Ancient Metallurgy

In addition to the preceding three papers, the following three contributions were received for publication

1. An analysis of Bantu-made iron implements from the Letaba district

M. KLAPWIJK*

INTRODUCTION

It has often been stated that it is hardly possible in South Africa to classify Bantu-made iron hoes according to their places of origin and manufacture. It is well known that these hoes were used for barter, and as currency in the purchase of livestock or the payment of lobolo, although reports of the value of the hoes differ widely. The difficulty in their classification has arisen from their distribution over a very wide area.

It is felt that insufficient research has been done on this question of distribution and locality of manufacture. It is accepted that one can never pinpoint the exact locality where a certain implement was made, but it would be a step forward if one could narrow down the area and could identify the district.

An approach to this problem from a different angle could well provide a different answer. To test the theory proposed in this paper, namely, that the majority of hoes and axes found in a certain district in the north-eastern Transvaal were made there and not imported from other places, an area in the Letaba district was singled out and 'exhausted' of iron implements. The people living there were offered an inducement for any iron object they could find and wished to part with.

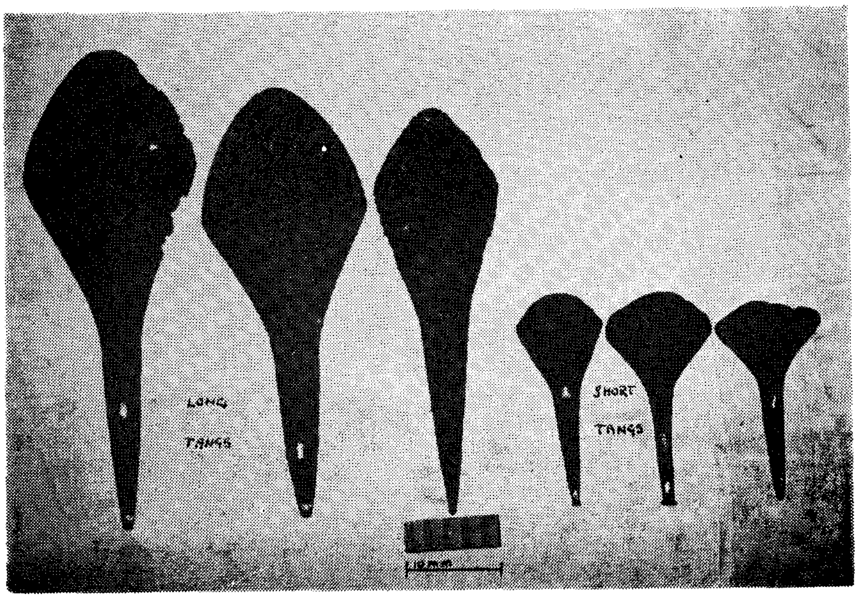
THE MATERIAL

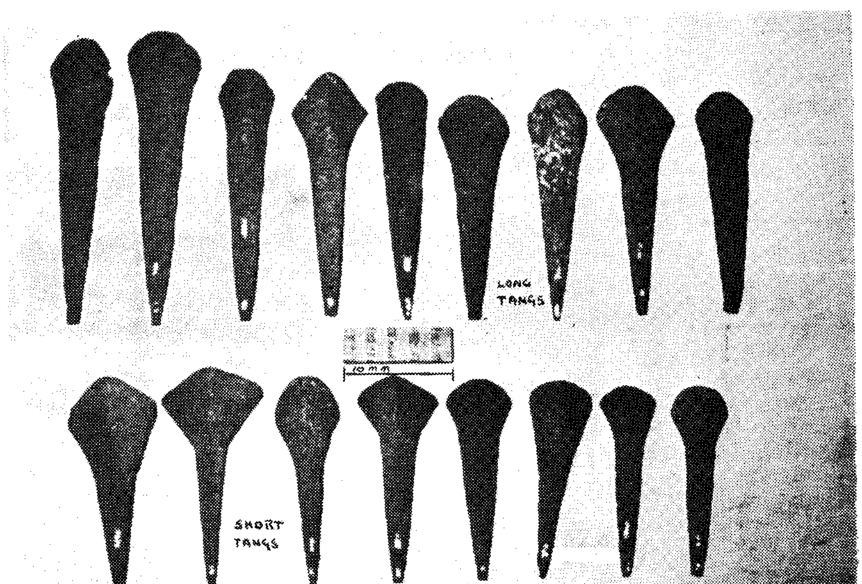
A total of 585 iron implements and weapons were examined and classified as follows:

134 Bantu-made hoes and axes,
390 non-Bantu-made hoes,
24 woodworking implements (adzes and chisels),
16 spearblades,
12 arrowheads, and
9 unidentified iron objects.

Of the 134 Bantu-made implements, 77 were classified as hoes and 57 as axes (Table I). They were further divided into 2 groups:

A group hoes and axes with tangs 140-220 mm in length and 36-55 mm in width, and





*Earthworks Contractor, Tzaneen.

B group hoes and axes with tangs 110-130 mm in length and 25-38 mm in width.

The A group contained 14 unused and 4 slightly used hoes (all diamond shaped), 37 used hoes, and 52 worn-down hoes that had been used as axes, making a total of 107 implements.

The B group contained only 3 used hoes and 24 axes. The original shape of these implements was probably oval.

Of these 134 implements, 79 hoes and axes, or 60 per cent of the total, came from the test area near Mojadji; the other 40 per cent came from the Letaba district within 20 miles east of Tzaneen. There were 37 different sub-types or shapes present, the classification being based on a difference of more than 1 cm in any measurement. The test area had 17 different sub-types, and 4 of these types accounted for 34 implements, or 42 per cent of the total found in the test area.

The measurements of thickness were not always true because some of the implements were badly corroded. Also, some arbitrary measurement of the tangs was unavoidable because the transition from tang to hoe was not always possible to determine.

Two hoes (unused) and one axe were out of character when compared with the rest of the implements. The hoes were oval-shaped with a tang length of 200 mm and a thickness of 18 mm. The axe had a constricted tang of 120 mm and was of the type Professor Mason[1] described as being a local style from the Louis Trichardt district. These three artifacts were accepted as having been imported into the Letaba district.

DISCUSSION

This paper is concerned only with Bantu-made hoes and axes, and only a few remarks concerning the other finds will be made.

Although one can say with certainty that all the 134 artifacts were Bantu-made, one cannot state that all the iron used was also Bantu made. During the eighteenth and nineteenth centuries there was already a large European trade with the coast Bantu, European iron being one of the articles of barter[2, 3].

The soil of the Letaba district is highly acid, and the rate of corrosion of iron is therefore very high. A comparison of the rate of corrosion of the Bantu hoes under discussion with the non-Bantu ones, raises doubts whether any of these Bantu hoes are older than the others. They were probably made not much later than the beginning of the nineteenth century. Before the introduction of non-Bantu hoes, every scrap of iron was re-smelted by the smiths and only those ancient implements buried in the earth would have survived.

In the northern parts of the Transvaal, especially in the Letaba area, numerous slag heaps, tuyères, and traces of furnaces have been found and are still regularly being discovered. Unfortunately, they are

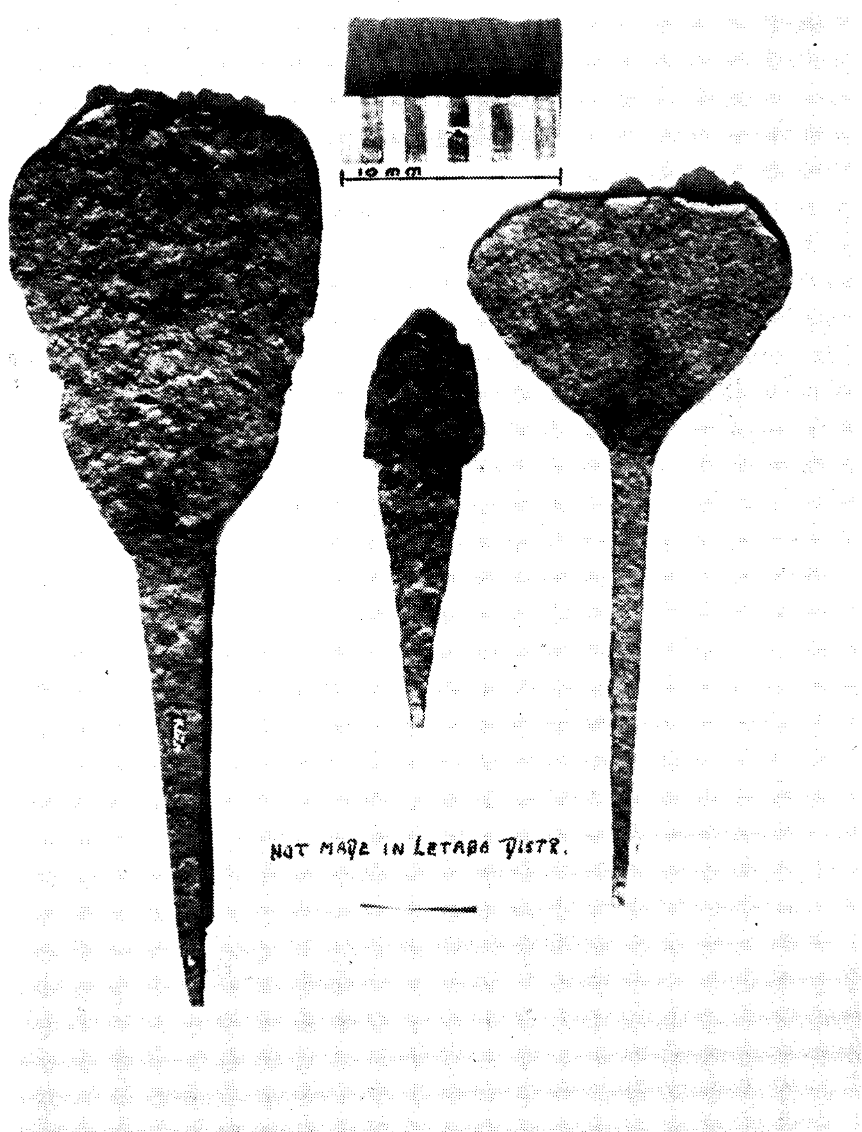


TABLE I

ANALYSIS OF 134 BANTU IRON HOES AND AXES

Marks	No.	Unused hoes	Used hoes	Axes	Group	Total	Weight lb	Overall length mm	Hoe width mm	Tang length mm	Tang width mm	Tang top thickness mm	Tang bottom thickness mm	Shape
K-S	1	1	1	4	A	6	18	530	190	220	47	8	7	DIAM.
K-O	2	2	2		A	4	12	480	180	200	47	9	7	„
K	3	1	3	4	A	8	24	480	170	180	46	9	7	„
KQRTUV	4	2	9	5	A	16	64	450	160	180	51	9	7	„
K	5	1	5	4	A	10	30	420	170	200	50	8	7	„
K	6	1			A	1	3	430	160	200	37	17	8	OVAL
K	7	1	2	1	A	4	12	400	170	160	36	10	8	DIAM.
K	8	1	4	6	A	11	33	390	160	170	41	8	6	„
K	9	¾	3	13	A	17	51	360	160	140	38	12	9	„
K	10	¾	4	3	A	8	24	350	150	140	36	15	9	„
K	11	¾			A	1	3	450	170	200	22	18	7	OVAL
K	12	¾		5	A	6	18	410	150	170	36	14	8	„
TS	13	1			A	1	3	460	150	200	55	8	6	DIAM.
K	14		2	4	B	6	10	280	120	120	29	12	7	OVAL
K	15			1	B	1	2½	300	150	130	36	10	7	„
K	16			4	B	4	10	320	150	130	28/34	9/12	8/9	„
K	17			1	B	1	2½	300	150	100	38	9	7	„
K	18			3	B	3	7½	320	150	130	28	13	8	„
K	19			2	B	2	5	300	140	130	28	9	7	„
K	20			5	B	5	12½	300	110	130	38	10	8	„
K	21		1	2	B	3	7½	320	140	110	25	17	*	„
K	21A			1	B	1	†	†	†	120	40	8	10	‡
TM-A	22	1			A	1	3	450	170	180	51	9	8	DIAM.
TM-B	23	1			A	1	3	450	180	190	51	7	6	„
TM-C	24	1			A	1	3	470	160	230	62	9	11	„
TM-F	25		1		A	1	3	440	160	190	54	9	7	„
TM-G	26			1	A	1	3	†	†	170	38	17	7	„
TM-H	27			1	A	1	3	440	160	180	60	8	7	„
TM-L	28			1	A	1	3	†	†	190	53	10	9	„
TM-M	29			1	A	1	3	†	†	190	52	9	8	„
TM-N	30			1	A	1	3	†	†	200	57	9	7	„
TM-W	31		1		A	1	3	530	190	210	55	9	8	„
TM-X	32			1	A	1	3	†	†	230	57	9	5	„
TM-Z	33			1	B	1	2½	310	140	130	33	14	8	OVAL
TM-Z1	34		1		A	1	3	470	180	210	65	9	5	DIAM.
TM-Z2	35		1		A	1	3	†	†	150	44	12	8	„
TM-Y	36			1	A	1	3	†	†	160	48	9	8	„
		18	40	76		134	396							

*Bottom of tang broken
†Unknown
‡Restricted tang
Nos. 6, 11, and 21A were imported into the district
Diam.: Diamond
Weight calculations are for unused implements (originals)
Nos. 20 and 21 are specially made axes.

also regularly being destroyed by road-making, bush-clearing, dam-building, and even by people who should know better, like the Phalaborwa Town Council, who recently destroyed one of the oldest Iron Age sites in South Africa.

It is reasonable to assume that hundreds of iron makers and smithies were established in this area and were turning out implements and weapons. Not all these individual smiths turned out hoes of the same measurements. The finding of 37 different shapes of hoes and axes within a small area is thus not important. The importance of the test lies in the finding that such a very high percentage of the same type of hoe came from one small area. That 42 per cent of the implements accounted for only 4 out of 17 different shapes points definitely to the probability that these were made in or very near the test area.

Through dam-building and other earth-working operations in the Letaba district, many Bantu hoes had already been discovered before this exercise was started. Several unused hoes were found near old smelting sites, and the pattern of the 'Letaba' hoes was thus already established (control pattern). The remaining 58 per cent of hoes and axes were similar to both the other 42 per cent and the control pattern; they were undoubtedly also made in the area.

Although the Bantu implements used as axes were mostly worn-down hoes with a sharpened edge, there is some evidence in the B group that several implements were specially made as axes and did not start their life as hoes. This evidence is mostly found in the thickness of the tangs and the fact that the generally heavier type of tool always has a short tang.

None of the axes shows any sign of having the tangs re-worked; the midrif or ogee is always in evidence. The B group is also the least corroded, which could be evidence that the short tangs were of a much later date than the long-tanged hoes, and that they were therefore made just before the non-Bantu hoes came onto the market or became freely available.

Reports that Bantu hoes made in Mocambique were of the well-known form of the ace of spades comes from H. A. Junod. Whether these spade-shaped hoes were actually Bantu made is doubtful as the Portugese-made product was already being imported in the eighteenth century. Today one is still able to buy these spade-shaped hoes in Lourenco Marques.

The present-day Bantu cannot differentiate between Bantu-made and other hoes. The iron hoes, mostly non-Bantu, along with beer and goat's blood as the main ingredients, still play a part in their ceremonies of ancestor worship.

The 24 wood-working tools consist mostly of chisels and a few adzes; both types were probably made from well-worn axes and broken-off tangs of Bantu-made and other hoes. Many of the wood-working implements found today are modern, and the mounted adze is still in use.

The 390 non-Bantu-made hoes examined ranged from clumsily and roughly forged to well-made implements. Many of them are definitely ancient. Manufacturers' stamp-marks have been found on 16 of the hoes, making a proper classification easier. It is probable that, among the 390 items, some very early imported hoes will be found. Work on these hoes is not yet complete.

MICROPROBE ANALYSIS

Analysis of the slag residue of Bantu iron by an electron-beam microprobe may provide the means of establishing the composition of the iron used in the manufacture of a certain implement.

Mr J. Stanko, of the National Institute for Metallurgy, has recently done some work in this line of research. A sample from a Bantu-made hoe from the same Letaba area as discussed here has been examined on a microprobe instrument. After detailing the composition of the iron, Mr Stanko reported as follows:

> It thus appears as if the smelter had made his iron without the addition of flux (flux would reduce the softening temperature of the slag), and that the iron ore had only silica as an impurity. The immediate conclusions are that coal was not used as a reducing agent (no sulphur). Phalaborwa or Lydenburg ore was not used (they contain vanadium and titanium and would show up in the slag). In addition the smith was not sophisticated—he did not add limestone (calcium) or bone (calcium plus phosphorus) to his smelting charge. Quite a lot of other points worth noting arise but it would be wise on my part to check some facts before committing myself.

The result of this test is highly significant, and further research along these lines should be encouraged. The next step could be to plot all the known furnace and slag sites, and to have the slag of each site 'microprobed'. If these results are tabulated, it will be an easy matter to correlate the iron composition of a certain implement with this chart and thus pinpoint its origin.

CONCLUSION

Results from the test show that a small area contained a preponderance of a certain type of hoe, which strongly indicates that the Bantu hoes and axes found in the Letaba district are of local manufacture, the exceptions being easily recognizable.

REFERENCES

1. MASON, R. *Prehistory of the Transvaal,* Johannesburg, University of the Witwatersrand Press, 1962. p. 424.
2. JUNOD, H. A. *The life of a South African tribe,* 1927. vol. 1, pp. 453-454; vol. 2, pp. 137-142.
3. TIRION, I. *Tegenwoordige staat van Afrika,* 1763. pp. 617-22.

2. An attempt to smelt iron in a Buispoort type of furnace

M. E. DINGLE*, J. STANKO†, and D. D. HOWAT*

Attempts at tracing African smithies capable of smelting iron in the old way proved unsuccessful, and it seems that the ancient art has died out. It is therefore a challenge to the modern technologist to rediscover the lost art of ironmaking as it was practised in Africa before the advent of the European.

Accordingly, it was decided to make an attempt at smelting iron in a primitive African furnace, the Buispoort furnace now in the Open Air Museum, Pretoria, being taken as the model.

Construction of the Furnace

The furnace was built of a modern refractory that would withstand the high temperatures expected. Like its Buispoort original, the furnace constructed (see Plate I) is slightly oval in shape and measures 90 cm long by 50 cm wide by 80 cm high, tapering to a chimney of 20 by 8 cm. A hole at each end of the furnace permits preparation of the fire and removal of the smelted material. Doors cover these holes, each door itself containing a small hole to admit a tuyère (a clay pipe) through which air can be blown.

Experimental Method

A fire was made on the base of the furnace, and, when it was burning, charcoal was placed on top of the fire and the tuyères were placed in position. The air was then switched on. (Compressed air—and not air from a bellows—was used). When the charcoal was burning satisfactorily, the doors were sealed with fireclay and the furnace was filled, via the chimney, with charcoal. After one hour, which was the time allowed for operating temp-

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erature to be reached, the furnace was filled with charcoal and 500 grams of ore were placed on top of the charcoal level. As this level dropped, more ore and charcoal were charged to the furnace in weighed amounts. After several hours, the charging was stopped, but the air-flow was continued until the level of the bed had dropped to half the furnace height. The air was then switched off and the furnace sealed. The following morning the doors were opened and the contents removed for examination.

Sixteen smelts were made with varying parameters, which included air flowrate, charcoal type and size, and ore type.

Results

High-grade ores such as those used in modern ironmaking practice were found to form pellets, instead of a coherent mass of forgable iron. Very low-grade ores formed large amounts of slag and no iron. The ore giving the best results was one having an iron content of about 55 per cent.

Blasts of more than 200 l/min were necessary to produce the temperatures of over 1100 °C required for reduction.

Plate I—The experimental furnace.

Hard, dense charcoal did not burn well, and temperatures were lower than when a softer charcoal was used.

Smelting times of about 8 hours were insufficient to produce enough iron for the manufacture of a hoe. However, when a high blast rate and an active (soft) charcoal were used, the iron produced would have been sufficient for the making of a small arrowhead and a large nail.

Forging proved difficult initially, and temperatures of about 1200 °C were found to be necessary because of the entrapped slag. However, when the slag was reduced by hammering, forging became easier and could be done at lower temperatures—as low as 800 °C.

The microstructures of the products show that the iron produced in this way has a carbon content of between 0 and 1,2 per cent.

Conclusion

The experiment showed that the smelting of iron in a primitive furnace is not as simple as was at first thought. Much work has still to be done before an account can be given of exactly how the African smith produced iron in the last century.

Ancient metallurgical practices in the Rooiberg area

H. WHITE* and G. ST. J. OXLEY OXLAND*

Very little is really known about ancient smelting techniques at Rooiberg, and most of the papers about the ancients of this area have dealt mainly with the mining methods of fire-setting and chipping with gad and stone hammers. These are referred to in our discussion of ancient mining. Here, we should like to give a brief description of smelting methods and techniques as we envisage them, and of the areas in which the smelting occurred.

To our knowledge, no complete tin-smelting ovens have as yet been unearthed at Rooiberg. The ovens used were probably similar in shape, but smaller, than the iron-smelting ovens found in the western Transvaal. Those dome-shaped ovens were approximately 1½ m in height and 1 m in diameter, with three slots approximately 400 mm in height and 200 mm in width at 120° to each other. Through the tuyères that protruded from these slots, air was blown by means of bellows to give the correct temperature for smelting. Excavations on the farm Vellefontein adjoining Rooiberg revealed a portion of a copper-smelting oven elliptical in shape and much smaller in size than the iron ovens described. The length along the major axis was approximately 450 mm and along the minor axis 300 mm. The height of the oven was about 700 mm.

The bellows used consisted of a long nozzle made from a straightened waterbuck horn secured to a hide bag. The straightening of such a horn can be achieved by boiling it until soft and then tying it to a stick to cool.

Smelterskop, named from the slags and ore found there, and described by Max Bauman[1] as an acropolis overlooking Rooiberg, was not the only smelting site in the area. Excavations 13 km to the south-east and 24 km to the north-west of Smelterskop have revealed large amounts of slag (iron and copper, but not tin), potsherds, and broken tuyères. This leads one to believe that most of the ancient workings were covered over after they had been worked out, as there

*Rooiberg Tin Mine.

are no indications of any mining activities in those areas. Copper and even gold workings, albeit on a small scale, have started up in modern times on the south-eastern boundary of Rooiberg, but, as far as we know, these have not yet been examined for signs of working by the ancients.

The ancient smelters found that, when one adds copper to an even softer metal (tin), one obtains an alloy (bronze) that is harder and more durable than either. This was a marvellous discovery for them. The working of bronze reached its finest expression in China, to which it had probably come from the Middle East, where bronze was discovered about 3800 B.C. The proportion of tin in bronze can vary between about 5 per cent and 20 per cent. The best Chinese bronzes have a tin content of 15 per cent, and at that proportion bronze is almost three times as hard as copper. Whether those ancient smelters of the Middle East had any connection with Rooiberg as a source of tin is a moot point.

Among the artefacts on display at the Symposium were a copper ingot (more than 98 per cent copper) and a brass ingot found at Rooiberg. The source of this copper is not known; it may well have been Messina or Phalaborwa, both some 400 km distant.

That the ancients buried their dead in the Blaauwbank area near Rooiberg has been discovered only fairly recently. Indications of two large burial sites occur on the southern boundary of the farm Blaauwbank, and that this was a burial site became more evident after the unearthing of a Bantu skeleton buried in a customary position with its knees tucked below the chin. Rough dating estimates were given at approximately 500 to 900 years old. This ties in with the information given by Professor Revil Mason[2] that the carbon-dating of a piece of timber from old workings at Rooiberg suggests a date of A.D. 1450. A copper ingot assaying 95,4 per cent copper was found near these diggings on Blaauwbank.

However, dates seem to confuse speculation on the identity of these ancient miners and the period that they lived here. This seems even more so when one considers the discovery of an ancient slave chain in the hills on the southern boundary of the farm Blaauwbank on the Rooiberg Mine property. This was said to have been used by Portuguese or Arabs some 200 to 300 years ago. However, a Professor Frobenius, who visited the mine in 1929, examined several of the ancient workings and considered them to be of pre-Phoenician age, possibly 5000 B.C. In view of the dating referred to above, this was clearly a guess at the antiquity of these workings. Discoveries in various other parts of the Transvaal have since proved that Bantu had indeed done a great deal of iron smelting in ancient times, but nothing older than about 1500 years has been found to date.

It must be said that a great deal of archaeological work is necessary in the Rooiberg area to solve the mystery of the ancient tin miners. This should be a fertile field for some keen archaeologist.

REFERENCES

1. Bauman, M. Ancient tin mines of the Transvaal. *J. Chem. Metall. Min. Soc. S. Afr.*, Feb. 1919.
2. Mason, R. Background to the Transvaal Iron Age—new discoveries at Olifantspoort and Broederstroom. *J. S. Afr. Inst. Min. Metall.*, vol. 74, no. 6. Jan. 1974 (this issue).

O.F.S. Branch, Welkom

Minutes of a Committee Meeting held in the V.I.P. Lounge of the Welkom Club on Tuesday, 26th June, 1973, at 5.00 p.m.

Present

Mr C. J. Isaac (in the Chair), Mr D. A. Smith, Mr G. Young, Mr E. T. Wilson.

Apology

Owing to transfers, Messrs J. M. Meyer, P. L. Nathan, D. Rankin, and R. Sutherland had previously resigned from the Committee.

Minutes of Previous Meeting

The minutes of the Committee Meeting held on 8th November, 1972, were taken as read, and their adoption was proposed by Mr D. A. Smith and seconded by Mr G. Young.

Matters Arising

Final arrangements were made for the visits to surface installations at President Steyn No. 4 Shaft and the Task Force Training at Virginia.

Election of Chairman and Vice-Chairman

Chairman: Mr E. T. Wilson, proposed by Mr D. A. Smith and seconded by Mr G. Young.

Vice-Chairman: Mr D. A. Smith, proposed by Mr G. Young and seconded by Mr C. Isaac.

Members of the Committee Offering Themselves for Re-election

Messrs C. Mostert and G. Young offered themselves for re-election to the Committee for 1973/1974.

Date of the Annual General Meeting

The date of the Annual General Meeting was fixed for Tuesday, 11th September, 1973.

General

Mr Smith mentioned that the readability of the *Journal* was such that mining engineers could not understand it. He asked the Chairman to take this matter up with Council.

The Chairman declared the meeting closed at 5.30 p.m.