The impact of slimes-dam formation on water quality and pollution

by R. T. RUDD*, B.Sc., AMI (S.A.) CE (Visitor)

SYNOPSIS

This paper discusses the mechanics of pollution by slimes dams in the gold- and fluorspar-mining industry, as well as that caused by coal dumps and slurry dams. The effect of coal mining on two typical rivers in Natal is shown and the implications discussed.

The implications and trends of sulphates pollution on the Rand Water Barrage in the Vaal River are discussed.

The spread of pollutants (sulphates and fluorides) from the Reef and elsewhere, and the impact on urban use and agriculture downstream of the barrage, are illustrated.

Conclusions and future policy are outlined.

SAMEVATTING

Hierdie verhandeling bespreek die meganika van besoedeling deur slykdamme in die goud- en vloeispaatmynbedryf asook dié wat deur steenkoolhope en flodderdamme veroorsaak word. Die uitwerking van steenkoolontginning op twee tipiese riviere in Natal word getoon en die implikasies daarvan word bespreek.

Die implikasies en neigings van sulfaatbesoedeling by die Barrage van die Randwaterraad in die Vaalrivier word bespreek.

Die verspreiding van besoedelende stowwe (sulfate en fluoriede) van die Rand en elders en die uitwerking op die stedelike gebruik en landbou onderkant die studam word geïllustreer.

Die gevolgtrekkings en toekomstige beleid word uiteengesit.

It is difficult to assess the impact of slimes dams on pollution and water quality because their effect is masked by other and similar mineral pollution, such as that caused by water being pumped directly from mines, and by industrial wastes. However, there is no doubt that these waste dumps can, and do, have a large, serious, and lasting effect on the quality of the river water in the areas where they have been built.

Thomas[1] has estimated that, on the Reef alone, the mine dumps and slimes dams cover 30 square miles (77,7 km^2). They even show as an important and recognizable feature in satellite photographs taken from 900 km above the surface. However, it must be emphasized that, because of carelessness in siting and maintenance during the first half of the century, factors such as breakaways, flood water, wind, other natural agencies, and human agencies have combined to spread the slimes over a very much greater area.

CAUSES OF POLLUTION

The physical and chemical phenomena that cause mineral material to become a pollutant are well known and will be summarized briefly.

Firstly, the minerals causing the trouble are removed from areas where they have lain covered and protected for aeons and are brought into contact with such agencies as air, water, and sunlight.

Secondly, the physical state of the minerals is changed. The rock mass is reduced from the solid, and sometimes amorphous, mass in which it occurs in nature to a finely ground powder or sand. In this process the specific surface of its constituent minerals is increased very considerably, and a mass that may have been comparatively inert becomes comparatively reactive.

These two factors—*exposure* and *crushing* (or grinding)—can be aided by others such as the spreading of finely ground material, or even its transportation, to areas possessing different geological and therefore chemical characteristics.

Undoubtedly the two minerals that have or could have had the largest impact on water pollution in South Africa are pyrite (FeS_2) and fluorspar (CaF_2).

Pyrite in its exposed and finely divided state is acted on by oxygen and bacteria. It is oxidized to form sulphuric acid and iron hydroxide, and is further converted to iron oxide, while the sulphuric acid reacts to form sulphates, which are all soluble to a greater or lesser degree and pollute water in which they are dissolved.

Fluorspar occurs in its natural state, usually in conjunction with dolomite, as a massive ore. Boreholes in areas where fluorspar occurs show concentrations of fluorine of from 0,8 mg/l up to about 8 mg/l. The maximum considered safe in drinking water is 1,5 mg/l. The solubility of fluorspar is generally taken to be about 15 mg/l, i.e., it is relatively insoluble.

However, in water that has been in contact with fluorspar slimes, concentrations in excess of 30 p.p.m. have been reported. This is an indication that the specific surface has been increased so much by grinding of the ore that a supersaturated solution has resulted. The introduction of such a solution into a stream can have disastrous consequences.

The pyrite problem is usually associated with the mining of coal and gold, while fluorspar occurs by itself and in conjunction with phosphatic ores mined for processing into fertilizer, as well as in smaller quantities in some coal and iron ores.

The effect of slimes dams and mining in general is most pronounced in the more humid and densely populated areas such as the Witwatersrand, where the effect of the pollutants leached into the streams is immediately felt by many people and where relatively high rates of run-off are available to do the work of leaching.

This could also be the case with fluorine. However, fluorspar generally occurs in dolomitic areas, and the

*Department of Water Affairs.

danger here is much more serious and insidious in that, in areas such as the Western Transvaal (Zeerust, Marico), the poisoning of *underground* water by fluorine could render the area uninhabitable since the dolomitic water is practically the only usable source of supply. It is perhaps fortunate that this area is being exploited only now, and that experience gained from the Witwatersrand, together with mining know-how in regard to the siting and design of really effective slimes dams, is available to enable the danger of pollution of the priceless underground supplies to be largely eliminated.

It can be mentioned that the techniques used are based on, firstly, siting of the slimes dams on ground that has been thoroughly investigated geologically and is known to be impervious, stable, and free from geological faults, fractures, and intrusions, and away from the dolomite; secondly, on the use of special milling and sorting techniques to provide slimes of the correct permeability for the inner lining of the dam, and of the correct permeability and stability for the outer structural portion; thirdly, on the design of the correct shape and slopes to the dams *ab initio* so that flora are easily established, if possible while the dam is still in use, on the sides of the dam; and, finally, the provision, also *ab initio*, of the necessary safeguards and controls to check the movement of pollutants, if any, in the substrata, and to prevent any breakaway or outward spread of slimes from the structure. The above is an expensive exercise but is considered absolutely essential in view of the issues at stake. Fig. 1 shows the area involved.

Though they cannot be classed as slimes dams, coal dumps cause sulphate pollution in the same way as do gold slimes. It is therefore interesting to examine the quality of surface water in the coal-mining areas as regards sulphates, total dissolved solids (T.D.S.), and pH.

Fig. 2 shows the position of some monitoring points on the Buffalo River in Natal in relation to some adjacent collieries. Spot samples taken from four of these points at about the same time were analysed for pH, T.D.S., and sulphates, and the results are shown in Table I.

A study of these figures immediately shows two facts: firstly, that the mines have caused a dramatic increase in both T.D.S. and sulphates content and, secondly, that this pollution is fairly quickly reduced by the diluting effects of the tributaries downstream of the mining areas. It is perhaps fortunate for the province of Natal that its rivers are relatively short and carry

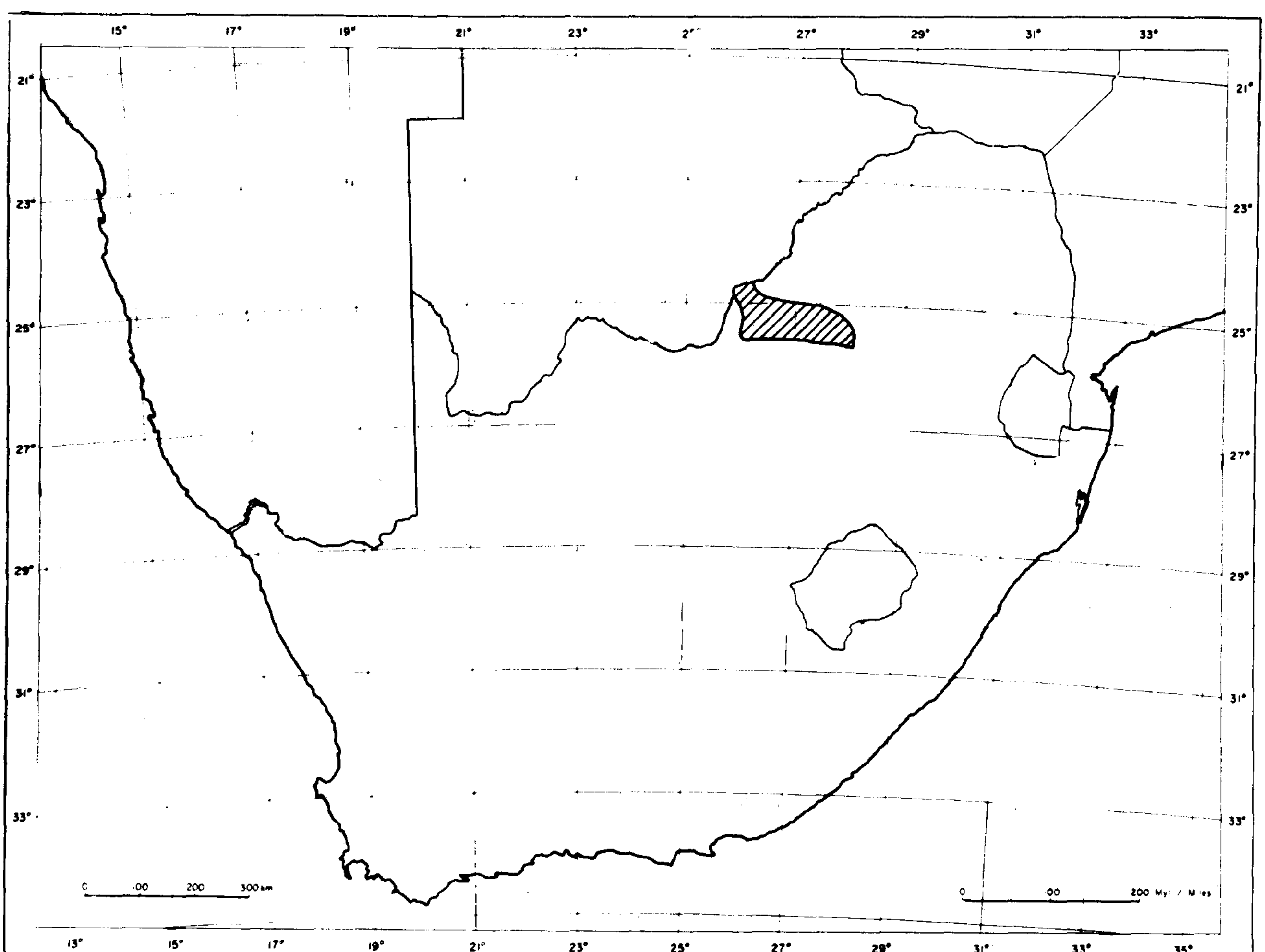

Fig. 1—Area that could be affected by fluorspar mining in the Western Transvaal

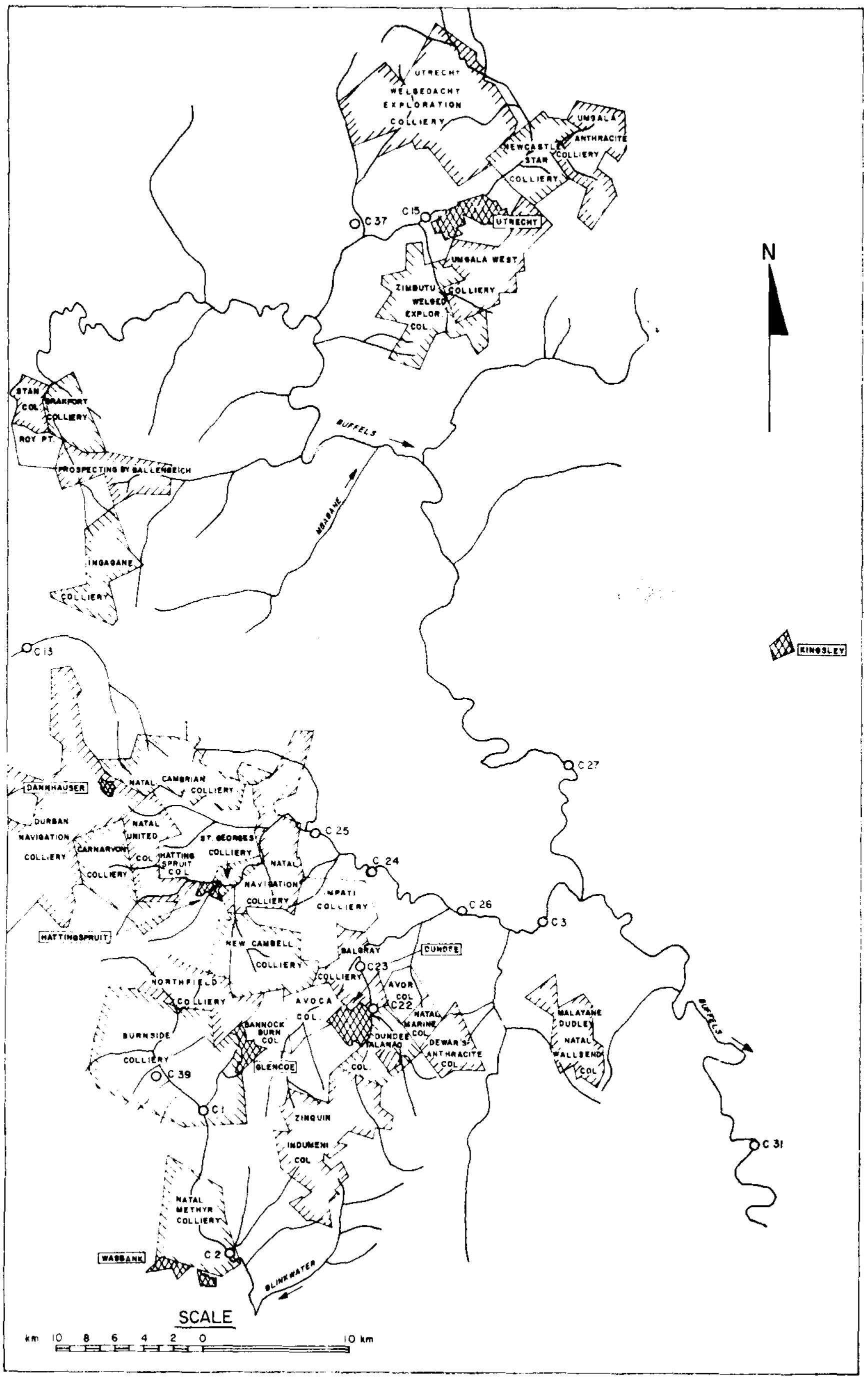

Fig. 2—Coal mines on the Buffalo River

TABLE I

THE QUALITY OF SURFACE WATER IN THE BUFFALO RIVER COAL-MINING AREA

Date	pH	T.D.S. p.p.m.	SO_4 p.p.m.
D29 Buffalo River above the collieries			
5/72	8,4	170	12
8/72	7,1	175	6
1/73	7,9	135	7
5/73	8,0	80	6
C3 Sandspruit just before its confluence with the Buffalo			
3/72	8,0	495	225
8/72	8,7	510	410
1/73	7,0	230	72
5/73	9,0	305	100
C27 Buffalo River just upstream of its confluence with the Sandspruit			
5/72	8,2	150	52
8/72	8,3	280	84
1/73	8,0	220	38
5/73	7,8	105	24
C31 Buffalo River downstream of its confluence with Blood River			
6/72	6,5	200	34
8/72	7,8	230	47
1/73	6,5	185	20
5/73	8,2	115	21

a strong flow; nevertheless, this polluted water enters the Tugela, which is the most important river in Natal and a source that is only now beginning to be used on any scale.

The picture on the M'kuzi is similar as Table II shows. Figure 3 shows the sampling points relative to the collieries. Here the diluting effect of the tributaries downstream is also evident.

Turvey[2], in a report to the Secretary for Water Affairs in 1961, found that the M'kuzi was polluted by the following:

(1) surplus underground water (acid water that was neutralized),
(2) run-off from coal washing,
(3) run-off from dumps,
(4) effluents from secondary activities such as coking, and
(5) storm run-off from the mining areas.

He pointed out that the effects of the storm run-off were rapidly minimized by dilution and the self-purification effect in the river, but that it was nevertheless necessary to take active steps to contain and minimize the pollution in the mine areas.

He found a sulphate concentration of 315 p.p.m. at point C5, which had been reduced to 63 p.p.m. at point C32. On the face of things, the figures given in Table II would indicate that the position has worsened since 1961 and that more stringent remedial measures may be necessary.

The Buffalo and M'kuzi Rivers can be regarded as fairly typical of conditions on the coal mines in Natal, and show quite clearly that, though the pollution is fortunately largely confined to the mining areas and its extent is not wide, there is nevertheless no call for complacency, and stricter remedial measures are in fact needed.

THE RAND WATER BOARD BARRAGE

The operation of the Rand Water Board Barrage is shown diagrammatically in Fig. 4[3]. From the diagram it is obvious that the dissolved solids in barrage water at any time will be affected by a large number of variables such as releases from Vaaldam, inflows from

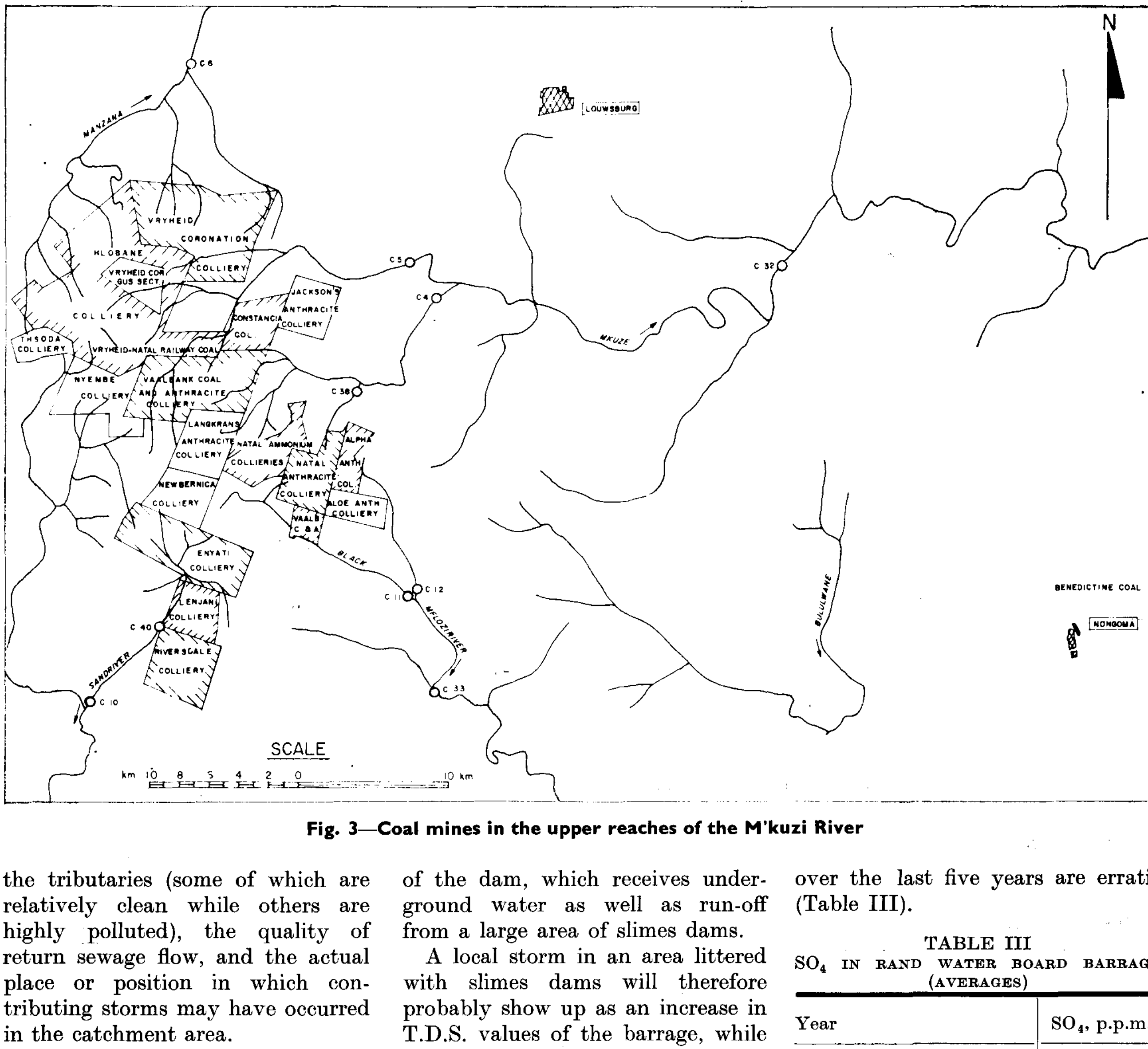

Fig. 3—Coal mines in the upper reaches of the M'kuzi River

the tributaries (some of which are relatively clean while others are highly polluted), the quality of return sewage flow, and the actual place or position in which contributing storms may have occurred in the catchment area.

Work by Verster on the Elsburg Dam[4] indicates 'that the results for sulphate content are surprisingly constant over long dry periods as well as over periods of heavy rainfall'. This refers to daily sampling of the dam, which receives underground water as well as run-off from a large area of slimes dams.

A local storm in an area littered with slimes dams will therefore probably show up as an increase in T.D.S. values of the barrage, while a storm in the upper reaches of the Suikerboschrand will have a corresponding diluting effect. It is therefore not surprising that average figures for sulphates in the barrage taken by the Rand Water Board over the last five years are erratic (Table III).

TABLE II
THE QUALITY OF SURFACE WATER IN UPPER M'KUZI AREA

Date	pH	T.D.S. p.p.m.	Sulphates p.p.m.
Point C4 M'kuzi to east from Vryheid on the Louwsburg Road			
5/72	8,1	265	128
6/72	6,4	325	154
8/72	8,4	315	122
1/73	6,7	230	156
Point C5 Nkongolwana River upstream of confluence with M'kuzi			
5/72	7,8	930	620
6/72	6,2	880	540
8/72	8,0	885	200
1/73	5,0	705	410
Point C32 M'kuzi River downstream of confluence			
6/72	6,6	330	120
8/72	7,8	300	134
1/73	7,2	220	102

TABLE III
SO_4 IN RAND WATER BOARD BARRAGE (AVERAGES)

Year	SO_4, p.p.m.
1967	95
1968	96
1969	121
1970	74
1971	170
1972	132

It must also be remembered that the figures taken by the Board are spot samples taken monthly, and other mechanisms may at times be operative and give a false picture. For instance, a sample taken during the initial stages of a flood may show the quality of semi-stagnant water leaving the barrage to accommodate the real flood water behind it.

The maxima for the same period are illuminating (Table IV).

Three of the five figures agree within 2½ per cent, but once more there is

TABLE IV

SO_4 IN RAND WATER BOARD BARRAGE (MAXIMA)

Year	SO_4, p.p.m.	Month
1967	172	August
1968	218	May
1969	215	July
1970	137	February
1971	220	July

TABLE V

AVERAGE SO_4 (IN p.p.m.) FOR STATIONS 9, 11, AND 12 ON THE KLIP RIVER (Fig. 5)

Year	Station on Klip River		
	9	11	12
1967	284	783	471
1968	235	807	409
1969	200	707	387
1970	189	778	375
1971	185	633	361

TABLE VI

AVERAGE SO_4 (IN p.p.m.) IN EAST RAND STREAMS

Year	Blesbokspruit	Suikerbos Weir
1967	481	198
1968	575	454
1969	663	361
1970	611	516
1971	444	218

apparently no detectable trend.

In view of the masking effect of releases from Vaaldam and flows from the tributaries, it is interesting to study the trends in those tributaries that are known to be heavily polluted. Table V gives averages of Rand Water Board figures for stations 9, 11, and 12 on the Klip River.

These three stations represent heavily polluted water arising on the west and central Witwatersrand. Station 12 represents the combined flow of 9 and 11, plus the accretions reaching the Klip in the reach between.

The very obvious downward trend in Station 9 is most reassuring and is thought to be due to the following four factors:

(1) decreased pumping from the mines,
(2) reclamation work being carried out in the area on slimes dams,
(3) decrease in pollution by industry, and
(4) slow neutralization by repeated leaching of the effect of slimes strewn and spread out over the whole area.

It is suggested that, where slimes are spread in thin layers, oxidizing of the pyrites will be rapid owing to the increased surface exposure, but removal of acid and sulphates will also be fairly rapid and will result in a slow tailing off of pollution from this source.

Average SO_4 figures for the streams emanating from the East Rand do not yet show a definite trend (Table VI).

If account is taken of the fact that high flows occurred in the Suikerboschrand River in 1967 and that 1970 was a very dry year, it appears that the sulphate content may be diminishing, but such deductions are by no means conclusive at this stage.

However, it is thought that, because of the factors already mentioned (i.e., decrease in pumping by the mines, reclamation work carried out on slimes dams and dumps, leaching of the sulphates still formed in slimes spread all over the Witwatersrand, and tighter control of industrial wastes reaching the sewers and rivers), the sulphates content of the waters in the tributaries below Vaaldam are likely to reach a peak and then decrease as has happened in the Natalspruit.

It is difficult to predict what will happen once closed mines fill up with water and start discharging the excess water once more in the form of springs, but it is thought that the position in the Vaal will stabilize at a sulphates content much lower than those found today. It is possible that earth movement will slowly close the areas opened by mining, and that ground-water movement is likely to be restricted to the upper area with little or no movement at any depth in the old workings.

The impact of the pollution of the Vaal River by sulphates from slimes dams and mines is indeed a serious one as the following, and reference to Fig. 6, will show.

The Vaal supplies the following with water for household purposes and industry:

- Parys and the Klerksdorp-Stilfontein-Orkney complex, where there is also gold mining and the danger of sulphate pollution
- Bothaville and the Free State Goldfields, including Odendaalsrus, Welkom, and Virginia
- Bloemhof via Bloemhof Dam (about which something more will be said later)
- Christiana
- The Vaal Hartz towns of Fourteen Streams, Warrenton, Jan Kempdorp, Hartswater, and Taungs
- The bustling dairy and cattle centre of Vryburg (water bled off the tail end of Vaal Hartz)
- Windsorton, Kimberley, Barkly West, Delportshoop, and Douglas
- Mining areas and towns around Postmasburg and Sishen (by pipeline).

Water is used for the irrigation of:

- some 4000 ha of land between Vaaldam and Fourteen Streams,
- some 36 800 ha of land on the Vaal Hartz Scheme,
- some 10 200 ha of land on the lower Vaal between Fourteen Streams and Douglas, and
- some 1700 ha of land on the lower Hartz.

It is therefore obvious that the lives and livelihood of people in an enormous tract of country outside the Witwatersrand are vitally and directly affected by the formation of slimes dams and mining activities, not only in the Witwatersrand, but in the O.F.S. Goldfields and at Stilfontein, Orkney, and Klerksdorp. It follows that the quality of water leaving the Vaal Barrage is of very great importance, and it is for this reason that the temptation to supply the Pretoria-Witwatersrand-Vereeniging complex with pure water from Vaaldam should be resisted until there is a significant improvement in the quality of the water in tributaries feeding the Barrage.

Another look at the map (Fig. 6) indicates additional complications. Run-off of polluted water from slimes dams in the O.F.S. Goldfields area could reach the Vaal via the Sand and Vet Rivers. Run-off from dams in the Klerksdorp area would go directly into the Vaal. Polluted water from these areas mixed with the Barrage discharge and accretions to the Vaal will now end up in the Bloemhof Dam.

Evaporation in Bloemhof Dam is a variable, but the percentage loss obviously increases with the run off, i.e., the volume stored and therefore the surface area. The few figures available (Table VII) do indicate that this is the trend.

The fuller the dam, the longer will water be held, and the greater will be the evaporation loss and the resultant increase in concentration of salts in the dam. This concentration will obviously depend on the origin of the water that fills the dam, and, if much of it arises in the Witwatersrand area, concentrations are likely to be higher than if it came from elsewhere, e.g., the catchment of the Sand or Vet River.

Unfortunately, the dam has been operating for the latter part of a rather dry cycle, and, except for 1971 when it was filled to over 60 per cent of its capacity, the monthly throughput of water has exceeded its contents in volume, and water has not really been stored but has merely flowed through. The figures

TABLE VII

EVAPORATION FROM BLOEMHOF DAM

Year (October to September)	Inflow ($m^3 \times 10^6$)	% Evap. loss
1968-69	623,9	2,68
1969-70	711,6	4,1
1970-71	813,8	12,0
1971-72	1228,2	13,5

TABLE VIII

BLOEMHOF DAM (ALL FIGURES IN $m^3 \times 10^6$)

Month	Water in dam	Inflow	Release	Evaporation
September	16,58	73,83	69,01	1,40
October	20,01	82,24	76,40	2,08

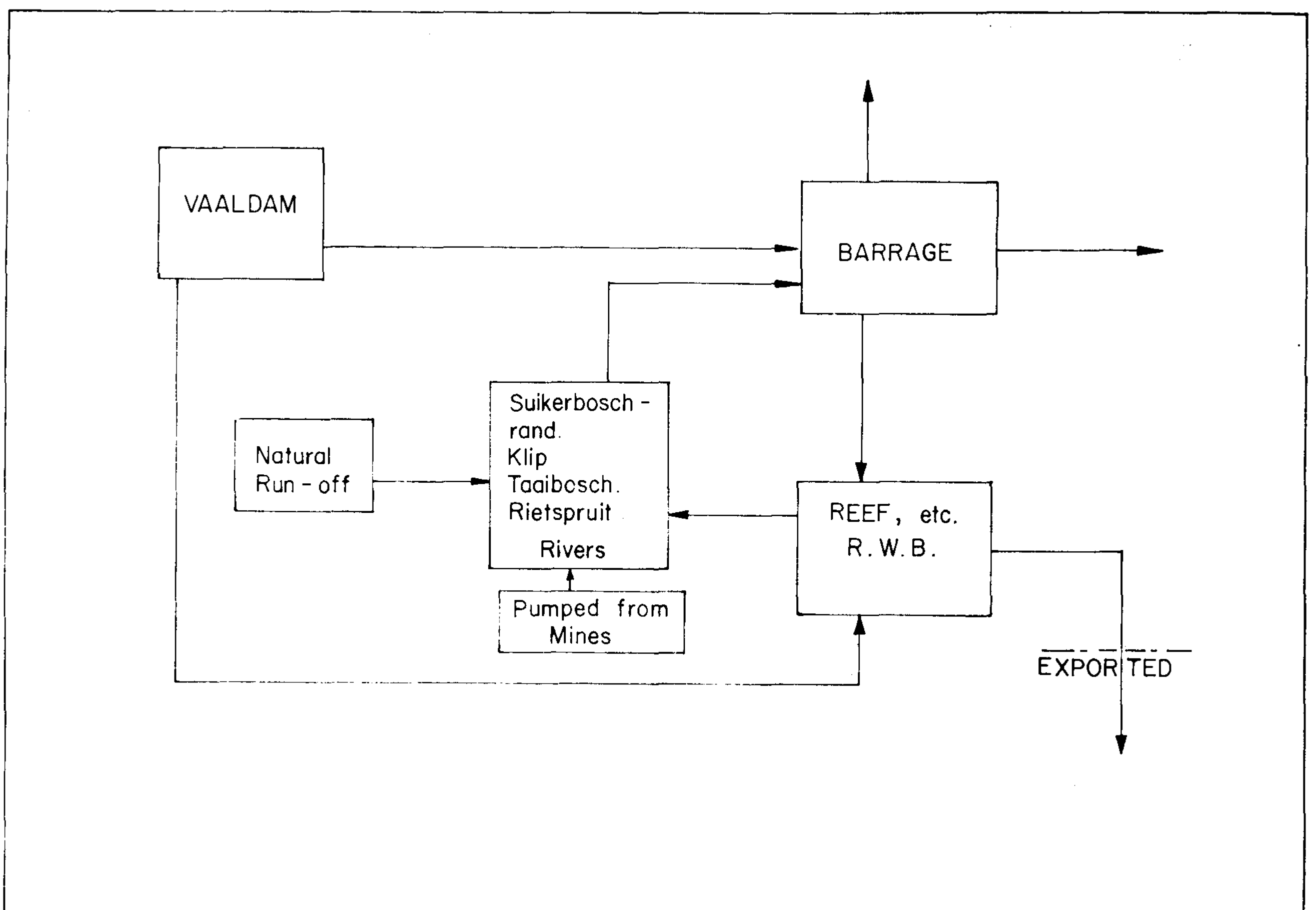

Fig. 4—Basic flow diagram for the Rand Water Board Barrage

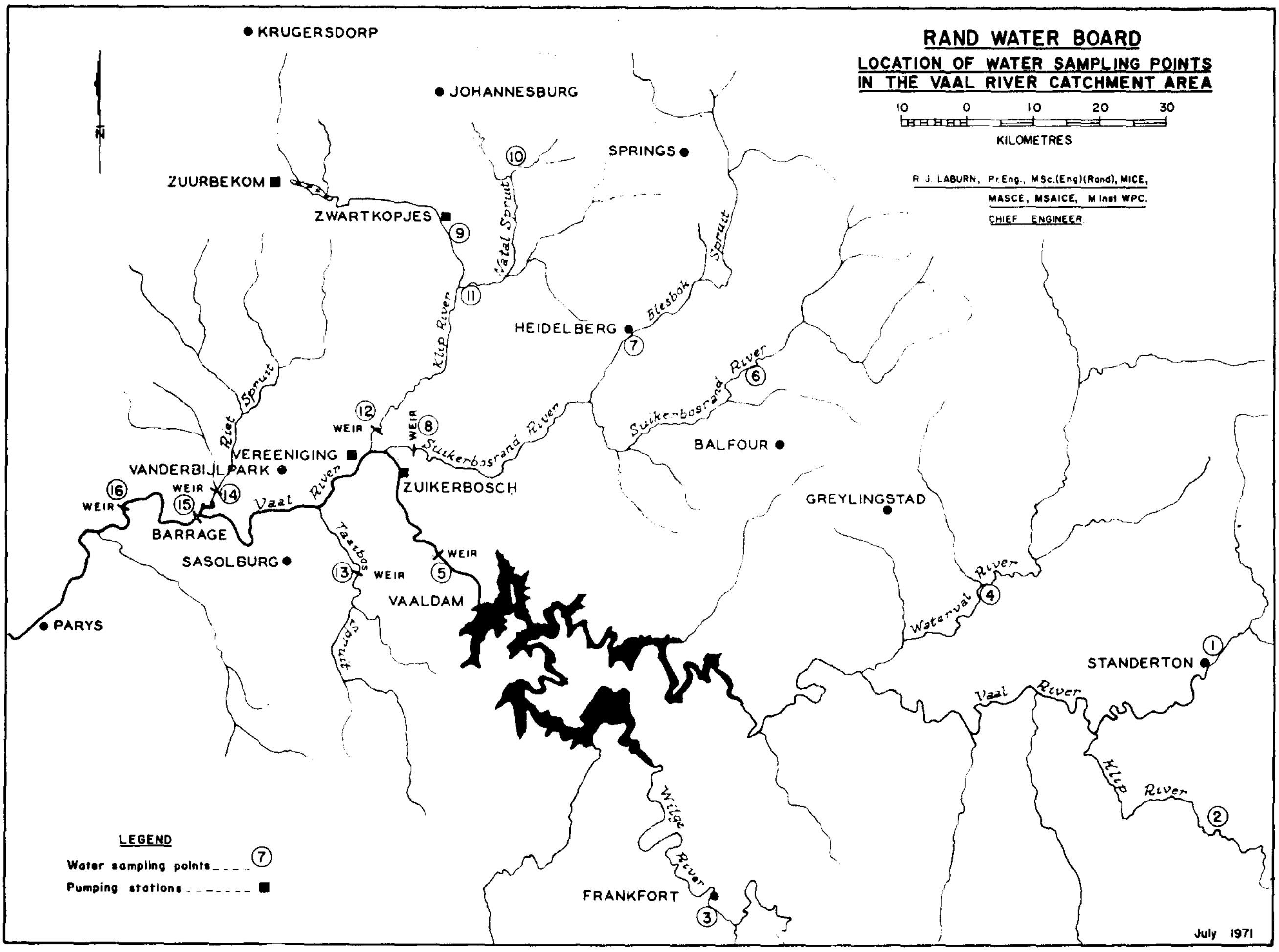

Fig. 5—Reproduced by kind permission of the Rand Water Board

for September and October 1970 (Table VIII) illustrate what is meant.

The year 1971, which has shown the highest evaporation rate, also shows a fairly normal inflow pattern with high flows in summer, the best flows in March, and low flows in the dry months. Available figures indicate that, at present, pollution from the O.F.S. Goldfields is minimal.

The Hartz, which is a tributary of the Vaal entering the Vaal at Delportshoop, has been mentioned as being affected, and the reasons for this are not immediately obvious. The mechanism involved is as follows.

Before the construction and settlement of the Vaal Hartz Scheme, the Hartz was a river with erratic and intermittent flow. However, soon after the first farmers were settled on Vaal Hartz in 1937, the seepage and wastage found its way to the Hartz. Injudicious irrigation of certain areas in the early days of Vaal Hartz caused waterlogging, and subsequent drainage of these areas increased the flow to the Hartz. Farmers along the Hartz started using this water, and at present some 1700 ha is being irrigated. The remarkable constancy of the flow in this river today is indicated by Table IX, which shows flows that were equalled or exceeded for 70 per cent of the time in the period 1948 to 1969.

TABLE IX

FLOWS IN THE HARTZ RIVER IN 1948-1969

Month	Flow, m^3/s
October	1,13
November	1,13
December	1,07
January	1,16
February	1,56
March	1,07
April	1,16
May	1,16
June	1,39
July	1,07
August	1,25
September	1,25

The effect of mining and slimesdam formation on the quality of this water is dramatically indicated by the sulphate and fluoride content of this water, as shown by Table X. Where more than one figure is available for a month, averages are shown.

These figures clearly show the diluting effects of floods in the Hartz River basin, and indicate that the sulphates and fluorides are in fact coming from water that has its origin in the Vaal River, i.e., the steady flow of the Hartz, which is caused by seepage and drainage from the Vaal Hartz Scheme.

The sulphate content of the Vaal River at Douglas indicates that, even though there is a fair amount of dilution in the 500 odd kilometres of Vaal River between the Vaaldam and Douglas, SO_4 concentrations of as much as 120 mg/l are reached fairly frequently.

It is disturbing to note, too, that

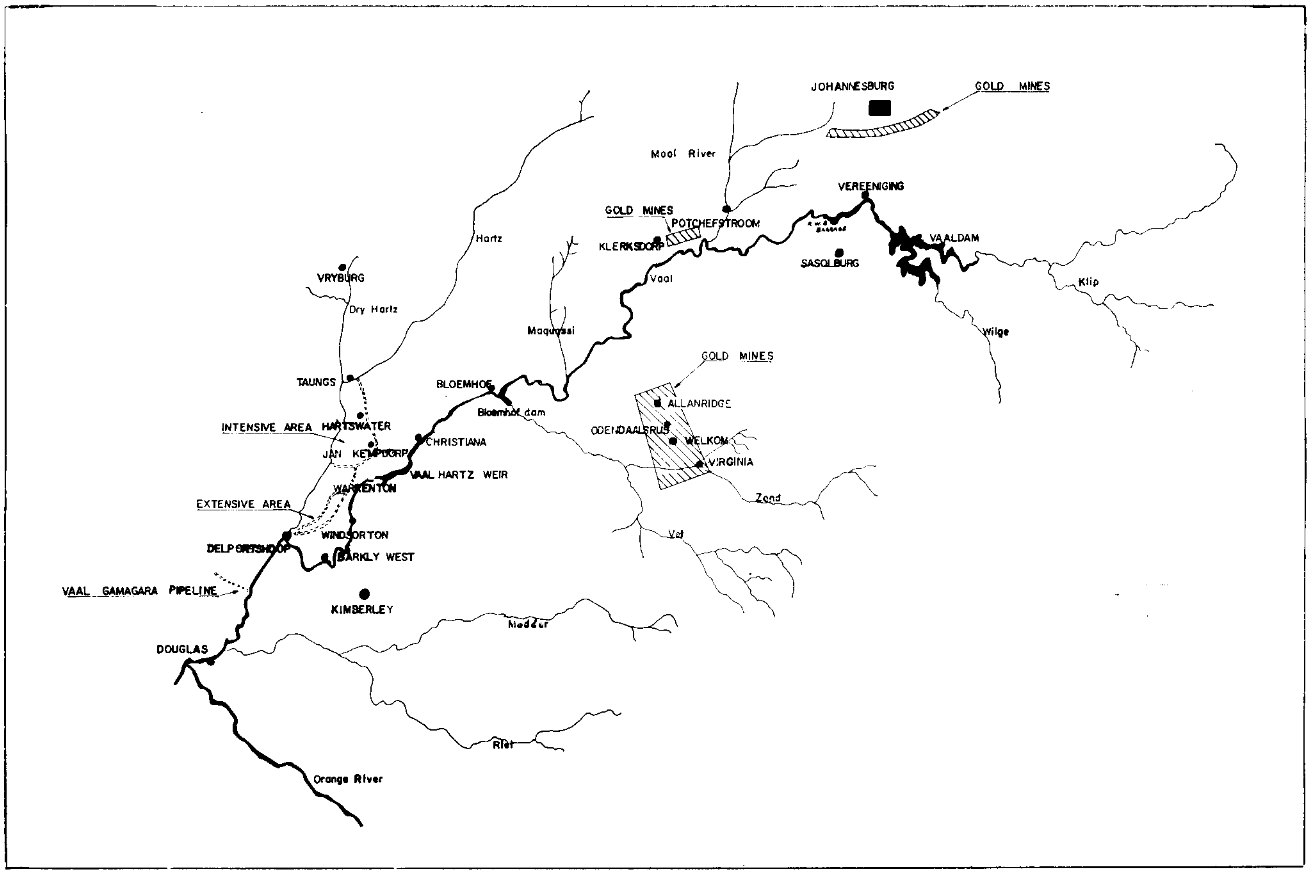

Fig. 6—Map of the Vaal from Vaaldam to Douglas, showing its main tributaries, the sites of important mines, and the main abstraction points and distribution of water

fluoride concentrations of 0,6 p.p.m. have been reported in this area.

Fluorides emanate mainly from the following sources:

(1) rock phosphate brought into areas such as Sasolburg for processing and the production of fertilizer,
(2) fluorspar in beneficiated form used as a flux in the steel industry,
(3) ash dumps arising from the burning of coal-containing fluorides, and
(4) coal-containing fluorides for the production of oil.

Concentrations of this chemical in excess of 1,5 p.p.m. are considered to be deleterious to health, while the allowable concentration according to the General Standard published in *Government Gazette* no. R553 of 1962 is 1,0 p.p.m.

Average concentrations in the Allemanskraal Dam of about 0,4 p.p.m. have been reported, while values in Erfenis Dam on the Vet are remarkably constant at about 0,35 p.p.m.

Analyses at Schweizer-Reneke on the upper Hartz show values of 0,10 to 0,14 p.p.m.

The fact that concentrations as high as 0,8 p.p.m. have been reported in the upper Vaal and 0,6 p.p.m. at Douglas leaves no room for complacency, and means that the situation in the Pretoria-Witwatersrand-Vereeniging complex requires careful watching.

TABLE X

QUALITY OF HARTZ RIVER WATER

Month	SO_4 mg/l	F p.p.m.	Flow
8/71	154 (average)	0,46	Low
9/71	179 (average)	0,49 (average)	Low
10/71	178 (average)	0,4 (average)	Low
11/71	122 (average)	0,4 (average)	Low
12/71	27 (average)	0,22 (average)	1st floods
1/72	35 (average)	0,15 (average)	Small floods
2/72	30 (spot)	0,15 (spot)	Flood receding
3/72	37 (average)	0,12 (average)	Flood receding
4/72	13,2 (spot)	0,06 (spot)	River in flood
6/72	117 (spot)	0,37 (spot)	Low

CONCLUSION

From the above it is evident that the formation of slimes dams and mining activities have an enormous impact on the quality of our inland waters and pollution.

Mining activity at Phalaborwa, through processing of the mined materials at Sasolburg, affects the fluorides content of the Vaal.

Slimes-dam formation without the necessary precautionary measures to prevent or contain pollution is affecting the lives of farmers and city dwellers in an enormous area stretching from Vaaldam to Douglas, is having a secondary effect on the quality of the Hartz River, and is affecting the operating costs of the Rand Water Board. Conditions, however, do appear to be showing improvement in some respects.

Coal mining in Natal is adversely affecting the quality of the rivers. The pollution at present is masked by dilution and self purification, but appears to be getting worse. Areas such as the St. Lucia Lake could be affected by mining in the Vryheid area. Stricter control is necessary in this area.

The opening of fluorspar mines with beneficiation plants in the Marico-Zeerust area is being watched so carefully that the pollution of the valuable underground resources of this area, on which it is dependent for its very livelihood, is thought to be unlikely. This is having a stimulating effect on the design and siting of slimes dams, as well as on the more intensive study of the geology of the area, which is necessary for proper siting of the dams and ensuring that they will not cause pollution.

Slimes dams therefore have an enormous impact on large tracts of country both within and outside the mining areas where they are built.

ACKNOWLEDGEMENT

The figures for the sulphate content of the Lower Vaal, Sand, Vet, and Hartz Rivers were taken from the records of the Division of Hydrology, Department of Water Affairs.

REFERENCES

1. THOMAS, B. A. The effect of the mining industry on public streams: eighty years of mining and pollution prevention measures. Association of Mine Managers of South Africa, *Papers and Discussions*, 1968-69.
2. TURVEY, L. G. S. Report to the Secretary for Water Affairs on mine pollution of Mkuze River. 1961.
3. TURVEY, L. G. S. Report to the Secretary for Water Affairs on Vaal Barrage water quality. 1972.
4. VERSTER, G. P. An addendum to an investigation of the mineral pollution in the Vaal River Barrage. Institution of Water Pollution Control, Symposium on Dissolved Solid Loads in the Vaal Barrage Water System, Apr., 1970.

NIM Reports

The following reports are available free of charge from the National Institute for Metallurgy, Private Bag 7, Auckland Park, Johannesburg.

Report No. 1563
Neutron activation analysis of samples from the Kimberley Reef Conglomerate.

The technique of instrumental neutron activation analysis as applied to the analysis of geological material has been studied, with particular emphasis on methods for the reduction or elimination of analytical errors.

The analytical technique developed has been applied to a problem of interest to the gold-mining industry in South Africa, namely the identification of sedimentary strata within a known succession. A quantitative method based on trace-element patterns has been found to be successful.

A series of conglomerate and quartzite samples from the Kimberley Reef Conglomerate at the Durban Roodepoort Deep Mine have been analysed, and 28 trace and minor elements determined. Multivariate statistical techniques have been used to determine trace-element patterns characteristic of each stratum. Six strata have been investigated, and a 100 per cent accuracy of separation has been achieved by the use of homogeneous powdered samples. It has also been shown that whole-rock conglomerate chip samples can be classified with 87 per cent confidence, and quartzite chip samples with 100 per cent confidence.

Report No. 1569
The use of DDTU as an analytical reagent for the noble metals.

The distribution coefficients of the noble metals and associated base metals between N,N′—diphenyl—s—(1—decyl) isothiourea (DDTU) and varying molarities of hydrochloric acid are given. DDTU is satisfactory for use as an analytical reagent in the liquid-liquid extraction of noble metals as a group from most of the associated base metals. Base metals that are extracted with the noble metals can be removed from the organic phase by washing with 1 M hydrochloric acid, the only noble metal lost in this washing step being iridium (10 per cent loss).

Special general meeting

A Special General Meeting of the Institute was held in Kelvin House, Johannesburg, on Wednesday, 14th November, 1973.

The President, Mr P. W. J. van Rensburg, opened the meeting at 9 a.m. and read the notice of the meeting, which was as follows:

To consider, and if approved, adopt with or without amendment, the proposal made by Council to add to and amend the following clauses of the Constitution:

1. THE INSTITUTE: This clause added after paragraph 1.1.
   'The Institute shall be capable, in its own name, of suing and being sued and of purchasing or otherwise acquiring, holding and alienating property, movable or otherwise, or any interest therein. In any legal proceedings by or against the Institute, the Council shall in their capacity as such sue and be sued on behalf thereof'.
3. THE COUNCIL: First sentence in paragraph 3.16 to be amended as follows:
   'All assets and property of the Institute, both movable and immovable, shall be vested in and registered in the name of the Institute'.

After giving the background to these recommendations made by Council, the President proposed the motion and called for a seconder.

Professor R. P. Plewman seconded the motion.

There were no counter proposals, and the meeting agreed that the Constitution should be amended as proposed.

The meeting closed at 9.5 a.m.