Agency Limited.

Shaft sinking commenced in August 1901, and in "January 1902, the main incline shaft or main drift of what became No. 1 Colliery had reached the coal".

During September 1903, the first trainload of coal left Wankie and coal production continued on a fairly regular basis from that time onward. In 1909, however, the limited demand for coal forced the Wankie (Rhodesia) Coal, Railway and Exploration Company into liquidation. It was immediately reconstructed as the Wankie Colliery Company Limited, under which name it continues production to this day, although financial and technical control have changed hands since the company was formed.

From the formation of the Company in 1909 output steadily increased. In 1910, 194 740 tons were produced. No. 2 Colliery was brought into production in 1927, during which year output amounted to 1 004 349 tons. As a result of the depression, however, No. 2 Colliery was mothballed and remained quiescent until 1937, when production was resumed. Output rose steadily, and in 1945 was over 2 000 000 tons.

In 1950 Powell Duffryn, Limited, took control of the company. The need for coal in the territories served by the coal mines (then Northern Rhodesia, Southern Rhodesia and the Congo) was rapidly increasing. To meet this demand, which by that time totalled 5 000 000 tons a year, a new colliery, No. 3, was brought into production.

It was at that time, towards the end of 1953, that the Anglo American Corporation of South Africa, Limited, acquired control of the Wankie Colliery Company from Powell Duffryn. Shortly thereafter yet another falling off in demand resulted in No. 1 Colliery being closed.

No. 2 and No. 3 Collieries continued to produce. Each of them had a productive capacity of 2 200 000 tons per annum.

In addition to expanding/.....

In addition to expanding its coal mining capacity the Wankie Colliery Company Limited extended its activities into a number of allied fields. The company produced both coking coal and coke. The coke was made first in beehive ovens, and as demand grew and market requirements became more stringent in terms of quality, modern, regenerative retort ovens were built. Complex and highly sophisticated by-products plants produced ammonia liquor, tars and benzol.

By 1972, when the explosion occurred, the Wankie Colliery Company had become a tremendous mining and commercial venture, employing four hundred Whites and four thousand Blacks.

A Brief Geological Description of the Wankie Coalfield

In order to understand fully the various factors which contributed in greater or lesser degree to the explosion it is necessary to have some understanding of the nature and peculiarities of the coal deposit.

The seam mined at Wankie is known as the Wankie Main seam. The general structure of the deposit is lenticular, the thickness of coal varying from about 12 metres in the centre of the deposit, where it reaches its maximum development, to nothing at the extremities. Over No. 2 Colliery, with which this paper is primarily concerned, the seam width varies between 6 and 8 metres. The depth below surface varies from 60 to 150 metres, the variation being due to changes in surface topography.

The seam is extensively fractured, the result of ancient tectonic activity. While major faulting is uncommon, the fracturing has broken the seam up into blocks, making roof support difficult.

The distribution of chemical and physical properties in the seam is remarkably consistent. The "bottom coal", i.e. that coal lying nearest the floor, possesses (for Southern African coals) a remarkably low ash content, sometimes less than 10%, and a high volatile content, varying between 27% and 29%. Swelling indices of 4 are common. Moving towards the upper part of the seam higher ash contents are encountered and the volatile content and swelling properties decrease.

No. 2 Colliery. A Description of Mining Methods

In common with most collieries working thick seams No. 2 Colliery practiced the pillar and bord method of mining. Primary extraction took place on the floor of the seam to a height of approximately 3 metres. This was followed by secondary extraction or "top coaling" to a final height of approximately six metres. This final upper horizon was, of course, largely dependent upon finding a good roof and could therefore vary by as much as half a metre or a metre.

Coal getting operations at No. 2 Colliery were fully mechanised. The standard configuration of universal coal cutter, gathering arm loader and cable reel shuttle car was used, but there were, in addition, a number of Ferret end tipping diesel cars. The coal was loaded via feeder breakers onto conveyors for transport to the surface.

A number of Landrovers/.....

A number of Landrovers were used for the transport of personnel underground. For the most part they were stripped down vehicles fitted with flame suppressors and exhaust gas scrubbers. Shortly prior to the explosion, however, two or three ordinary, standard diesel engined road models had been introduced. Neither type of vehicle was permitted within 600 feet of a working face.

Layout of No. 2 Colliery

The general layout of the underground workings of No. 2 Colliery is shown on the accompanying plans (Appendices G and H).

The workings of No. 2 may be divided into two quite separate and distinct areas, those which were worked between 1927 and about 1950, and those worked between 1950, when the decision was taken to mechanise, and June 1972, when the explosion occurred.

The "old workings" of No. 2, i.e. those mined between 1927 and 1950 by handgot methods, were mainly open workings with the haulages and intake and return airways demarcated by long pillars. No attempt was made to mine in "panels" or to leave barrier pillars.

The post 1950 workings of No. 2 Colliery formed an extension of the old No. 2 workings, but barrier pillars were left and the panel system adopted. The "old" and "new" No. 2 Collieries were sealed off from one another so that only the "new" workings were included in the ventilation circuit.

Ventilation was effected by means of axial flow fans situated at the top of the Kamandama and Bisa vertical upcast shafts (refer to Appendix "H"). Fresh air was drawn in by way of the Central incline shaft - also the haulage shaft - the Kamandama incline shaft - which was also the main transport and travelling shaft - and the Bisa vertical downcast shaft. None of the vertical shafts, either upcast or downcast, were equipped with ladderways for emergency exit purposes, the two incline shafts being regarded as the two outlets to surface required by law.

The two vertical Bisa shafts were fairly recent installations. The Bisa fan was, in fact, commissioned about the time of the author's arrival at Wankie.

Four production sections were deployed at the time of the disaster. They were N.M.4, the Matura Main, G. West and G. North.

The southern workings of the mine where the G sections were located, attracted a great deal of criticism from the Commissioners during the course of the inquiry into the explosion. The Report states:-

"In much of the area comprising No. 2 Colliery the workings were systematically laid out in panels. In the southern portion of the Mine, however, a geological disturbance extending roughly from east to west, led to a departure from an orderly layout. While not underestimating the difficulties which must have faced the Management in exploiting the coal in that portion of the Mine, the way in which the working sections were laid out does not indicate an analytical attitude to the problem but suggests a rule of thumb approach based on expediency".

The "difficulties which must have faced the Management" were posed by a fault zone whose strike ran in an approximately east-west direction parallel to the railway line. The throw of the fault zone was roughly 16 metres with the upthrow to the south. Between the fault zone and the railway line the coal formed a level plateau and was fairly easily worked.

G. South was driven/.....

G. South was driven at right angles to the strike until the plateau was reached and the seam was then worked east and west from there. G. North was connected through to the Railway West Main for reasons of ventilation.

It is true that the approach to working the coal on the "plateau" was dictated by expediency. The area was a greatly disturbed one geologically and the mine pressed on in the expectation that production would be halted at any time. In retrospect it is undoubtedly true to say that barriers should have been left, both for reasons of control of ventilation and for stability.

However, it is unlikely that the lack of barriers contributed to either the magnitude of the explosion or the loss of life.

"High Extraction" Panels

Because of the thickness of the seam and the increasing depth from the surface Wankie was faced with a problem which will be all too familiar to South African coal mining engineers, i.e., an extremely low rate of volumetric extraction.

It is to the Company's credit that in spite of the immense reserves contained within the lease area determined attempts were made over a number of years to improve extraction.

Again referring to Plan No. LBW5 (Appendix "H") it will be seen that there were six panels lying within the area demarcated by the Railway West Main, Railway North Main and the Bisa Main identified as HE A, B and C and HE 1, 2 and 3. These were the panels within which "high extraction" methods of mining were practiced.

The method adopted, although varying from time to time and from panel to panel, was basically systematic reduction, or "robbing" of pillars.

As has already been said, very determined efforts were made over a considerable period to devise a workable mining method. However, the difficulties involved were formidable. Panels would have to be abandoned for two or three shifts until the roof had "goafed" and stabilized. These constant interruptions to production became unacceptable. In addition, tremendous volumes of methane were released by the collapse of the overlying Madumabisa shales and, although special bleeder roads were driven, the gas presented a continual hazard.

When the author first arrived at Wankie in September 1970, mining was taking place in HE 3. Panel HE 1 had been mined out and sealed off with explosion-proof stoppings.

The Colliery Manager, Mr Basil Papenfus, decided to cut through the barrier pillar between HE 3 and HE 2 with the object of mining the pillars in HE 2 from the HE 3 conveyor system. His reasoning was that when conditions in one panel compelled the shift to retreat, mining could continue in the other panel. The idea had some merit, but, upon holing, the pillars in HE 2 were found to be crushing badly. A great deal of spalling had taken place and the pillars presented the typical "waisted" appearance associated with excessive weight. The decision was taken to abandon HE 2 altogether.

Mining continued for some time/.....

Mining continued for some time thereafter in HE 3. However, deteriorating roof conditions and poor productivity decided the author to close the operation down.

Instructions were given to seal off both HE 2 and HE 3 with explosion-proof stoppings. For reasons which will remain unknown this was never done and ordinary 14" walls were erected.

This fact is recorded for the reason that it could well have had to do with the cause of the explosion. This postulation is discussed later.

Wankie Colliery Company and the Law

During the course of the inquiry conducted into the disaster of the 6th June, 1972, it emerged that a great deal of confusion existed concerning Wankie's obligations and responsibilities in law. A brief explanation will assist the reader to understand how this apparent dichotomy came about.

Wankie's relationship with the Department of Mines has always been a rather special and very close one. For many years a Government Mining Engineer had been resident in Wankie. He supervised the conduct of mining operations both of the Colliery Company and various base metal and other mines scattered throughout the district. He reported to the Regional Government Mining Engineer, Bulawayo. From this office, the chain of authority and responsibility rose through the Deputy Chief Government Mining Engineer and Chief Government Mining Engineer, both of whom were stationed in Salisbury.

Rhodesia has its own code of mining regulations and, of course, these governed the conduct of mining operations at Wankie. However, after certain events had taken place, including an explosion of methane and the detection of further emissions, which will be described later, the Management of the Company decided to carry out operations in compliance with the far more stringent requirements of the South African Regulations governing fiery mines.

At the time of the explosion, therefore, one had the situation where the mine was legally bound by an inadequate code of regulations, and worked voluntarily to a set of regulations which had no legal status except as "local rules".

Incredibly, at the time of the explosion Wankie had not been declared a "fiery mine" in terms of the Rhodesian Act and Regulations.

The Explosion

At approximately 10h27 on Monday the 6th June, 1972, a violent explosion ripped through the entire extent of the underground workings of No. 2 Colliery. Tremendous columns of smoke and gases poured out of all the shafts, mounting hundreds of feet into the atmosphere. The Kamandama fan was totally destroyed and the Bisa fan nearly so. The Kamandama incline shaft was completely blocked by falls of roof and twisted steel girders.

For nearly four days rescue teams made the most determined efforts to reach possible trapped survivors. The Kamandama incline shaft was sufficiently cleared to permit the entry of proto teams and necessary equipment. Forty-one hours after the explosion the Bisa fan was brought back into operation and a sluggish ventilation current established.

Brattices were erected/.....

Brattices were erected in the splits along the Railway Main to direct the current of air towards the areas where the workers were known to have been at the time.

The proto teams, working in relays, penetrated 2 000 metres into the mine among scenes of the most appalling devastation. Explosions were heard at frequent intervals and freely burning fires were encountered.

In the end the rescue attempt was abandoned and the teams withdrawn. It had become obvious that nobody had survived the holocaust - 427 persons had died in one of the greatest underground explosions ever known.

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The Inquiry into the Disaster and the Appointment of a Commission

Immediately following the disaster an investigation into the possible causes was set in motion by the office of the Chief Government Mining Engineer, Mr Bernard Davey. In charge of the inquiry was Mr Les Bills, Regional Government Mining Engineer, Bulawayo. He was assisted by a team from the Department.

His investigation was both thorough and wide ranging. As well as examining the possible causes of the disaster he widened the scope of his inquiries to include the whole interface of relations and communications between the Department of Mines and the Colliery Company and every aspect of the Company's conduct of mining operations. His final report to the Chief Government Mining Engineer is best described by the Commission of Inquiry.

"It impressed us", they said, "with its thoroughness, objectivity and thoughtfulness".

Following on the submission of this report to the Chief Government Mining Engineer a Commission of Inquiry was appointed. The chairman of the Commission was a distinguished jurist, Sir Vincent Quénet Q.C., and the members three mining engineers well known in southern African mining circles, Mr Charles Henry Chandler, Dr Miklos Salamon and Mr Albert Vos.

The terms of reference laid down for the Commission were explicit and quite specific. The Commission was required:-

"In the light of the accident which occurred at Wankie No. 2 Colliery on the 6th June, 1972, to inquire into and report on the following matters:-

- a) any question arising out of or connected with the said accident, which, in the opinion of the Commission has not been adequately covered by any other investigation.
- b) The principal systems of coal mining practiced in Rhodesia, with special reference to safety.
- c) The adequacy of the provision of the Mines and Minerals Act (Chap. 203) and the regulations made thereunder concerning safety in coal mines.
- d) Any amendments to the same Act and, additionally or alternatively, regulations as may be considered advisable and necessary in the interests of safety in coal mines.
- e) Whether the supervision of mines exercised by the Ministry of Mines in terms of the said Act and regulations is adequate, and if not, in what respects it should be improved in the interests of safety".

In addition to the action taken/.....

In addition to the action taken by the Government of Rhodesia in appointing a Commission of Inquiry, the Anglo American Corporation of Rhodesia, principal shareholders in the company and technical advisers to it, and the Associated Mineworkers of Rhodesia each secured the services of an expert in the field of mine accidents to carry out independent investigations into the likely cause of the disaster and to advise on precautionary measures to prevent a repetition.

Dr H.L. Willett, OBE, D. Sc., (Eng) Ph D, B. Sc. (Min) C. Eng. F.I. Min. E., M.I.C.E., F.G.S., was retained as adviser to the Corporation and Mr Keith H. Saunders, B. Sc. (Min) M.I. Min. E., C. Eng., served in a similar capacity on behalf of the Union.

The Conduct of the Inquiry

The Commission of Inquiry was sworn in on the 4th September, 1972, and public sittings were commenced on the 6th. The Commission invited the submission of evidence from all interested parties both at the public sessions or in the form of written memorandae which would, should the witness so desire, be treated as confidential.

The Commission was fortunate in that many of the senior executives of the Wankie Colliery Company were men who had been in Wankie for many years and were thus able to trace the history of mining in the area back for a considerable period. For example, Mr Les Price, the Mining Manager, began his service with the company as Assistant Colliery Manager in 1948. Mr T.A.J. Braithwaite was appointed General Manager in 1950 when Powell Duffryn assumed control and remained in that position until September 1970.

From their evidence and from the company's comprehensive written records it was established that Wankie had been worked as a naked light mine until as late as 1960.

Mr Price, when questioned about conditions when he arrived in 1948, said:-

"When I came to Wankie I found they were blasting off the solid with 60% gelignite, and I was told there was no danger of an explosion in Wankie, they had been doing it from 1903 to 1948". He then went on to describe the use of candles, carbide lamps and fuze blasting.

He did say that he had a vague recollection of stone dusting having been carried out at one stage, but had no personal knowledge of it or why it was discontinued.

Mr Braithwaite gave similar evidence concerning naked lights and carbide lamps. He described mining conditions and methods generally as being "indescribably bad". The report of the Commission quotes him as saying that stone dusting was not being practised when he arrived or at any time during his 20 years at Wankie.

The First Recorded Ignition at Wankie

At 09h30 on the 29th December, 1960, there occurred what is described in the Report as "the first recorded ignition at Wankie". Three persons were severely burned as a result of an ignition of methane in No. 4 Section, the Kamandama area of No. 2 Colliery. A match was struck to light a fuze igniter.

The miner in charge described the ignition in these terms:-

"the whole face area was filled with flame. There was no noise. There was a pale blue and reddish flame that moved out from the face".

This description is particularly interesting/.....

This description is particularly interesting because the "second recorded ignition", that which occurred in the HE 3 panel of No. 2 Colliery on the 21st October, 1970, could have been described in identical terms, a "pale blue and reddish flame".

The first recorded ignition" was investigated by Mr R.M. Mooney, then the Inspector of Mines stationed in Wankie. He formed the opinion that the ignition was not the first that occurred.

Mr Braithwaite said of the ignition:-

"This came as a great surprise to everybody. It was at that time a naked light mine, a non-fiery mine It was from this time that we started to take serious precautions in relation to gas and its detection".

The Report, regrettably, is not very informative as to what the "serious precautions" were. No mention is made of requiring flameproof equipment or the banning of naked lights.

The action taken by the Inspector of Mines, Mr Mooney, was to declare certain areas of the mine to be fiery. In a letter dated the 31st December, 1960, Mr Mooney declared sections 2, 4 and 7 of No. 2 Colliery to be fiery areas. He also issued general instructions which applied to all shafts of No. 2 and No. 3 Collieries.

Another letter followed, dated the 17th February, 1961. As a result of the detection of small quantities of firedamp in No. 3 Colliery Section 4 in 67 crosscut South and Section 1 in 49 crosscut South were declared to be fiery areas.

In view of the increasing frequency and wide scatter of the emissions of methane it is difficult to understand why the whole of the underground workings of both collieries were not declared fiery.

It is at about this time, interestingly, that some concern began to manifest itself regarding the dangers of coal dust. The instructions given in Mr Mooney's letter of the 31st December, 1960, were repeated in a letter dated the 16th March, 1962, to the Chief Government Mining Engineer, Salisbury. Mr Mooney said:- "The institution of coal dust suppression methods has been under discussion for some time with the Management. It was recently agreed that a directive in terms of section 46 of the Mining Regulations, 1951, was called for in view of the recent ignition of inflammable gas in No. 2 Colliery".

On the 3rd April, 1961, the Inspector of Mines addressed a further letter to the General Manager of the colliery. It was headed "Coal Dust Suppression Measures : Wankie Collieries". The relevant part reads:-

"In view of the recent ignition of inflammable gas at No. 2 Colliery and the detection of inflammable gas at No. 3 Colliery, the following instructions are given in terms of Section 46 of the Mining Regulation, 1951, in the interests of general safety. This directive replaces the previous instruction which was given on the 16.3.61. Ref:- R/61/13.

- (1) All underground working parts of the Collieries where the conditions are dry shall be kept as clear as practicable of fine coal.
- (2) Before work is stopped/.....

- (2) Before work is stopped in any part of the underground workings all fine coal shall be removed as far as practicable.
- (3) At all points where the spillage of coal occurs the accumulated coal shall be cleared daily and the floor of such places shall be kept damp.
- (4) The floor of any portion of a haulage road that is liable to become dry and dusty shall be wetted sufficiently to keep it damp.
- (5) Sprays shall be fitted to all underground transfer points to keep the amount of airborne dust to a minimum.
- (6) No dust laden air shall be discharged into any airway.
- (7) Under no circumstances shall fine coal be used for tamping shot-holes.

Clearly then, there was a suspicion, at least, that the coal dust was explosible.

It will be made clear, later in this paper, that both Management and the Mines Department had concrete evidence that the coal dust was explosible.

Then, on the 19th February, 1962, methane was found in District 30, No. 3 Colliery and this area was declared to be fiery on the 4th April, 1962. Later, on the 8th August, 1962, the Inspector of Mines laid down the conditions under which the welding or cutting operations could be performed underground.

On the 15th October, 1965, the directives which had declared parts of No. 2 and No. 3 Collieries to be fiery were revoked. The letter explained:-

"In view of the fact that the original districts which were given the designation of "Fiery Sections" can no longer be clearly defined by boundaries, notice of revocation is hereby given

Commenting on this decision the Report of the Commission had this to say:-

"On the face of it, the reason advanced for the revocation would, in our opinion, have supported the conclusion that the whole of both collieries should have been declared fiery".

Some time later an experimental section at No. 3 Colliery was declared to be fiery. The declaration was contained in a letter dated the 18th December, 1965. According to evidence given by Mr Braithwaite the declaration was made at the request of the mine itself rather than at the insistence of the Government Mining Engineer.

The Commission continued to examine witnesses on the question of the failure to use stone dust, and the reasons for such failure. The witnesses were unanimous in saying that coal dust had never been regarded as explosible at Wankie. The use of stone dust had apparently been discussed and rejected. This is made clear by Mr Braithwaite's reply to the question as to whether at this time (December 1965) consideration had been given to the desirability of stonedusting the mine. He is quoted in the Report as saying:-

"I recall conversations with Mr Mooney in this connection and we were in reaching a conclusion influenced first by the steps we were taking at Wankie, and secondly, by practice in similar mining conditions in South Africa, and the conclusion was reached that the coal dust, particularly in the working areas on all main travelling ways, should be controlled by wetting down and not by stonedusting".

Mr Braithwaite was then asked/.....

Mr Braithwaite was then asked whether the decision not to stonedust was based on a belief that the coal dust was not explosible. He replied:- "Yes".

He continued:- "its explosibility was, I think, certainly a matter which had been the subject of some research for some considerable time. Then secondly, I think another factor which influenced us at this time was the sheer size of the excavation and thirdly, the fact that the sections were swept and were watered down".

Later he added:- "I think, to put it correctly, we did not regard it as a serious risk. We regarded dust underground from the health point of view to be a much more serious risk".

The Mining Manager, Mr Les Price, was equally emphatic that coal dust in Wankie was not considered to be explosible:- "We just didn't believe", he stated, "that there was any great danger from coal dust in Wankie".

Although the Inspector of Mines had revoked the directives declaring certain areas of the Collieries to be fiery areas the mine decided to regard No. 2 Colliery as fiery. Codes of Practice were drawn up dealing with the maintenance of flame-proof equipment, the dangers and detection of methane and a third code laid down standard procedures for the operation of mechanised sections. The directions and procedures laid down in these codes were rigidly adhered to by the mine's personnel.

The Second Ignition

An ignition of methane took place in HE 3 panel of No. 2 Colliery on the 21st October, 1970. The Report of the Commission refers to it as "the second ignition", thus inferring that no ignitions had taken place since the ignition in No. 4 section on the 29th December, 1960.

A thorough investigation into the circumstances surrounding the incident was conducted by Mr Price. It was established that methane had been ignited by a blown out shot. The miner admitted that he had not tested for gas and that the auxiliary fan had been switched off for ten minutes before blasting.

The ignition and Mr Price's investigation and subsequent report figured largely both in Mr Bill's inquiry into the disaster and the Report of the Commission, for the reason that Mr Price phrased his report in such a manner as to suggest that he was aware that Wankie's coal dust was explosible.

His report contained the following statement:-

"It is, perhaps, fortunate that HE 3 is kept well watered down and very clean, otherwise an explosion of far greater magnitude could have occurred".

Mr Price went on to make a number of recommendations to prevent a repetition of the incident. His third recommendation read: "Additional watering down crews to be allocated to development sections, and in particular, to HE 3, where the Long Airdox drill creates a dust hazard when drilling the upper holes".

Later in his evidence Mr Price stated that he was "positive" that it was not a coal dust explosion. When examined more closely on this point he agreed that his recommendation regarding more extensive watering down would not affect the presence of methane and that he had in mind the allaying of coal dust. He said as to whether he had the danger of coal dust in mind:- "Yes, if the coal dust had not been watered down it could have propagated an explosion, this I realise".

From its examination/.....

From its examination of all the evidence the Commission reached the conclusion that the various witnesses realised that coal dust could be explosible but that they did not regard coal dust at Wankie as presenting a particularly serious hazard.

Previous Ignitions

The Report of the Commission of Inquiry was finalised and presented to the President on the 22nd March 1973. It was only on the 31st May 1973, almost a year after the disaster, that evidence of ignitions previous to the "first recorded ignition" was discovered on old records.

The ignitions were of coal dust, and methane was not involved.

The General Manager, in a letter dated the 1st April, 1958, addressed to the Consulting Engineer, wrote:-

"The Mines Department have asked that we should arrange for tests to be carried out in order to determine the inflammability of dust derived from Wankie coal.

It is my personal opinion that having regard to the character of the coal, we might well find some rather unexpected results from such a test.

I believe that this request results from the fact there have in the last two or three years been, I think, two "flashes" at the tipplers and on coal feeders which it is thought might have been due to ignition of a heavy concentration of coal dust suspended in air".

In his reply dated the 14th April, 1958, the Consulting Engineer wrote:-

"With regard to the "flashes" at the tipplers etc., will you please give me more details about these occurrences; for example, what were the appearance and duration of the flashes, what injuries, if any, were caused, and what were the possible sources of ignition in each case.

In the meantime, I would suggest that you do not agree to any precautionary measures, such as stonedusting, being imposed on you by the Government Mining Engineer".

To this Mr Braithwaite replied on the 23rd May, 1958 as follows:-

"COAL DUST INFLAMMABILITY TESTS

I have to acknowledge your letter of the 14th April, and I am afraid that the details of one of the "flashes" have got lost in the mists of time. Details of the other "flash" are set out hereunder:-

- (a) Appearance: Dull red flash
- (b) Size: Approximately 2 cu. yards of air space
- (c) Duration: Split second
- (d) Injuries: Nil
- (e) Causes: A cutting torch was being used in one of the underground tipplers when a tub was tipped in the adjacent tippler, liberating a cloud of coal dust which came in contact with the cutting torch and exploded.
- (f) Precautionary measures: Instructions have been issued that no Oxy-Acetylene cutting is to be performed during tipping operations.

The Mines Department/.....

The Mines Department have not suggested that we should adopt any precautionary measures at present, but have merely asked that inflammability tests should be carried out.

I confirm that 4-lb. samples of $\frac{1}{2}$ " Coal from Nos. 1, 2 and 3 Collieries have been packed in tins, and have been crated and despatched to you. The tins are marked on the outside 1, 2, and 3, indicating the Collieries of origin, and a label has also been included inside each tin.

For check purposes, we have carried out Proximate Analyses on the samples, which are as follows:-

PROXIMATE ANALYSES

	<u>Air Dried</u>		
	<u>No. 1</u>	<u>No. 2</u>	<u>No. 3</u>
	%	%	%
Moisture	0,8	0,8	0,7
Ash	12,4	13,9	10,8
Volatile matter	26,8	23,3	29,7
Fixed Carbon	<u>60,0</u>	<u>62,0</u>	<u>58,8</u>
	<u>100,0</u>	<u>100,0</u>	<u>100,0</u> "

There was, apparently, no follow up. The results of any test work, if indeed it was carried out, are not recorded.

There can be little doubt that the "flashes" were explosions of coal dust. The description given by Mr Braithwaite places this conclusion beyond all reasonable doubt.

The Inspector of Mines at Wankie carried out his own test work on coal dust, obviously as a result of the reports of "flashes". The report of the Commissioners states:-

"As long ago as 1958, Mr Davey (then stationed at Wankie) tried unsuccessfully to explode coal dust. "Very crude apparatus", so he said, was used in the experiments he conducted. That circumstance, the "tremendous improvement" in underground conditions and the fact that no gas was detected made him feel "reasonably happy" that coal dust did not present any particular hazard".

There can be little doubt that had the evidence of these letters been placed before the Commission it would not have concluded that Management and the Department of Mines were genuinely unaware that Wankie's coal dust was explosible.

In view of the frequent occurrences of methane, and the clear evidence that Wankie's coal dust was explosible, the failure of the Department of Mines to declare the mines fiery, and of management to introduce stonedusting becomes incomprehensible.

In most other coal mining countries of the world it had by this time been accepted that stonedusting was the most effective defence against coal dust explosions. The use of water had, for the most part, been abandoned in favour of general stonedusting and stone dust barriers.

POSSIBLE CAUSES OF THE EXPLOSION/.....

POSSIBLE CAUSES OF THE EXPLOSIONBlown out Shot in the Matura Main

1. "We think, but it is no more than conjecture, that the explosion originated in the Matura Main as the result of a blown out shot, the flame of which ignited firedamp.

In this regard we have in mind the fact that methane was being encountered in this area with increasing frequency; the fact that the blasting pattern recommended by the Management had led to blown out shots; the fact that on the day of the disaster the miner-in-charge of the section was a man with little coal mining experience at Wankie; the fact that the disaster took place at a time when, in the ordinary way, blasting operations would have been at their peak; and finally, if the course of the return airways is examined it is not difficult to visualize the development of an area of still air along the line of the Matura faces". (The Report, page 17)

Thus the Commissioners summed up their thinking on the probable cause of the disaster. Later (the Report page 61) the Commissioners observed:- "The Management instructed miners to follow a set pattern and sequence of blasting the shot holes in the coal faces. The directive required that certain charges with the heaviest burdens should be amongst the first to be fired. This, in effect, was an open invitation for blown out shots to occur. The directive must be numbered as one of the more likely causes of the disaster".

It is indisputable that a blown out shot in an explosible mixture of methane and air could have resulted in an explosion which could, in turn, have triggered off a coal dust explosion, nor is it the intention of the author to question the validity of this assertion.

It must be admitted, however, that there are a number of equally possible causes. No doubt the Commission recognised this fact and gave consideration to every possibility before reaching the conclusion that a blown out shot in the Matura Main was the most likely cause. It is a pity that the Commissioners did not discuss these other possibilities in their report. It is the author's intention to examine a few of the more likely of the alternatives. However, before doing so, the blasting pattern used at Wankie, on which the Commissioners remarked more than once, calls for comment.

Both instantaneous and delay detonators were used in blasting operations. What made the blasting pattern at Wankie so unusual was the fact that the side holes were fired first, followed by the centre holes. This pattern was laid down in the Company's Code of Practice.

The pattern had not been decided upon by managerial whim. Problems had been encountered with coal fragmentation and Mr Papenfus had been required by management to experiment and devise a pattern which would produce the best possible results. According to Mr Price (in conversation with the author) Mr Papenfus had spent considerable time and expended no little effort on the experiments and had finally decided on the pattern referred to.

The pattern and firing sequence were approved and incorporated in the Mines' Code of Practice, and had been in use for some years prior to the disaster.

It cannot be denied that the sequence of firing laid down by management, and which the miner in the section was compelled to use, at least increased the possibility of blown out shots. However, it is equally true that blown out shots make for inefficient blasting, which leads in turn to increased costs and poor fragmentation. It would seem logical to assume that had blown out shots become a regular feature of blasting operations a different pattern would have been evolved.

Nevertheless, the conclusion/.....

Nevertheless, the conclusion of the Commission that a blown out shot could have been the cause must remain valid.

2. Welding

It is known that at the time of the disaster welding was being carried out at the intersection of G.South and G.East, where a new conveyor structure was being installed. This too, must be regarded as one of the more likely causes of the disaster, particularly as evidence exists that the coal dust was ignitable directly by a welding torch.

3. Collapse of the Panels

Reference has been made earlier in this paper to the "high extraction" panels and to the enormous volumes of methane gas generated during mining operations. Mention was made of the fact that panels HE 2 and HE 3 had been sealed off by 14" brick stoppings instead of by explosion proof stoppings such as had been erected in HE 1.

The method of mining practiced in these areas involved the systematic reduction of pillars to the degree where ultimate pillar failure occurred and large scale collapse of the superincumbent strata resulted. However, for reasons which have already been discussed, such collapse did not always occur and large areas were left standing on pillars which were totally inadequate in the long term.

It is, in the opinion of the author, entirely conceivable that a large scale collapse did in fact occur and that the resulting air blast destroyed, or partially destroyed, the stoppings between the panels and the Railway West Main. This would undoubtedly have released methane into the conveyor road where it would have been ignited by broken electric light bulbs or other agency.

Large scale collapses were not unknown at Wankie. Under the heading of "Unusual occurrences at No. 2 Colliery" Mr Les Bills, the Inspector of Mines, describes such a collapse which occurred in 12 - 1 East panel in February 1968. A full investigation was carried out into this occurrence and a synopsis of the report is reproduced here, together with observations made by Mr Bills:-

SYNOPSIS

"From evidence taken it appeared that four days' warning was given that a general collapse in 12 - 1 East panel was imminent, but that the signs were not recognised as being indicative that pillars were being over-stressed. Pressure bursts in the pillars in the worked out area increased in rate and intensity until on Friday morning the Miner withdrew all personnel to what was considered to be a safe place.

At 8.15 a.m. a general subsidence in 12 - 1 East panel took place and the resultant air blast threw personnel to the ground, causing many minor injuries. A dust cloud, which reduced visibility to less than one foot, was raised by the air blast and this hampered the search to ensure that no person remained in the area.

After a search/.....

After a search by senior officials, the evacuation of the whole mine was ordered.

A thorough investigation into the accepted practices which govern mining activity at Wankie at depths of less than 350' showed that, although these practices had been applied to 12 - 1 East panel, they contained a fundamental error. The correct application of the formula postulated by the United States Bureau of Mines for the design of pillars to 12 - 1 East panel revealed that the accepted Wankie practices were unsound. The error was not shown up by work done in 1967 on the subject of pillar design where the accepted practice was compared with the latest South African practice, adjusted to take into account the greater strength of Wankie coal.

A comparison between the methods recommended by the U.S. Bureau of Mines and the S.A. Chamber of Mines revealed that at mining heights of between 18 and 24 feet, almost identical results were obtained with respect to depth below surface and pillar widths. The South African method accurately predicted the collapse of 12 - 1 East panel.

Factors were considered which might have contributed to the subsidence and it was concluded that the effect of the numerous slip-planes on the strength of the pillars in 12 - 1 East panel was to reduce the strength to that of average South African pillars".

The above synopsis indicates the general picture, but a few extracts from the report are thought necessary to illustrate the magnitude of the occurrence.

"When walking back, about 60' from the miner's box he (the miner) felt a slight breeze on his back which lasted about 10 seconds, indicating that the ventilation had been reversed. As he arrived at the box and took the phone, he felt an air blast which threw him against the sidewall and coal particles peppered his back".

"The force of the air blast threw everybody in the vicinity to the ground and raised a dust cloud which reduced visibility to less than one foot. Small pieces of coal became airborne and most persons were subject to "peppering"."

"In 12 W panel (Marked A on plan LBW 6) the miner was thrown to the ground". This was 250 yards from the collapsed area.

"The Mine Captain and a shift boss who were at the Bisa Exchange area (marked B on plan LBW 6) saw dust being raised into the air current which had been reversed". This was 1 700 yards from the collapsed area.

"At approximately 10.30 a.m. the Colliery Manager telephoned the Mine Manager and a decision was taken to vacate the entire mine".

Eight Europeans and twenty Africans were injured, five Europeans and two Africans insufficiently to cause absence from work. One European and six Africans lost more than fourteen days, i.e. were reportable accidents. No mention was made in the reports concerning the testing for or detection of gas during the whole occurrence. No mention was made of the isolating of electric power from the non-flameproof equipment in areas outside of the designated danger areas into which air from the collapsed area was forced with the accompanying coal dust.

The questions that arise are:-

1. Had the section been completely worked out and sealed off by means of the usual plastered nine inch brick walls would;
 - (a) The panel have filled with a dangerous accumulation of inflammable gas?
 - (b) The strength of the air blast have been sufficient to break through the stoppings?
2. In how many/.....

2. In how many of the worked out sections could a similar collapse have been a possibility?
3. What would have been the result of such a collapse?

(Report by L. Bills, Inspector of Mines to B. Davey, Chief Government Mining Engineer)

Some months after the disaster it was found that a trigonometrical survey beacon, situated on the Maduma-bisa Hill, which overlay HE 3, had subsided. Such a subsidence could only have been due to a collapse of pillars underground, although when this collapse occurred will, unfortunately, never be known. It could be argued that the collapse could have been the result of the explosion rather than the cause of it. However, the fact remains that such a collapse did occur, and it is entirely possible that a sequence of events such as described was set in train.

4. Explosion in the HE Panels

Wankie's coal is extremely liable to spontaneous combustion and the various mines had a long history of underground fires.

This introduces another possibility in the high extraction panels, that spontaneous combustion occurred in the mixed coal and carbonaceous Maduma-bisa shales, thousands of tons of which were left lying in the panels when they were sealed off. These fires could have caused an explosion of methane within the panel, or even more likely, a collapse of pillars followed by a fall of roof could have raised a cloud of coal dust which was directly ignited by flame. Again, this must be regarded as one of the more likely causes of the disaster.

The subsidence of the Maduma-bisa beacon, indicating a collapse of pillars in HE 3, again supports this possibility.

5. Other Possible Causes

There are, of course, a number of other possible causes of an ignition of coal dust, and in considering them it is necessary to bear in mind the fact that the methane need not necessarily have played a part. If one accepts the fact that coal dust explosions took place just prior to 1958 and that these were caused by the direct application of a naked flame to coal dust, then the list of possible agencies of ignition becomes virtually endless. Amongst them, and not in order of likelihood, must be numbered:-

- (a) Diesel fuel fires, either from an accident involving fuel pumps or an accident between vehicles.
- (b) Electrical accidents, such as an explosion in a transformer or in switchgear.
- (c) A fire in accumulated coal dust at the tail end or beneath the return idlers of a conveyor. Dr Willett made the point that because of accumulations of coal dust on both belt and structure, conveyors were the most likely route for chain reaction explosions.
- (d) Sabotage. The author does not regard this a likely cause. It is, however, a possibility.

None of the possibilities can be completely dismissed. It is the author's personal conviction that the explosion was caused by either welding at the G.South/G.East intersection, or by an accident in HE 3 involving either a sudden subsidence or an explosion inside the panel.

The reasoning/.....

The reasoning of the Commissioners in arriving at their conclusion that the most likely cause of the explosion was a blown out shot is not difficult to understand. Most explosions take place at the working face for the reason that the face is where gas most often occurs and agents capable of igniting gas are most frequently found. Although the truth of the Commissioners observations concerning ventilation of the Matura Main cannot be denied, i.e. that, "if the course of the return airways is examined it is not difficult to visualise an area of still air along the line of the Matura faces", it is known that both the Bisa and Kamandama fans had been operating normally and that ventilation in the Matura Main should have been normal. Had either fan tripped, however briefly, that fact would have been recorded.

If it is true that the greatest danger lies at the working face then by the same token it is at the working face that the greatest precautions are taken. Standards underground at Wankie were of the highest order, and the author is satisfied that watering down at the face would have been sufficient to allay coal dust.

In the Report (Page 17) the Commissioners state that one of the reasons that led them to consider the Matura Main as one of the most likely sites for an explosion was the fact that "methane was being encountered in this area with increasing frequency". There were two mentions in the monthly reports of gas in No. 2 Colliery in 1972, one in April and one in May. Both reports stated that gas was detected if auxiliary fans were on stop for more than 15 minutes, a not unusual occurrence in any fiery mine.

On the 24th May 1972 the miners daily report read:-

"Belt road	3%
F. Road	3%
E. Road	3%
Belt road, F, E Roads no fan piping.	
We must get more fan piping in this section".	

Since nothing further was reported up till the day of the disaster one has to assume that the fan ducting was forthcoming and the situation rectified.

While not minimising the danger of gas in however small a quantity, the author submits that two reports within six months hardly justifies the use of the phrase "with increasing frequency".

The author, as has already been stated, is firmly of the opinion that the explosion was caused either by:-

- (a) Welding, since it has been demonstrated fairly convincingly that coal dust explosions had been initiated by this means

OR

- (b) some unusual circumstance such as an air blast or explosion in the high extraction panels.

In support of this contention the author wishes to draw attention to the following facts:-

- (i) Watering down at the face was of a high standard and it is unlikely that there were any significant dust deposits.
- (ii) On the other hand watering down on conveyor roads tended to be neglected. the author speaks from personal observation and from evidence presented by certain witnesses to the Commission.
- (iii) The two recorded ignitions at Wankie, those of 1960 and 1970 were confined to the face. Certainly, in the case of the ignition of 1970, this was probably due to the liberal use of water.
- (iv) The unusual blasting pattern/.....

- (iv) The usual blasting pattern had been in use for several years and there is no evidence to support the view that it resulted in more the usual number of blown out shots.

It is a great pity that circumstances compelled the sealing of the mine. If the epicentre of the explosion could have been established it would probably have removed all conjecture as to the cause.

RECOMMENDATIONS OF THE COMMISSION

The five terms of reference of the Commission required, inter alia, that the Commissioners make recommendations as to steps to be taken to improve safety in coal mines in Rhodesia. In view of the similarity between conditions and methods practiced at Wankie and those in South Africa it is hardly surprising that most of the recommendations made were based upon South African practice and legislation.

With regard to the second term of reference, which required that the Commission "inquire into and report on the principal systems of coal mining practiced in Rhodesia, with special reference to safety", the Commission summarized its conclusions in this way:-

1. The regulations should require at least two separate means of egress from underground workings.
2. Bord and pillar workings should be laid out in a system of panels and the number of entries to a panel through the circumscribing barrier pillar should be restricted to the minimum necessary to mine and ventilate the panel properly.
3. Any workings which are not stonedusted and which are supported by pillars of doubtful strength should be isolated by stoppings capable of withstanding an air blast resulting from a pillar collapse.
4. In the layout of bord and pillar workings pillar dimensions should be designed in accordance with recognised standards to ensure that unintentional collapse of the workings and surface subsidences cannot occur.
5. Any conveyor belt installed in the underground workings of a mine should be constructed of flame retardant material.
6. A full time, properly qualified ventilation officer reporting directly to the General Manager of the Mine should be appointed. This officer should be provided with the facilities for obtaining advice and assistance and his duties should be clearly defined, by regulation.
7. A regulation should be introduced requiring that the siting of a mine fan in relation to the shaft it serves and the construction of the connecting duct should be such as to ensure, so far as is practicable, that the fan is not damaged in the event of an explosion.
8. Regulations, supplemented if necessary by a code of practice, should be introduced to control the use of auxiliary fans.
9. The Management should ensure that persons who are required to make out tests for methane should have the means at their disposal for carrying out this extremely important task with ease.
10. Consideration should be given to the use of mechanical devices for applying stone dust to the roadway surfaces.
11. If safe conditions/.....

11. If safe conditions are to be maintained, roadway dust must be monitored regularly.
12. If welding operations have to be carried out underground they must take place in a properly constructed and ventilated workshop approved in terms of regulations or, where this is not possible, under the direct and constant supervision of a mine overseer.
13. Every underground artisan and every operator of an electrically driven machine should be able to test for methane and should be provided with the means for doing so, and required to report its detection. The regulations should include appropriate provision for this.
14. An examination for methane in the course of the working shift, independent of that carried out by the miner-in-charge, should be made by a shiftboss or other official. A regulation similar to section 8.9.10 of the South African Regulations, Chapter 8, should be introduced.
15. Attention is particularly directed to our observations in regard to opencast working.

The third and fourth terms of reference instructed the Commission to inquire into and report on:-

- (c) the adequacy of the provisions of the Mines and Minerals Act (Chapter 203) and the regulations made thereunder concerning safety in coal mines;
- (d) any amendments to the said Act and, additionally or alternatively, regulations as may be considered advisable and necessary in the interests of safety in coal-mines.

The Commission's recommendations in so far as these terms of reference were concerned read as follows:-

1. We recommend that the regulations relating to coal mines form a separate and distinct part of the Mining Regulations.
2. We recommend that all underground coal mines should be controlled by the same regulations. The existing distinction between fiery and non-fiery mines will then disappear.
3. Subject to the qualifications set out in para. 4.3, supra, we consider that the Codes of Practice which deal with safety techniques, and are so framed as to serve as a practical guide, are of real benefit to the mining industry.
4. We recommend the adoption of the definition "manager" in the South African Mining Regulations, Chapter 1, Definitions (15)(para. 4.4).
5. We recommend certain qualifications in the case of:-
 Mine Manager;
 Officials subordinate to the Mine Manager;
 Miners or persons in charge of coal producing sections;
 Applicants for full blasting licences; and
 Electricians and Artisans employed underground.
6. We recommend that more attention/.....

6. We recommend that more attention be given to the appointment by the Mine of competent Ventilation Officers whose duties should be limited to problems relating to ventilation, underground environment and explosion hazards.
7. We recommend that section 74 of the Mining Regulations, 1961, be repealed and replaced by regulations framed on the lines of sections 8.9.1 to 8.9.10 of the South African Mining Regulations, Chapter 8, (para. 4.5).
8. We recommend that Government in collaboration with the Wankie Colliery Company, Limited, undertake an investigation into the scope of a miner's duties.
9. We do not recommend the establishment of a Central Rescue Station. The fact that the Mine's resources were not equal to the exceptional demands which the events of the 6th June, 1972, made upon them is in no way a reflection on a state of preparedness otherwise wholly commendable.
10. The Mine is to be congratulated on the formation of an Accident Prevention Committee and the useful work it has done over a number of years.
11. Section 84 of the Mining Regulations, 1961, makes adequate provision for guarding against the danger of contraband being taken underground.
12. If the recommendation set out in para. 4.5 supra is implemented there would, in our opinion, be no need for gas testing by officials making an underground visit.
13. We do not recommend the compulsory use of self-rescuers or the adoption of a two-token checking system or the introduction, at this time, of the Garforth-type safety lamp or a system of Workmens' Inspectors.
14. The Ministry of Mines and the Chamber of Mines should be on the look-out for literature (including films) of an educational and instructive character relating to coal mines. When such literature comes to their notice they should immediately notify the Mine Manager, and the Department of Mining Engineering should spare no effort in informing itself of current mining techniques and safety procedures.
15. While we do not think the time is right for the laying down of Airborne Dust Standards, we recommend that a provision similar to section 10.9.4. of the South African Mining Regulations, Chapter 10, be introduced.
16. We recommend the adoption of sections 10.24.1. to 10.24.8. and 10.24.10 and 10.24.11 of the South African Mining Regulations, Chapter 10. These sections make stonedusting compulsory in coal mines. The Commission is divided, however, on the question whether the erection of stonedust barriers should be made compulsory.

It is difficult to take issue with any of the recommendations or observations of the Commission.

The author, however, wishes to place on record his own very strongly held opinion on the subject of second outlets to surface.

The vertical shafts at Wankie/.....

The vertical shafts at Wankie were not equipped with ladderways and thus were not regarded as alternative outlets to surface. In any event the explosion of the 6th June, 1972, would have destroyed the ladderways so that possible survivors could not have escaped by these routes.

If, however, one examines the plan of No. 2 Colliery workings (and for that matter the plans of many another colliery) it is not difficult to imagine an accident, either an explosion or a collapse of overburden, that would have effectively blocked off escape by either the Kamandama or Central inclined shafts, but which would have left the greater portion of the mine unaffected. The only means of egress would then have been either of the Bisa vertical shafts.

Even had these ladderways existed the evacuation of over 400 men, some of them possibly injured, by way of a ladderway 83m in vertical dimension, would be an enormously difficult task, to put it in the mildest possible terms.

It is the author's opinion that for any shaft to be recognised as a second outlet a mechanical means travelling must be provided, so that large numbers of men can be brought to surface in the shortest possible time and with the least possible effort.

On the recommendation concerning the Commission's fifth term of reference, "to inquire into and report on whether the supervision of mines exercised by the Ministry of Mines in terms of the said Act and regulations is adequate, and, if not, in what respects it should be improved in the interests of safety".

- it is not the author's intention to comment.

The tragedy of Wankie resulted in a new awareness throughout Southern Africa of the hitherto neglected dangers of coal dust. Exemptions from stonedusting were withdrawn and all but a few anthracite mines were required to apply stonedust.

Experimental work carried out on South African coal dusts reveal that many of them fall within the explosive range. As at Wankie, the fact that no major disaster had occurred was largely fortuitous.

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