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OF SOUTH AFRICA.

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VOL. VIII. APRIL, 1908. No. 10.

Proceedings
AT
Ordinary General Meeting, April 18, 1908.

The Ordinary General Meeting of the Society was held in the Chamber of Mines, on Saturday, April 18th, Dr. James Moir (Vice-President), in the chair. There were also present:—

33 Members: Messrs. T. Lane Carter, F. F. Alexander, R. G. Bevington, W. R. Dowling, K. L. Graham, A. McA. Johnston, A. Richardson, G. O. Smart, Prof. G. H. Stanley, A. Whitby, H. A. White, Prof. J. A. Wilkinson, W. A. Caldecott, S. Beaton, W. Beaver, A. D. Gilmore, F. G. Guthrie, J. I'Ons, H. R. Jolly, J. Kennedy, C. B. Kingston, Hy. Lea, Jas. Lea, W. P. O. Macqueen, G. Melvill, J. T. Milligan, J. F. Pyles, O. D. Ross, C. E. Rusden, Ralph Stokes, W. H. Stout and W. Taylor.

10 Associates and Students: Messrs. J. Chilton, J. Cronin, C. L. Dewar, D. B. Donovan, A. L. Edwards, J. H. Harris, Jas. Hawthorn, R. W. Leng, W. E. Thorpe and L. J. Wilmoth.

6 Visitors and Fred. Rowland, Secretary.

The minutes of the previous monthly meeting as published in the *Journal*, were confirmed.

NEW MEMBERS.

Messrs. W. Taylor and G. Melvill were elected scrutineers, and after their scrutiny of the ballot papers, the Chairman announced that the candidates for membership had been duly elected, as follows:—

CURNOW, ROBERT, Nigel G. M. Co., Ltd., P. O. Nigel. Mine Manager.

ORR, JOHN, B.Sc., M.I.Mech.E., A.M.I.C.E., Transvaal University College, P. O. Box 1176, Johannesburg. Professor of Mech. Engineering.

SIMPSON, FREEBAIRN LIDDON, Village Main Reef G. M. Co., Ltd., P. O. Box 1091, Johannesburg. Amalgamator.

THOMAS, JOHN, West Bonanza G. M. Co., Ltd., P. O. Box 137, Klerksdorp. Cyanide Manager. *(Transfer from Associate Roll.)*

The Secretary announced that the following gentlemen had been admitted as Associates by the Council since the last general meeting:

BROWN, WILLIAM SINCLAIR, Lebong Soelit, Ketaun, Sumatra, Dutch East. Indies (via Benkoelen). Metallurgist.

KAEDING, HENRY B., 1421, Winfred Street, Los Angeles, Colo., U.S.A. Mining Engineer.

LOFTS, HORACE F., St. Stephen's Lodge, Trowbridge, Wiltshire, England. Metallurgist.

NELLMAPIUS, ALBERT PHILLIP, P. O. Box 6499, Johannesburg. Mining Engineer.

SHORT, ARTHUR REGINALD, New West Bonanza G. M. Co., Ltd., P. O. Box 137, Klerksdorp. Assayer.

WISEMAN, EDWARD JAMES, Village Main Reef G. M. Co., Ltd., P. O. Box 1091, Johannesburg. Foreman Trammer.

And as Students:

GAISFORD, ARTHUR, Transvaal University College, P. O. Box 1176, Johannesburg.

ELOFF, STEPHANUS JOHANNES PAULUS, Transvaal University College, P. O. Box 1176, Johannesburg.

MOON, CYRIL LESLIE, P. O. Box 6695, Johannesburg.

All are Students of the Transvaal University College.

GENERAL BUSINESS.

The Secretary: I wish to bring to your notice the visit to the Nigel, which had to be postponed, until the 9th of May, providing we get a sufficient attendance. I would ask members, if they can possibly take part in this excursion, to send in their applications as soon as possible. We have to guarantee £32 10s. for the special train. It is useless going down by the ordinary train and coming back by the Natal Mail because that will only give us about an hour at the mine. A limited number of ladies may accompany the party, and the Managing Director and the General Manager of the mine have gone to considerable trouble to make the visit a success.

Prof. J. A. Wilkinson then proposed a very hearty vote of thanks to the gentlemen who formed the sub-committee for the Annual Dinner, which was carried unanimously.

A FEW NOTES ON STAMP MILLING.

By W. H. JANE (Associate).

In placing these notes before this Society, I am actuated with a desire not to impart, but to obtain, information during the discussion which I hope will follow.

It is, I believe, a generally accepted theory that five stamps are run in one battery, to complete as nearly as possible a cycle, thereby obtaining a steady load on the driving belt; but apparently the fact is often lost sight of that it is also intended to produce the action of a cycle in reducing ore. In other words, the five stamps ought in falling on the dies to act as nearly as possible in the same manner as a roller which exercises the pressure of a battery of stamps, would in passing over a given quantity of ore. If it were possible to produce a metal of sufficient resistance which would wear evenly along the whole of its face, it would no longer be necessary to reduce our ores by means of stamp mills, with their serious loss of efficiency—by applying the power consumed to the point at which it does its work, *i.e.*, between the shoe and the die.

If we accept this theory, we must set our cams on the cam shaft so as to get an even distribution of ore along the crushing faces, and not (as is often seen) Nos. 1 and 5 falling on a much greater quantity of ore than Nos. 2, 3, and 4. In this case it is necessary to run Nos. 1 and 5 with a longer drop than Nos. 2, 3, and 4. This practice at once destroys the cycle and continuity of action, impedes the discharge of crushed ore from the mortar, puts an uneven strain on the driving belt, and causes a loss of power at Nos. 2, 3, and 4. The fact that the centre stamp is called upon to feed ore into the mortar, and Nos. 2 and 4 to distribute it to Nos. 1 and 5 upsets the theory but only to a small extent; and this can be remedied, either by having slightly heavier centre shoes, or a slightly longer drop, but all stamps should be run at the longest possible drop, and should not be shortened more than the maximum amount of wear of the shoes and dies per day, at any one time. The practice of shortening stamps by inches should on no account be allowed.

Another practice I do not agree with, is running the stamps at over 100 drops per minute. On a hard ore, stamps running at 98 drops per min., with a maximum drop, will do more work with less wear on the mill than stamps running at 100 drops per min. This is caused by the increased force of the blow, owing to increased length of drop and the laws governing falling bodies. In short, the exact speed required is that which allows the stamp to fall the full length of the cam minus the necessary clearance, the stamp to be lifted immediately it has expended its force. In crushing soft ores it would be necessary to strike oftener and with less weight, or increase the diameters of shoes and dies, and crush a greater quantity at each blow, though in the latter case we have a distinct loss, owing to waste space in the mortars, which would have a tendency to allow the ore to pack between the shoes and the liners, which again would interfere with fine feeding. For this reason, I think, it is not desirable to increase the diameters of shoes and dies, even when installing heavier stamps, as I do not think we are as yet very near the point at which increased diameters will be essential. To feed perfectly it is necessary to have gear to operate the Challenge feeders with the least possible movement of the rocker bar. That is, the collar must not strike the rocker bar until the stamp has almost finished its stroke. In the old suspension gear, even when in fair order, the bar had to move a fair distance before operating the feeder. The use of springs to pull back the pawl or friction discs is objectionable. Taken singly, the pull of each spring amounts to little, but in a large mill we have a considerable amount of power expended uselessly. The rocker bar designed by Mr. G. O. Smart, and installed in several of the Consol. Goldfield's mills, makes an almost ideal rocker bar, its perfect balance using up very little power. It feeds from the stamp in proximity to the tappets, and conveys motion by means of a hemp rope to the feeder gear. If the rope is wound spirally with hoop iron, 1 ft. or so above and below where it passes through the cam platform it lasts a very long time and gives no trouble. With tube mills running in conjunction with gravity stamps, it is highly undesirable to make the stamps do too much work, since at each blow struck the stamps liberate a lot of stuff which is not expeditiously expelled from the mortars, and though it is admitted that a tube mill is not an economical primary grinder, yet taken in conjunction with gravity stamps, it will be found we do not reach a very high standard of efficiency when using too fine screening. There are enough tube mills installed on the Rand at present to enable us to discover by actual practice the percentage of work which stamps and tube mills should do, if members will only give us the benefit of their experience.

The Chairman: This is a paper by one of our younger Associates, and I am glad to see that he is not afraid to face the Society in the excellent way he has. I hope that some of our older members will discuss the paper and possibly supply Mr. Jane with some of the data which he asks for.

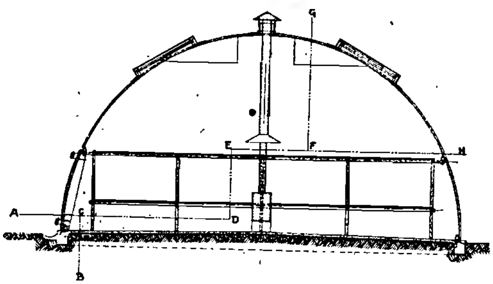
NEW TYPE OF NATIVE COMPOUND BUILDING OF ALL METALLIC CONSTRUCTION.

By C. B. Kingston, B.A., B.A.Sc. (Member).

Having occasion recently to erect a new compound for the Great Eastern Colliery, at Springs, the writer set about designing a cheaper type of building than the one generally used for housing natives.

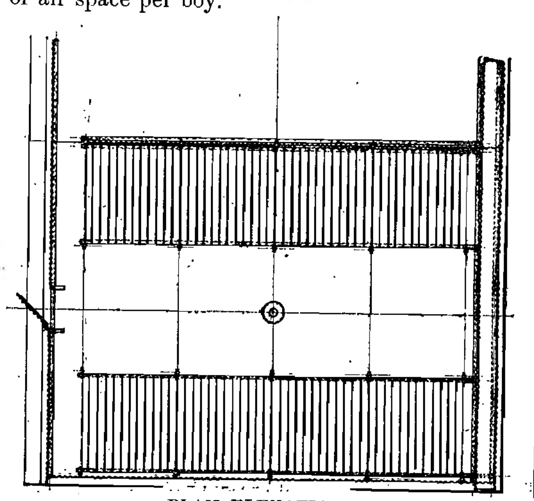
It was first decided to erect a wood and iron building. To save framing, it appeared that a curved iron roof was desirable. To lessen the framing in the walls, it was sought to reduce these to a minimum, and as a natural consequence, it was finally decided to eliminate the walls altogether. This was done, and the building, as erected, consists simply of a corrugated-iron roof resting on a magnesite concrete floor.

The section of the building is a semi-circle with a radius of 14 ft. The radius was fixed by



END ELEVATION.

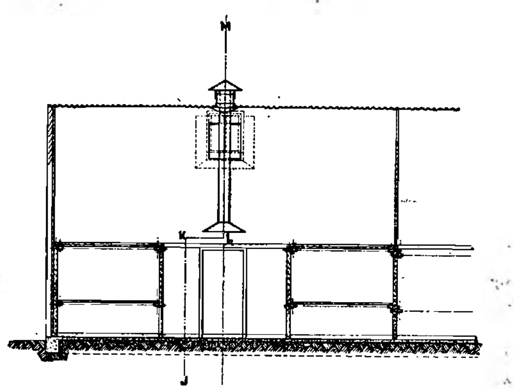
the Regulation that provides that in calculating the cubical air space of rooms with two tiers of bunks, no allowance is made for space above 14 ft. from the floor. The rooms are therefore 28 ft. long and 14 ft. high. They are made 21 ft. wide to accommodate 32 boys with 200 cub. ft. of air space per boy.



PLAN ELEVATION.

The building is constructed of good 24-gauge iron, curved in the rolls used in the manufacture of ordinary water tanks. The sheets are single riveted on the curved joints, and double riveted on the horizontal joints. The edges are attached by clamps to a $1\frac{1}{4}$ in. black iron pipe bolted down to the concrete floor. The floor has a slope of 3 in. in the 14 ft. from the centre of the rooms to the sides. The bunk frames are of $1\frac{1}{4}$ in. pipe stayed with $\frac{5}{8}$ in. iron bolts. A stringer of similar pipe runs the length of the building on either side above the doors, and is bolted to the top members of the bunk frames, which are thus tied together. The corrugated iron of the roof is also clamped to these stringers and supported by the bunk frames. This reduces the span of the unsupported curved iron roof to 24 ft. The rooms are separated by partitions of 24 gauge corrugated iron attached to the roof by angle pieces of plain galvanised iron of the same gauge. Spaces are left to allow the air to circulate freely through all the rooms. To give extra stiffness, the two central sheets of iron in each partition are extended, and securely fastened to the roof.

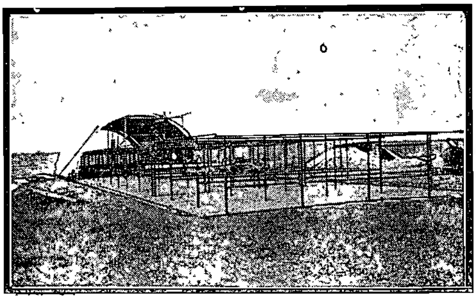
The door and window frames are easily attached to the corrugated iron in a perfectly water tight manner. The building is fitted with regulation



SIDE ELEVATION.

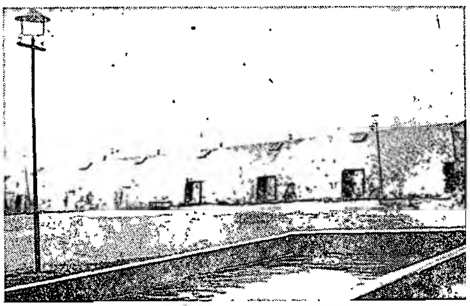
ventilators and stove pipes. Small spaces between the floor and the roof are left at regular intervals for intake ventilators. These also act as scuppers to run the water off into the outside drains when the floors are hosed down. If the pipes to which the roof is attached are fastened to the floor with clamps, instead of through bolts, they can be fitted with stop cocks in each room and can be used to supply a water service for washing and fire purposes. As there is no framework in the building except the pipe on the floor and the pipe tying all the bunk frames together, there is a minimum lodgment for dirt, and therefore the building is very easily kept clean.

Since its occupation, it has been tried in hot weather and in cold weather, and has been exposed



BUNK FRAMES ERECTED ON MAGNESITE CEMENT FLOOR AND USED AS SCAFFOLDING FOR ERECTING THE ROOF.

to heavy storms of rain and wind, and under all circumstances has proved entirely satisfactory. Eighteen bed-rooms complete, to house 576 natives, were erected at a cost of £2 12s. per boy. The kitchen and hospital were transferred from the company's old compound, and therefore the cost of these additions, if of the same construction as the rest of the building, cannot be given exactly. A compound of this construction, however, can



VIEW OF COMPOUND FROM INSIDE.

be erected complete with hospital, kitchen and bathroom for from £2 17s. 6d. to £3 10s. per native, according to the number of boys to be housed. The ordinary well-equipped compound of the existing type costs, complete, from £7 10s. to £10 per native. The new type of building of all metallic construction costs therefore less than one-half of the present compounds. The roof of the ordinary compound contains 70% of the quantity of iron in the whole of the new type of building, and as the ordinary roof requires wooden trusses, ridging and guttering, it costs almost, if not quite, as much as the entire iron sheathing of the new building. In point of durability, if used on a deep level mine with a long life, the new type of building compares favourably with the old compounds. The interior iron work of the new type is permanent, while the curved roof will probably last a little longer than the usual pitched roof, and can be renewed for about the same cost.

If erected on a mine with a prospective life of 25 years, the corrugated iron sheathing might have to be renewed once, which would be the case with the roof of the ordinary compound also.

In the present brick compounds an appreciable amount of money is spent in 12 years on the maintenance and cleansing of the walls, and this expenditure would tend to increase rather than diminish during the second half of its life. In the new type of building the cost of cleansing the walls is much less than in the old, and when the iron sheathing is renewed, the building is fresh and new throughout, which is a distinct advantage from an hygienic point of view.

The difference in first cost between the new type of building and the old is so great, that the interest t for 12 years on the money saved will more than cover the cost of renewing the corrugated iron.

Dr. Sansom, lately District Medical Officer of Health for the Witwatersrand, when examining the plans of the new building, was good enough to express strong approval of it from his point of view, viz., the health of the natives, and on his recommendation the Native Affairs Department propose to adopt this type of building for the native rest houses to be erected on the Natal border. In its general appearance the new compound is neat and workmanlike. It has at least as strong a claim to architectural beauty as the old compound, and the boys appear to like it, perhaps because the curve of the roof suggests the outlines of their native grass huts. The merits claimed for this new type of building are its low cost and its exceeding cleanliness.

The accompanying drawings and photographs show the details of construction.

The Chairman: This is a very interesting paper. I think the new invention seems to be quite excellent—apart from the question of saving money. It seems to be likely to be beneficial to the health of the boys: and I may say also I thought the building had some claim to beauty when I saw it last week. I move a hearty vote of thanks to the author.

Mr. T. Lane Carter: I beg to second the motion. There is only one point that strikes me. Mr. Kingston spoke of the new deep levels, and the suitability of these compounds for such mines is only a question of durability. Suppose you have a deep level mine lasting 25 or 30 years, as they will do, how would a compound of this type come out after such a period?

Mr. C. B. Kingston: I think you would find that in the course of 25 or 30 years you would have to renew the original iron roof on the ordinary compound, and if you work it out there is not very much more iron in this semi-circular section than there is in the pitched roof of an ordinary compound, and the new type is so much cheaper that it would pay you to renew the iron sheathing at least once and even twice in that period

Mr. F. F. Alexander: I should like to know how the doors of the compound are worked. I take it the door would open outside, and if so, how does this door prevent leakage from the circular roof running into the hut itself?

Mr. C. B. Kingston: The wooden frame of the door is inside, on the curve running from the floor up to the stringing pipe that runs across the top of the bunks. The door lies flat in the frame, and there is a small ridge projecting above the top which keeps out the water completely. We have had several heavy rainstorms since this compound was erected, and no water has found its way in at all.

LABORATORY TESTS ON THE USE OF COARSE AND FINE LIME FOR CYANIDING.

By W. J. Sharwood, Ph.D., R.S.M. (Associate).

The object of these experiments was to ascertain the relative rapidity with which commercial lime, in varying states of division, would be dissolved when distributed through a charge of inert sand subjected to the action of percolating water or cyanide solution—the proportions of water, sand, and liquid being practically the same as prevail in the leaching of tailings at the cyanide plants of the Homestake mine. This involves the addition of about 3·5 lb. of lime per ton of sand, through which solution percolates at the rate of about 1 ton of solution in 5 days for each ton of sand.

As the tailings actually treated are pyritic, and would develop acidity sufficient to decompose a considerable proportion of the free lime, a clean quartzose sand (over 98% SiO_2) was used in the tests. This was crushed through a sieve of 40 meshes per linear inch (aperture ·015 in.) and was washed free from slime. One gram of lime was mixed with 575 gm. of sand, placed in a narrow percolator, and leached with distilled water (or in a few cases with stock solution from the cyanide plant) at as nearly as possible a uniform rate of 115 c.c. per day. The effluents were removed and measured at intervals, and the alkalinity of each was determined by titration with sulphuric acid.

A sample of a few pounds weight of the lime lumps, as delivered at the cyanide plant, was crushed and sized by passing through sieves ranging from 10 to 200 meshes per linear inch, the average apertures of which approximated ·074, ·033, ·015, ·011, ·006, and ·003 in. respectively. All coarser than 10 mesh was rejected. The quantities obtained from the various grades differed greatly, very small amounts being found between 40 and 200 mesh, and these particles being comparatively hard and gritty. Another sample was taken from a lot of lime which had been stored for some months and had become air-slaked. All but a minute fraction of this passed a 200 mesh screen, with the aid of a little gentle rubbing. Each sample was analysed by the usual proximate method. The "available" lime was also determined in two ways. (1) Two grams were treated with 1,000 c.c. water containing 20 gm. sugar for 2 hours, with occaional very gentle shaking, to avoid breaking up the particles, with the object of obtaining, as far as possible, surface action only. (2) A like amount, weighed out after grinding to impalpable powder, was mechanically shaken with the same proportions of sugar and water for 3½ hours, to get the maximum solvent effect. Bottles of 2,500 c.c. capacity

Table I.—Analyses of Sifted Lime.

Lot	1	2	3	4	5	6	7
Mesh of sieves ...	10 – 20	20 – 40	40 – 60	60 – 100	100 – 200	200 +	Air-slaked
Dimensions of Apertures Ins.							
"Through" ...	·074	·033	·015	·011	·006	·003	·003
"On" ...	·033	·015	·011	·006	·003	0	0
Percentage Composition—							
Loss on ignition ...	3·58	4·13	4·14	4·23	4·06	3·95	22·2
Insoluble ...	2·61	2·52	2·51	2·98	3·85	2·92	1·83
Fe_2O_3, Al_2O_3 ...	1·42	1·18	0·85	1·30	1·40	1·88	1·12
MgO ...	2·32	2·29	2·23	2·31	2·13	1·98	1·36
CaO (total) ...	89·02	88·53	88·81	88·04	87·34	88·18	72·90
Total determined ...	98·95	98·65	98·54	98·86	98·78	98·91	99·41
Soluble CaO by Sugar—							
(I.) 2 hours, not ground...	60·5	58·8	58·3	66·1	76·7	82·9	64·5
(II.) 3·5 hours, ground fine	81·9	80·3	81·4	80·7	77·5	82·0	62·0

were used in all cases (see Note II.). The analytical results are given on previous page in Table I.

The method of recording the results is illustrated by a typical log, shown in Table II. In some tests the effluent samples were taken at more frequent intervals, but this was found unnecessary except in the case of the coarser fractions, or near the beginning and end of a run.

TABLE II.—LOG OF LIME PERCOLATION TEST.

Grade of lime, 40 – 60 mesh, ·015 – ·011 in. Leached with water.
Weight, 1·0 gm. = 0·888 gm. total CaO or 0·814 gm. available CaO.

Volume Effluent c.c.	Cumulative Volume of Effluents c.c.	Volume $N/5$ Acid for Effluents c.c.	Cumulative Volume $N/5$ Acid c.c.	Cumulative CaO in Effluents. Grams.	Percentage of CaO in Charge Dissolved. Total.	Available.	Alkalinity of Effluent (Note III.).
35	35	5·5	5·5	·031	3·5	3·8	31·4
110	145	25·4	30·9	·173	19·6	21·3	46·2
110	255	24·5	55·4	·311	35·	38·2	44·5
110	365	24·3	79·7	·446	50·2	54·8	44·25
110	475	21·4	101·1	·566	63·7	69·6	39·0
100	575	16·4	117·5	·658	74·1	80·8	32·8
125	700	13·1	130·6	·731	82·3	89·9	21·0
100	800	3·1	133·7	·749	84·3	92·0	6·2

As it was obvious that, weight for weight, the slaked lime carried only about three-quarters as much available CaO as the fresh, a special run was made using one-third more, or 1·33 gm. of slaked lime to 575 of sand, to make the amount of "available" practically equal to that used in other tests.

Fig. I. shows the variations in alkalinity of the effluents at various stages of the leaching. The abscissæ represent times or volumes of effluent. The ordinates representing the average alkalinity of the various effluents are erected at the middle points of the periods (or volumes) to which they correspond. For the sake of clearness, when represented on a small scale, some of the curves corresponding to intermediate grades of lime have been omitted in this series, and also in Fig. II.

Fig. II. shows in a similar manner the cumulative amounts of lime dissolved and removed *during the progress of percolation, expressed* as percentages of the total available CaO present in the charge at the commencement of the tests. The ordinates corresponding to percentage (taken from column 8 of log) are erected at the points representing the ends of the periods to which they refer.

The complete series of curves, indicated in Fig. II., were plotted on a large scale, and the percentages removed at the end of each day were scaled off, and are tabulated in Table III.

With regard to the results omitted from the figures, the curves corresponding to 40—60 and 100—200 mesh, and also that for "slaked lime 1·33 gm.," all approximated closely to the curve representing 60—100 mesh which appears in Figs. I. and II.

It will be noted that the curves in Fig. I., representing the alkalinity of cyanide solutions percolated through a mixture of lime and sand, are nearly parallel to those obtained with water and lime of the same grades, the solvent power of the cyanide solution for CaO being substantially the same as that of water.

TABLE III.

Number of days leaching ...	1	2	3	4	5	6
Tons effluent per ton of sand	0·2	0·4	0·6	0·8	1·0	1·2
GRADE OF LIME USED. Mesh of sieves used, per linear inch.	Percentage of available lime leached out.					
10 – 20	6·7	19·4	33·0	44·6	54·5	—
20 – 40	13·4	31·3	48·8	63·6	77·5	88·0
40 – 60	16·7	34·0	51·7	67·5	80·6	89·0
60 – 100	16·9	35·0	53·9	69·8	83·5	90·1
100 – 200	19·4	37·8	57·6	74·0	88·5	95·5
Through 200	21·0	40·0	60·0	74·0	85·6	—
Slaked lime, lot 1 Through 200	25·0	47·3	70·2	84·0	92·0	—
" " lot 2	22·1	44·0	67·0	83·6	92·0	94·5
" " lot 3 Weight increased 33% to give equal CaO	18·0	36·0	55·2	70·6	80·6	89·6

In a general way, the result of this series of experiments confirms the experience obtained in the Homestake practice, viz., that the most desirable condition is to have the lime largely in particles which are neither very coarse nor extremely fine. If much of it is in granules, *e.g.*, coarser than a 20 mesh (linear) screen (·033 in.) these grains will in great part remain undissolved at the end of the treatment. Previously slaked lime, and particles finer than 100 mesh (·006 in.) yield about 90% of their available alkali in 5 days' leaching, but yield it at a rate which is not sufficiently uniform. Such highly comminuted lime gives too high an alkalinity to the cyanide solution at the earlier stages of leaching, a condition which (with the pyritic ore in question) is detrimental to the solution of gold, it having been found that a "protective alkali" higher than 0·3 lb. per ton of solution gives decidedly low extractions. Another point in favour of a granular lime is the fact that the acidity of these tailings is distinctly cumulative, there being 5 to 10% of sulphide of iron present, a large proportion of which is pyrrhotite. The experimental results were obtained with an inert charge; under working conditions, with an acid charge, and especially with one constantly developing acidity, there is no doubt that the available CaO added would have disappeared more rapidly—in spite of the fact that the whole of it was actually introduced into the charge, which is not the case in actual work. With too fine a lime a very large proportion either dissolves in the water conveying the tailings, or remains suspended in it while the vat is filling, and so passes off at the peripheral overflow. In some cases this overflow water has been found to be a nearly saturated solution of caustic lime. While this would suffice to neutralise any original acidity existing in the tailings, it is, of course, useless as regards that which may develop later.

The lime used at the Homestake plants is burned in continuous wood-fired kilns at the company's quarry, and loaded into railroad cars. At No. I. plant the cars are unloaded into bins, from which the lime is conveyed by a gravity wire rope system to bins in the plant. Here it is crushed through a jaw crusher to about 1½ in. size, and sufficient is weighed out for 2 hours' supply. This is dumped into the hopper of a Challenge feeder supplying the mortar of a one-stamp mill, having one screen, 11 in. × 14 in., and fed with a small stream of water, which carries the lime to a launder where it mixes with the previously classified tailings on their way to the distributor and leaching tank. A further addition of lime is made during the progress of leaching, by spreading 200 lb. over the surface of each charge of 600 tons. If, however, the alkalinity of the earlier effluents is unduly high in comparison with the percentage of cyanide (or in other words, if the protective alkali is excessive) this top-lime is omitted.

Note I. Analyses of Lime.—The values quoted for "insoluble" include the total silica. The mixed oxides, as weighed, contain approximately equal proportions of alumina and oxide of iron, together with a very little oxide of manganese.

Note II. Estimation of Available Lime.—The method followed is based on that of Mr. G. W. Williams,* using a 2% sugar solution. I filter a portion of the liquid through dry paper as soon as possible after it has settled comparatively clear, and at once measure out the volume to be titrated into a beaker or flask. If titrated at once phenolphthalein is generally used as indicator. Identical results are, however, obtained with methyl orange, if the liquid has been filtered, and this indicator is distinctly preferable, as it may be used after a considerable amount of carbonate has been formed by exposure to the atmosphere, a slight excess of standard sulphuric acid being added to decompose any carbonate thus formed, and the excess of acid being titrated with standard soda.

Since writing these notes I have received the November and December numbers of the *Journal*, containing criticisms of the sugar process. My own experience has been that a 2% solution of sugar, 1,000 c.c. to 2 gm. of sample, gives very satisfactory results; its solvent power is ample as regards finely divided CaO, and its effect on other calcium compounds appears to be little if any greater than that of pure water. Of course the object of this determination (from the cyanider's point of view) is to establish the amount of alkali available to neutralise weak acids, and in this case there is no doubt that some of the calcium silicates have a slight solubility and can exercise a feeble protective effect. Calcium carbonate in the original sample does not appear to influence the results of this determination in the slightest degree.

Note III.—The "alkalinity number" used at these plants corresponds to the number of cubic centimetres of decinormal acid required to neutralise 100 c.c. of solution. This system has been in use for over 10 years and is very convenient, as it does not presuppose the existence of any particular compound, such as CaO, in expressing the alkali present, while it can at once be translated into terms of percentage of CaO or NaOH by multiplying by the equivalent weight of either compound.

1 unit =	·0028% CaO	= ·056 lb. CaO	per ton.
„	·0056% KOH	= ·112 lb. KOH	„
„	·0040% NaOH	= ·080 lb. NaOH	„
„	·0065% KCN	= ·13 lb. KCN	„

* See this *Journal* Vol. v., April, 1905, p. 253; also vol. viii., pp. 37, 124 and 206.

A saturated solution of lime in water has an alkalinity of about 45.

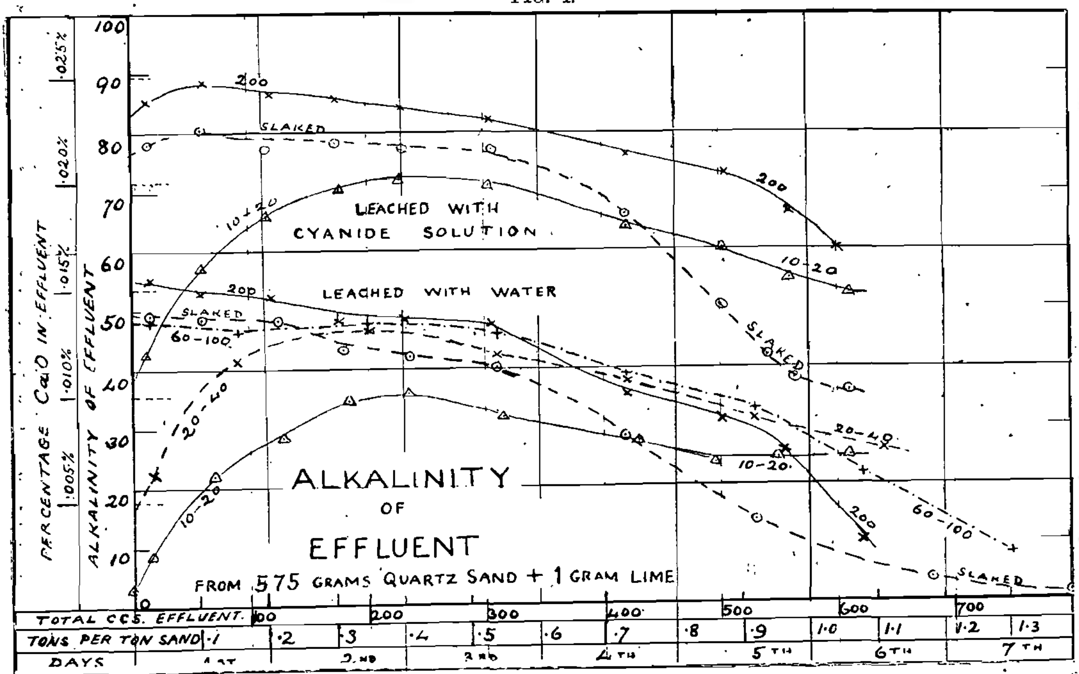
In a cyanide solution of known percentage KCN and alkalinity estimated by above standard, the "protective alkali" in pounds CaO per ton, can be calculated by the formula :—

$$\cdot 056a - 8\cdot 6k = \text{pounds CaO per ton,}$$

where a = alkalinity by above standard, and k = percentage KCN.

In daily work the solution man takes samples of 20 c.c., adds 2 or 3 drops of 1% phenolphthalein solution, and titrates with $N/5$ sulphuric

FIG. I.



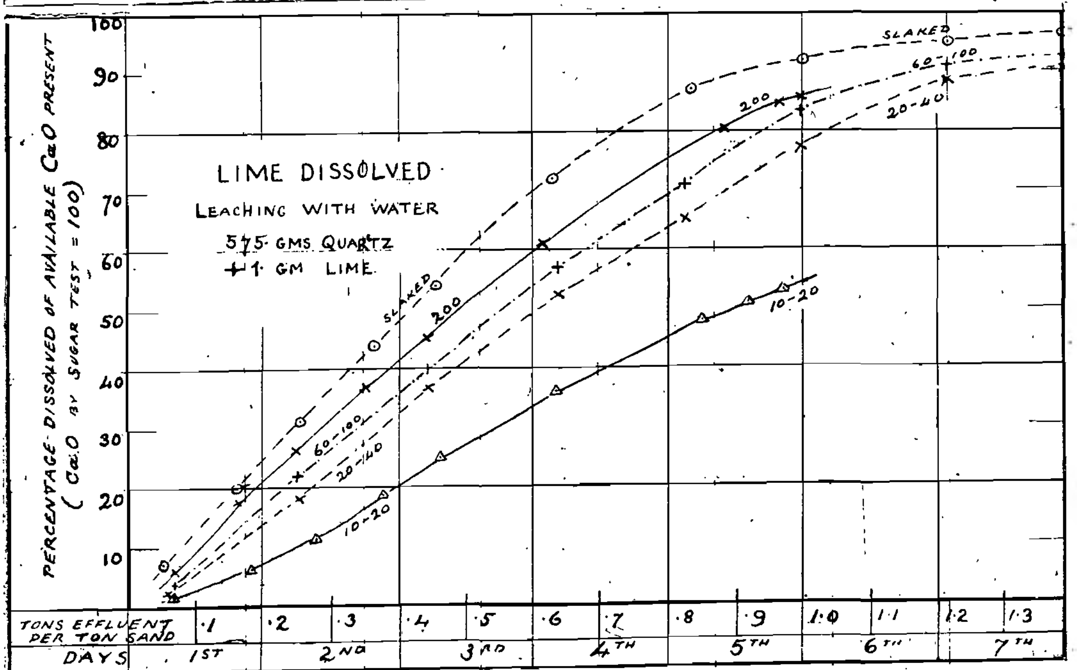


FIG. II.

acid. Each tenth of a cubic centimetre of acid used represents one unit of alkalinity. When the "protective alkali" value is required in pounds lime per tons it is read from a table calculated from the formula above given. Synthetic tests have shown that this method, while not by any means strictly accurate in the presence of double zinc cyanide, is liable to no greater errors than the methods based on titration after precipitation with silver nitrate.

Note IV. Preparation of Standard Sulphuric Acid.—Strong acid is diluted to give a stock solution of medium strength, slightly greater than 4N. Exactly 100 c.c. of this is diluted to 2,000 c.c., and the H_2SO_4 in a sample of this diluted acid is estimated gravimetrically with the greatest care. If, for instance, it proves to be 0·2055 N, we must then dilute 100 c.c. of the stock acid up to 2,000 and add 55 c.c. more, in order to get standard acid of exactly 1/5 normal strength.

Mr. W. A. Caldecott: I have much pleasure in proposing a very hearty vote of thanks to Mr. W. J. Sharwood for his able and instructive paper upon a subject that concerns so many of us. The author has done much valuable research work upon the chemistry of cyaniding, and has been long associated with Mr. C. W. Merrill, whose name and historical work at the Homestake will be familiar. In explanation of a portion of the paper, I may say that Homestake practice consists in separating sands from slimes in the tailings pulp by means of a large number of conical classifiers. The district being blessed with an abundance of water, and ample fall having been secured by locating the sand plant a long way further down the creek than the mill, it is possible to deliver a sand pulp to the vats, in which the sand is both collected and treated, almost free from slimes. It is to this sand pulp underflow from the cones that lime is added before entering the distributors, so that it is deposited uniformly throughout the sand charge. The sand contains a good deal of the reducer pyrrhotite, and lime is required to neutralise the oxidation products of this mineral during treatment. Great importance is attached to aeration of the charge during treatment in the vat in which it is collected, and hence every attention is paid to preventing slimes being deposited with the sands, as free access of air into the interstitial spaces between the sand grains is essential to secure "envelope aeration," as it is termed by Mr. Merrill.

Among other interesting features at the Homestake are the very large number of light 900 lb. stamps employed, crushing fine with a 10 in. discharge and a high water ratio. A very high percentage recovery by amalgamation is secured on an extremely large plate and which is dressed once daily.* Regrinding of the coarser sand is now being tentatively introduced, both grinding pans and a tube-mill being employed.† The satisfactory working of Mr. Merrill's large filter-press plant, in which some 1,600 tons daily of very poor slimes are collected, treated, washed and discharged with water without opening the press, has already been described in our *Journal*, as likewise the method employed for efficient zinc dust precipitation.‡

It is to be hoped that Mr. Sharwood's paper is but the first of series detailing the remarkably successful results, achieved by the enterprise and skill of Mr. Merrill and his band of able lieutenants, in solving the problems presented in the treatment of an enormous tonnage of low grade ore handled at one of the greatest gold mines in the world.

The Chairman: I am sure we all wish to thank Mr. Caldecott for his valuable explanation, and accord at the same time a hearty vote of thanks to Dr. Sharwood for his paper.

THE LABORATORY: ITS ECONOMIC VALUE.

(*Read at October Meeting, 1907.*)

By A. McArthur Johnston, M.A., F.C.S. (Member).

REPLY TO DISCUSSION.

Mr. A. McA. Johnston: The criticism evolved by my paper has brought forth complimentary remarks on the one hand and useful opinions and controversial matter on the other. To the latter we can confine our attention, and I am pleased to note the strong attitude taken up by all the speakers in advocating the recognition of the testing laboratory as a profit saving, as well as a scientific institution. It would seem, however, that some of the remarks should have been delivered before our confrères, the mechanical engineers, where, I am sure, they would have brought forth anything but laudatory rejoinders. Still, it is pleasing to note that the testing department is so much thought of by many engineers, as is evidenced by the substantial token afforded to Mr. H. C. Behr for the reply to the criticism on his original paper. Actual buying of coal on the stipulations outlined by him should soon be an accomplished fact, and its concomitant saving in steam produced will then be recognised.

* See this *Journal*, p. 243, March 1905.
† See *The Mining World*, p. 541, March 28, 1908.
‡ See this *Journal*, p. 24, July, 1907; also *Mines and Minerals*, p. 432, April, 1908.

The method of testing the volatile matter in coal samples does not altogether meet with the approval of Prof. Stanley or Mr. Croghan. In this I can bear with them, for it is not absolutely correct, and I would be only too pleased if money could be obtained to purchase a platinum muffle, crucibles and trays as well as erect a gas plant, so that we could conduct determinations of coal and ash samples averaging, at certain times of the month, from 10 to 20 a day. What I was outlining rather was a practical method which is used by us and could be adopted by any well equipped assayer on these fields. With uniform apparatus and careful manipulation it will be found that the results obtained are accurate enough for all practical purposes, and could well be used for the basis of buying coal supplies. In the calculation of the evaporative power by means of a constant factor, I am afraid my experience is not consistent with that mentioned by Mr. Croghan. To illustrate my point, I will give the proximate analyses of four samples submitted to us and chosen indiscriminately from four different coal producing districts :—

	(1) %	(2) %	(3) %	(4) %
Moisture ...	2·20	1·80	1·00	5·48
Volatile matter	18·42	27·34	19·12	19·83
Fixed carbon ...	62·33	60·38	69·76	62·10
Ash	17·05	10·48	10·12	12·59
Evaporat. factor				
Mahler bomb	11·94	13·48	13·88	11·76
As calculated by				
Mr. Croghan	11·30	12·28	12·44	11·47
Difference ...	– 0·64	– 1·20	– 1·44	– 0·29

These results sufficiently show the difficulty, if not the impossibility, of calculating heat values from the proximate analysis.

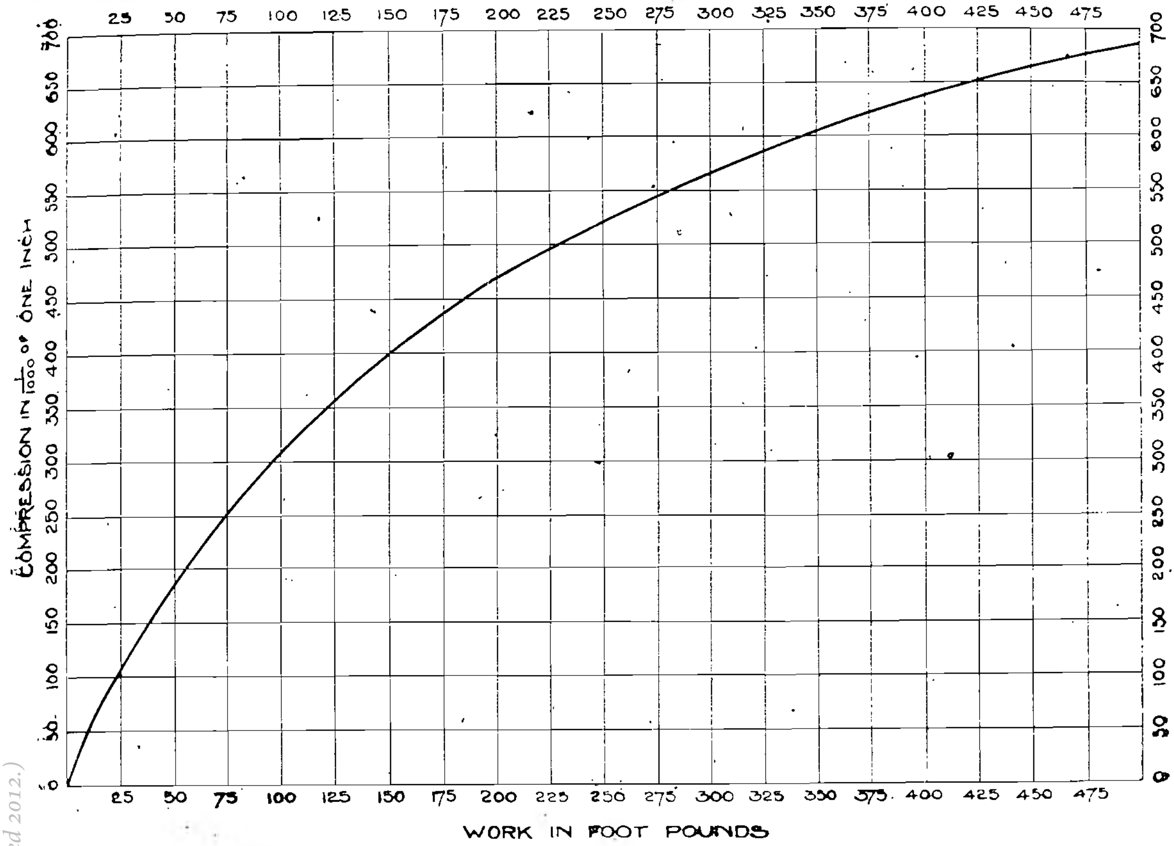
Mr. Whitby is right in answering to Prof. Wilkinson that I did not enumerate paints in my paper, because it would have been tedious to mention all the work carried on the laboratory. Were some of our reports on paints published, they would open the eyes of engineers on these fields. One that I can call to mind, when analysed, was found capable of being made up here for about 10s. per unit, whilst the agent sold it at about 24 times this amount. This profit represents the value of a high sounding name, a drum and an engaging personality or persuasive tongue.

With Mr. Whitby I agree that the viscosity test is improperly reported, hence my remarks. That some better method should be employed is undoubted, and at the present time a committee of the American Society for testing materials is engaged in experimenting on the question. To be of value, the standard must be uniform, and I would draw Mr. Whitby's attention to the above society, which is doing so much in this direction. Similar conclusions also apply to the examination of greases, though it is difficult to conceive of any but comparative tests when experimenting with rope greases, since their cohesive ability in actual work is a very important factor.

Mr. Richardson's remarks are very much to the point, and worthy of thorough investigation. It seems to me, however, that such testing can best be done in actual work—it is rather beyond the scope of the testing laboratory. His remarks probably hit at the reason for the quantity of explosives used per ton of rock broken on these fields, as compared with that used on mines in other parts of the world. The use of a more powerful detonator and the adoption of careful tamping would, I am convinced, considerably reduce this ratio. The value of the explosion apparatus or crusher gauge is undoubted, since it enables one to keep a careful watch on the quality of explosives supplied. It must be remembered, however, that the results obtained are only comparative when the lead cylinders are uniform in quality, and when similar classes of explosives are used. To obtain this uniformity in lead cylinders a large melt is made and a number of cylinders are cast at one time, the lead used being purest sheet lead. The Quinan curve is useful in that it converts the amount of compression into foot pounds of energy, this amount of compression being in itself variable since the more the compression the less is the compressibility.

Through the courtesy of Lieut. Quinan, I am able to reproduce here the curve plotted by him so as to convert the compression into foot-pounds of energy. The quantity of explosive used is 24 gr., or 1·555 gm. A trial is first made with the detonator alone to find the compression due to this. A No. 3 detonator is a convenient size to use. In the diagram the abscissae represent the foot-pounds of work generated and the ordinates, the compression in thousands of 1 in. The diameter of the lead cylinder before use is 1 in., and the length also approximately 1 in. A machine is used for compressing these cast cylinders into this size, any excess being squeezed through two little holes in the sides.

Mr. Caldecott's contribution is valuable in that it tells of a personal experience of the work being done in this direction in other parts of the world. He shows there the slow but steady growth of the largest testing laboratory and, moreover, the recognition of its utility. On railroads where lives are so much at stake it is imperative that only reliable goods must be used, an important evidence of this being in the increased attention now given to the manufacture and testing of steel rails. Why, then, on these mines should



Foot Pounds Machine.—Diagram showing relation of Compression of Lead Cylinders to work done measured as foot pounds.

not every care be taken to see that the best materials only are obtained? The inability to trace accidents to defective material should not militate against constant supervision in testing, but should rather encourage caution amongst managers, engineers, and other heads of departments.

The sole idea of testing materials is to obtain uniformity in quality and provide against fraud. The specifications when drawn up should be such that no impossible clauses shall be included. Each requirement must be legitimate and exact, whilst there should be nothing underhand or unfair in the tests conducted on behalf of the buyer. Our object is to enable the seller to understand the methods employed and to meet him and discuss with him any differences arising in the quality of the supply.

In again thanking you for your kind encouragement, I can only reiterate the feeling of the synoptical nature of my paper, and apologise for the rather summary manner in which I have dealt with various subjects of tests. I feel, like Prof. Wilkinson, that many of them could do with a separate paper for themselves. Should any of the members of the Society find further interest in these remarks, I shall be only too pleased to see them at the laboratory and there exhibit and discuss the testing of all materials in use on these mines.

The Chairman: The original paper was a very good one, and the discussion has caused the author to give us this still better reply. In thanking him I should like to express the pleasure of the meeting at seeing him back again after his serious illness.

THE INCIDENCE OF METHODS OF PAYMENT ON THE EFFICENCY OF MINERS.

(*Read at November Meeting, 1907.*)

By Kenneth Austin, M.Am.I.M.E.

DISCUSSION.

Mr. W. Taylor: The author states at the commencement of his paper, that there is "a considerable difference amongst workmen even when subject to the same conditions." This no one will dispute, but, that the vast differences in the amount of rock broken by various miners are entirely due to their efficiency or otherwise, I am not prepared to admit.

In hand stoping, if a contractor has a gang of boys, a fair proportion of whom can drill the requisite number of inches, his fathomage depends on the skill, with which he plans his holes, and his monthly cheque on his accuracy in estimating the minimum amount of explosives necessary to break the burden on each hole.

With drilling machines, however, less account is taken of the formation, and the fathomage is more dependent on the number of holes drilled per machine shift. Before the strike, contract prices were based on four holes per machine, one man in charge of two machines. Now, however, one man has to superintend three machines or more, and each machine must drill five holes per shift, if the contractor wishes to come out. The general conditions remain the same, and these conditions are not such as to enable a miner to put in his five holes regularly, as they cause a large waste of time nearly every day. Given a good machine, and good air pressure, I find 1·75 in. per minute the average rate of drilling, although I have timed machines drilling at rates varying from 0·47 up to 2·4 in. per minute. Taking the average, the actual drilling time for a 6-ft. hole is 40 minutes, therefore, with eight hours at his disposal, assuming $9\frac{1}{2}$ hours for a full shift and allowing $1\frac{1}{2}$ hours for getting to his working face, charging up, etc., a contractor could put in 12 holes if there were no stoppages of any kind. Now, of course, it is obvious that a machine cannot be drilling constantly, but it is also obvious that there must be a considerable waste of time if it takes eight hours to do two hours and 40 minutes' drilling. A fair time allowance for work, incidental to running a machine is, I think, the following: three-quarters of an hour for rigging up and oiling the machine, five minutes for changing drills and ten minutes for shifting the machine on the bar to start a new hole; this would give an average of a little over an hour per hole, excluding rigging up, or time for six holes per shift and two rigs. I believe it is the exception to find this amount of work done by miners in charge of several machines, and there are numerous cases where even four holes are not drilled with unfailing regularity.

There are many causes for this waste of time, most of them avoidable, but some of them are: low air pressure (no air at all on occasions); air mains inconveniently situated; leaky hoses; machines out of order; bolts or nuts worn; bars an unsuitable length; incapable boys; broken rock not cleared from the faces; insufficient drill steel; drills that do not follow; drills arriving late underground.

Without a doubt, the cause of most of the trouble underground is the drill question. Nearly all the miners who appeared before the Commission, which has recently sent in its report, stated they were kept short of steel, but still the majority of mines go on running in the same hand-to-mouth style. Drills come down *en masse*, after all the workers are below ground, and tumbled out on the station, where the piccanins have to sort them out, examining the number on each one before distributing them to the different machine runners. There are many obstacles to hinder the quick delivery, such as loose rock on the line, trucks in the way, waiting for a trolley, etc. The pushing contractor sends his machine boys out to bring in their starters, but 10 minutes wasted means 18 in. that might have been drilled, and when a start has been made it is as likely as not the following drills will not "go" without altering the position of the machine. To obviate this loss of time I would suggest that machine steel be sent down every shift to be used on the following shift, in charge of a white man with sufficient boys under him to sort them out into proper lengths and place them, clamped together in sets, in a convenient position. This would necessitate having more drills in use at a time, but also in the ultimate saving of steel, and by the saving of time, reduction in costs.

Machines out of order is the next most fruitful cause of wasted time. Any breakage generally involves the loss of at least one shift, and any sort of repairs, requiring the machine to be taken to surface means two or three shifts lost. If a competent fitter were employed exclusively underground, and had a few spare machines in his charge, wherewith to replace immediately those sent up, the saving in time would pay for his wages many times over. He should inspect all machines at frequent intervals, report on their condition, and be generally responsible for them. The other points require little comment, but if the management and staff were a little keener on removing causes of delay and made every effort to have everything necessary on the spot ahead of time, drilling operations would run smoother and it would be possible for each man to drill an equal number of holes per machine shift.

When all possible causes for wasting time have been removed by the management it would appear that nothing further should be necessary than to lay down the minimum amount of work required per shift and average amount of intelligence in the position and direction of the holes drilled to secure a reasonable fathomage, and there would seem no reason why this should not be achieved by paying a fair day's wage in the same manner as is done for work on the surface. But there is the necessary skill in the use of explosives to be reckoned with and also the fact that a man can always do a little more work if his pocket will be benefited, so that one always comes back to the conclusion that the contract system yields the best results. If stopes were put up to open tender, and all miners were treated impartially, I believe we should get more uniform work and see a still further reduction in mining costs.

REPLY TO DISCUSSION.

Mr. H. Kenneth Austin: The chief difficulty in preparing the original notes submitted was that they might become unsuitable for a technical society, and that they might be considered too sociological, too political. The discussion, however, though small, has not been unimportant. It has been ascertained and established that the individual miner works best and to the utmost of his powers when subject to the conditions of a free, equitable contract, simple, subject to the common law, and based upon fathomage of ground broken.

Much attention has been given to the performances of "show-rock-drills" lately, but little or none has been paid to the human factor, than which there is nothing more important. The number of inches drilled per minute by machines has been noted to two places of decimals, but this kind of thing does not give us with exactness how to attract and cultivate the greater intelligence needed to use them properly, the absence of which we all deplore. The chief advantage of the proposed "free" contract system over long periods lies in the fact that it appeals to the business side of both employer and employed; where Kafir labour has to be used, it is specially advantageous. It is the system which can be most easily adjusted to the constantly changing conditions of the labour market, and the variation in efficiency between one contractor and another. I cannot join with Mr. A. Richardson in deploring the impossibility of finding a "perfect" system, for the simple reason that I consider the "free" contract system is the most perfect one to suit conditions in this Colony.

Mr. W. Taylor has very ably pointed out the practical defects in the details of working, but all the complaints made by him are due to the fact that everything is cut down to reduce the charges for delivering material underground. No doubt, very many of the troubles of contractors are caused by defective organisation in the distribution of material, but this defect bears equally upon everyone. Providing that waste and expense can be prevented, there is no objection to Mr. Taylor's suggestions about the employment of a competent underground fitter to look after machines, but I have clearly laid down that the better plan will be to train the miners themselves; in other words, to attract and to train a better class of man in the elements of his business, before he goes underground, instead of leaving him to fumble about in the darkness of a mine, wasting time and capital in his attempt to "making dirt for the mill" with machines in bad order.

The alleged prevailing conditions, which Mr. Richardson described, where contractors demanding "a price per foot" *for sliding down stopes* appears to be one more fitted for the region of "comic opera" than serious business, and it reflects upon the absurd discipline, if such description applies to any mine on these fields. As Mr. Richardson stated, there is, no doubt, a good deal of "miners' bluff" in the business; there is also no doubt, that the careless and casual method of pricing contracts is the cause of the trouble; the fear of a "cut" or reduction in price causes some amount of anxiety, but the "free contract" system and open tendering with long periods of agreement advocated by me meets this defect.

In summing up the small amount of discussion on this paper, I have to draw special attention to the valuable contribution of Mr. W. Taylor, which is a very correct description in detail of what takes place in underground operations. The attention of those, who are responsible for carrying on underground work is directed to the very practical suggestions made by him. The radical defects in our present system can only be met by the attraction of a better class of trained workman, a skilled artisan instead of the navvy being wanted underground, and when such men are treated with absolute impartiality by capable, even tempered and judicious overseers, there can be no doubt whatever that managers' difficulties with regard to underground work will diminish, and through greater efficiency a further reduction in mining costs will be made possible. It is the common practice to push all responsibility for obtaining better work upon the shoulders of the "shift boss" and mine captain, but, as stated above, a skilled artisan must take the place of the ignorant, careless, bluffing miner, and in order to attract him, the writer has maintained that the incidence of payment for work done has a most important bearing upon whether we get and keep the right sort of men, or not. Progress is to be made by the choice, the conscious choice, of the right path; not by fumbling about in all directions, nor by the indolence which rests on unquestioned, established systems. Content in the correct choice of system, content in what has been secured by methods which work with the most practical and satisfactory results above ground, one may look forward to a time when the underground worker will take his proper position in the industrial world and be paid according to his ability. The payment of the worker underground is necessarily a business matter; there is no reward for him other than the pecuniary one. His work is very exhausting; he starts early from home and returns late, and the rewards should be high enough to enable him to save and establish himself and his family on the spot, free from care and want. Reckless waste, extravagance, dissolute and poverty-stricken lives have frequently been the order of the day amongst miners in the past, indirectly making for high mining costs. Economy, frugality, self-control, enrichment of life, is to be the order of the day in the future. To attain these benefits in a mining community we must establish a better type, a better ideal, and in the attainment of this broadened, fuller, more perfect life and conditions, the method of payment will have a marked, a most material, effect upon efficiency.

The Chairman: I am sure you have all appreciated Mr. Austin's reply, which has sometimes attained to flights of eloquence to which we are not accustomed in this Society, and yet I think it will be found on looking into it that the matter is as good as the manner. Although in some departments of gold-winning we may be able to give points to the rest of the world, yet in the underground work it is evident that we have a good deal to learn.

THE ORIGIN OF THE GOLD IN BANKET

(Having reference to Prof. J. W. Gregory's paper on the same subject, read before the Institution of Mining and Metallurgy.)

(*Read at January Meeting, 1908.*)

By J. S. Curtis (Member).

DISCUSSION.

Mr. T. Lane Carter: I have only had time to take down a few notes on Mr. Curtis' paper, which deals with a very big subject. As a matter of fact, a number of people have attempted to describe the origin of gold in the banket, and they have come to very different conclusions. It is a question which should be tackled by our Geological Survey, and I trust that, in the days to come when the Geological Survey has got through discussing coal and granite formations and so on, they will try to find out for us how the gold got into the banket.

All of you who are acquainted with the work done by the Geological Survey in the United States know what able papers have been given on such auriferous districts as the Rand. I might mention the paper published some years ago on the Cripple Creek district, and one published still further back on Leadville, Colorado. These are monographs, which are authoritative on these particular districts, and I hope we may have the same experience here, and that the Geological Survey will yet give us its final word on this important subject.

There is one man of all others who I wish could have come here and discussed this question, and that is the man who might almost be called the father of the modern science of ore deposits. I mean Prof. Posepny, of Bohemia. In his classical work on Ore Deposits* he mentions the Rand, but unfortunately, on account of the enormous amount of work he had to do in Europe, he never got out to this country, but I think he could have spoken with the greatest authority if he had come here and made a long study of this question. I will read you what he said under the heading of South Africa. Unfortunately he only had a few specimens, and he bases his opinion of the formation here on these specimens and the literature on the subject which had been published up to the time of his death. "In South Africa, at Witwatersrand, in the Transvaal, ancient detrital deposits have yielded a considerable gold production. According to E. Cohen, the Witwatersrand consists of sandstones (which closely resemble that of Table Mountain, at the Cape of Good Hope) and dolomites of high age—undoubtedly palæozoic. Conglomerates of the same age, intercalated among these strata, occur in the vicinity of Johannesburg in several nearly parallel outcrops, and are for certain distances tolerably rich in gold. They are composed mostly of quartz pebbles, sometimes with fragments not entirely rounded, which are united by strong, ferruginous, arkose-like cement. The quartz pebbles are sometimes porous and impregnated with hydrated ferric oxide, thus presenting the peculiar corroded appearance so characteristic of auriferous quartz. The gold occurs chiefly in the cement, immediately next to the pebbles. It is mostly coarse-grained, and sometimes even crystalline. The latter circumstance has raised the question whether the gold has not here been chemically precipitated, and hence whether these are detritus deposits at all. My standpoint in this discussion is that I do not deny the presence of chemical influences in the detrital deposits, although I have personally not happened upon them. So far as I can judge from the treatises of A. R. Sawyer and Charles A. Alford, and from a specimen of the Witwatersrand conglomerate kindly sent to me by A. H. Halder, it is my opinion that the gold was mechanically brought into the conglomerates from still older auriferous

* Ore Deposits, by Prof. P. I. Posepny, published by American Institute of Mining Engineers.

quartz veins occurring in the rocks which form the basis of this palæozoic formation; and since the idea of a later entrance of the gold is excluded by the almost vertical position of the conglomerate beds near Johannesburg, I suppose the gold to have been deposited at the same time as the detritus. The greater part of the gold, as has been said, occurs in the cement. There are no vein-like deposits whatever in the conglomerate; and the only chemical changes which could be presumed are confined to the decomposition of pyrites and the segregation of its contained gold."

Prof. Posepny's theory of the deposition of gold on the Rand is somewhat like that of Prof. Gregory, which the author refutes. Prof. Gregory claims that the gold has been redissolved and again precipitated, whereas Prof. Posepny simply claims that this is placer gold. The author has given us his ideas very clearly, and they differ entirely from those of Prof. Gregory. We may call the author an ascensionist or lateral-secretionist, I think, so far as Rand deposits are concerned.

We have then these three theories, two of which are alike, and the author's, which is entirely different from the other two. As I said before, I have the greatest admiration for Prof. Posepny's work, but seeing that he only had before him the literature published at that time (which was extremely meagre), and only a few specimens to form his opinion on, I feel I must go with the author. It strikes me that the way he sums up his case covers the facts more satisfactorily than either Professor Gregory or Posepny does.

As regards crystalline gold, I remember in 1897 seeing a very beautiful gold crystal, which was found in the Pioneer mine. I understand that these crystals are fairly common, but that was the first and the last that I have seen. This bears out what the author says. Then, too, we find every now and then remarkable masses of gold on the Rand. It is not correct to call them nuggets. Before the war there was a remarkable one found in the Rose Deep, I believe. It was certainly not a nugget. It was a mass of gold deposited from a solution. At the Ferreira mine, in 1904, another remarkable mass of gold was found, similar to that of the Rose Deep.

The author refutes one remark made by Prof. Gregory in regard to the occurrence of gold in the footwall. I do not see what reason Prof. Gregory had to make this statement as it is incorrect to say that the greater occurrence of gold in the footwall is general, for the gold occurs in the hanging-wall as often as in the footwall.

I also agree with the author when he says that Prof. Gregory's remark with regard to the redistribution of gold after solution is far-fetched and complicates matters, and I do not see that it is necessary at all. Another point that the author refutes is in regard to the gold in the bastard reefs. This is not correct either. Those of you who have examined the country rock and these bastard reefs very carefully, know that gold often occurs in both places in weighable quantities. The bastard reefs do not contain much, but they certainly do contain an appreciable amount. The author refers to the "bullet" pyrites at Rietfontein. I do not know whether he is acquainted with the West Rand, but there is a very interesting occurrence on the Lancaster mine in the Kimberley reef series. As you know, this series is not worked anywhere on the Rand except at the Lancaster and the Lancaster West. Out there it is their main gold producer. In the Kimberley series you often see pellets of pyrites of varying sizes. There seems to be a connection between the occurrence of pellets and the amount of gold in the rock.

Another point which the author brings out is that gold jumps from one reef to another. A most interesting point on the Rand is that a reef which is of very good grade in the central Rand increases or diminishes in value, as the case may be, as you go either east or west.

The author mentions also finding several other minerals in the banket. I can bear out this statement. We have very often found interesting collections of minerals in the banket itself. In one place on the West Rand we have quite a large number of faults, and there has been a large amount of water action, and in consequence there is some deposition of different minerals. I have a piece of banket which is full of galena and zinc blende, and of high gold value.

I disagree somewhat with the author when he says that the bigger the pebble the richer the ore. I can show him in my district some of the finest and most superb looking pebbles the world ever saw, and there is no reef in the country which can compare with it in looks, but unfortunately when you assay it you find that the gold is missing.

With regard to the question of chutes versus patches, I agree with the author that we get well defined chutes on the Rand. Besides the Central Rand chutes there are several others, one of which I am well acquainted with, being the Champ d'Or chute. There is one of the best examples on the Nigel mine. These bear out the author's statement where he refutes Prof. Gregory's assertion that chutes do not occur on the Rand. Prof. Gregory says they are patches, but I agree with the author that we get well defined chutes on the Rand.

The Chairman: We all thank Mr. Lane Carter for his enlightening remarks. I should like to make a few remarks myself. In discussions of this sort it would be well if chemists and geologists would consult together, for as a matter of fact I think the two fields are kept too wide apart. A chemical point which has some bearing on this discussion, is the extreme instability of all the compounds of gold even at comparatively low temperatures. There is, as far as I remember, no compound of gold which will stand 300° C., so that if the gold has come up from any depth it is difficult to see how it could have come up as any sort of compound of gold in solution. The alternative supposition to that made by geologists is that the gold might be in simple solution in water. Now it is true that for the purpose of expounding the modern theory of solution it is necessary to assume that all metals are soluble in water, but it has been found that the solubility of gold in water is exceedingly small, possibly the smallest of all the metals, and something like one part in a million millions. The other point is with regard to the physical properties of water. Geologists sometimes give the impression, in talking of other aqueous problems, that water can exist at any temperature. Now the critical temperature of water is about 330° C., a comparatively low temperature, and one which is attained at comparatively shallow depths in the earth, whence it follows that no sort of aqueous solution at all can exist above 330° C. One must therefore assume from that, that if the gold really has come from any great depth, it cannot have come up with water as a solvent; and I therefore think that the theories which make iron pyrites the gold solvent, are far more likely than the others.

EXPERIMENTS IN FIRE ASSAYING AT THE REDJANG LEBONG MINE, SUMATRA.

(Read at September Meeting, 1907.)

By G. B. Hogenraad (Associate).

DISCUSSION.

Mr. J. E. Clennell (contributed): Although I have not had the pleasure of seeing this paper in the September *Journal*, I gather from the discussion on it that it covers the same ground as a report which I received some time since from Mr. Hogenraad, and hope I may be allowed to make a few comments on the points raised, if the paper is still open for discussion.

I entirely agree with Mr. Wilmoth and Mr. Whitby that the use of borax was not the cause of the losses of gold and silver observed; in my opinion, the low results with the original flux were chiefly due to insufficient litharge, or to excess of charcoal, rendering the charge somewhat infusible and hence causing mechanical losses. As this flux had formerly given satisfactory results, I am inclined to think that some change has occurred in the average character of the samples dealt with at the Redjang Lebong assay office, probably an increase in the amount of pyrites and possibly also of selenium. However, the point of chief interest is the influence of borax on the assay charge, and as I have recently had occasion to test this point in reference to another class of ore, the conclusions arrived at may possibly be of some interest to assayers on the Rand.

Without going into details, I may say that the ore on which these tests were made was similar in general character and appearance to the Rand banket, but was practically free from iron pyrites, though carrying considerable quantities of iron in the form of black oxide, perhaps titaniferous, and that a large part of the gold appears to be intimately associated with the oxide of iron.

An average of 297 assays made without using borax gave the result 18·169 dwt. An average of 297 assays made on the same samples, and with similar fluxes, but containing borax, gave the result 18·185 dwt., showing a slight advantage for the borax flux. Unfortunately, I have no opportunity of experimenting on an ore rich in silver, but I think it may safely be concluded that the use of a moderate amount of borax is at any rate not detrimental in the assay of free-milling gold ores.

In the course of these experiments the following points were observed :—

(1) A large excess of borax gives a hard, stony slag, very difficult to separate clean from the lead button. In hammering out, the slag flies to pieces violently, carrying with it a portion of the lead; some part of it is sure to be lost, unless extreme care be taken in collecting all the fragments. This may very possibly be a cause of some of the observed losses through the use of borax.

(2) When no borax at all was added, the button usually separated quite clean from the slag; the latter was amber-coloured and, while cooling, a scum of straw-coloured crystal collected on the surface. The addition of borax rendered the charge distinctly more fusible; this seems to be contrary to Mr. Hogenraad's view, as he apparently ascribes the sticking of the lead to the moulds to the extreme fluidity of the non-borax slag. I should be inclined to draw the opposite conclusion; the fact of the lead leaving the pot before the slag, would seem to show that the latter was not sufficiently fluid.

(3) The non-borax flux was considerably more deliquescent than the ordinary borax flux; this,

however, caused no inconvenience, unless the fusions happened to be left in the moulds for some hours after pouring.

(4) By using a *small* quantity of borax in the charge, not exceeding 5 to 10 gm. per A.T. of ore, it was found that a uniform fusible slag was produced without any noticeable amount of the scum above mentioned; the buttons could be detached from the slag by a slight blow, and none of the lead adhered to the slag.

With regard to the reducing power of charcoal on litharge, Mr. Hogenraad is, no doubt, correct in stating that the button of 34 to 35 gm. lead is obtained by fusing a mixture of 1 gm. charcoal with an excess of litharge, in the absence of interfering substances. But such conditions do not obtain in an ore assay. A part of the charcoal may be consumed in reducing metallic oxides or, in an uncovered crucible, may be oxidised by the atmosphere. On the other had, a part of the litharge may go to form silicate of lead with the quartz of the ore, this compound being only reduced with difficulty by charcoal, and some lead may be produced by the reducing action of metallic sulphides, etc., on the litharge. Hence the weight of lead obtained cannot be predicted from the composition of the flux. In general, an excess of litharge over the theoretical amount should be used. In the case of the ore on which my experiments were made, the average quantities of lead obtained per gramme of charcoal in the charge, with three different fluxes, each containing soda, borax, and a moderate excess of litharge were respectively 19·3, 18·7, and 18·3 gm., this low result being probably due to the oxidising effect of the ferric oxide in the ore.

The fluxes finally adopted as giving, on the whole, the most satisfactory results, were as follows:—

Class of Samples.	A Mine and Mill.	B Cyanide Originals and Slimes.	C Cyanide Residues.
Flux: Parts by weight:			
Bicarbonate of soda ...	2,500	2,400	3,600
Fused borax glass ...	200	200	400
Litharge	2,500	2,400	3,600
Charcoal	60	50	60
Weight of charge:			
Ore for assay ...	1 A.T	2 A.T	4 A.T
Flux (grammes) ...	120	200	300
Cover of soda (grms.) ...	10	15	20
Crucibles used (Battersea)	G	H	No. 12
Cupels (Mabor) ...	No. 7	No. 8	No. 8
Approximate weight of lead buttons obtained (grammes)...	30	40	45
Lead reduced per grm. charcoal (grammes)	22	20·2	19.2

(varies slightly with quality of charcoal and nature of ore).

It is perhaps necessary to point out that the charges adopted were partly determined by the stock of fluxes and crucibles available, and could, no doubt, be improved under ideal conditions; for example, carbonate of soda might advantageously be used instead of bicarbonate.

I have purposly omitted all details of my experiments, as these have already been submitted for publication elsewhere.

SOME FEATURES OF SILVER ORE TREATMENT IN MEXICO.

By W. A Caldecott, B.A., F.C.S. (Member).

Part II.—Theoretical Considerations.

Mr. W. A. Caldecott (contributed): I wish to point out an error which has occurred in the second part of my paper. On p. 267 of the March *Journal*, first column, 10th line, read "*50* c.c. of each of which was titrated with *0·01%* sodium sulphide solution," instead of as there printed.

NOTES ON RAND MINING.

(Read at March Meeting, 1908.)

By Tom Johnson (Member).

DISCUSSION.

Mr. A. L. Edwards: The author in his valuable paper puts forward the suggestion that the sand residues from the cyanide works should be hauled to the mine shaft and utilised in filling up the old stopes, claiming that the residues could be hauled to the shaft at a cost considerably below that of hauling the same material to the dump. As far as comparisons of mere costs go, it will at once be conceded that he is right, but the more pertinent question which will appeal to those most conversant with the physiological effect, which the combination of cyanogen and the acid waters of the mine will produce is, "is it safe for the workers down below?" and we must bear in mind that the health and safety of the men underground is of even greater importance than economy of working costs, however desirable this might otherwise be.

It is essential that in our endeavour to reduce working costs we must not be allowed to overlook the health and welfare of the employee, for, anxious as we all are, to reduce working costs to the absolute minimum, and willingly as we would all help to attain this highly desirable end, we must recognise the fact that this is one of the economies that cannot be recommended for adoption, because the health and safety of the men employed in the mine must be the guiding and deciding factor in this particular instance.

It may not be out of place here to point out that this intended method of dealing with the sands residues has already been tried on these fields and abandoned. When the cyanide process was first being adopted here, it was one of the conditions obtaining in the contract between a company and a syndicate that the whole of the treated sands had to be carted to the company's mine and dumped down the old stopes. This dumping continued until the company's manager found that the results that ensued were not conducive to the health of the employees engaged below. It may be information to some, that Blyth in his book on poisons, p. 214, draws attention to the fact that all cyanide workers invariably suffer from giddiness, noises in the ears, difficult respiration, pain over the heart, a feeling of throat constriction, loss of appetite, nausea, etc.

The author in his endeavour to reduce working costs may rest assured that, he will have the whole-hearted support and endorsement of the members of this Society, and it will indeed be a glorious day for the mining industry when the present disproportion between the mining and milling costs shall have been sensibly reduced. The cost of mining and hauling a ton of rock is approximately 10s. per ton to-day, yet a ton of ore can be treated in the reduction works and have 95% of its gold values won at an inclusive cost of 5s. Now the difference between these two amounts is altogether too great to allow of their being accepted as standards of what the future working costs should ultimately be, and it is to the reduction of costs in this direction that we are all earnestly looking forward.

The meeting then closed.

RESCUE APPLIANCES: LESSONS FROM GLENCOE.

(*Read at March Meeting, 1908*).

By H. Kestner.

After a historical introduction in which the author discussed earlier forms of apparatus, he proceeds as follows: The first impulse to construct a circulation rescue apparatus was given by Prof. Albert Habets of Liège. At the Brussels exhibition, there was introduced for the first time, in the respiratory appliances of Messrs. Theodore Schwann and E. Schulz, a principle entirely different, and which appears thoroughly worthy of study as an advance towards the solution of the problem in which we are interested. As my paper would become too extended in reviewing the ideas of Prof. Schwann, I will abstain from describing this special apparatus. However, I would here mention that it has been recognised, that he had actually produced portable oxygen breathing appliances half a century ago. It is especially to be noted that his ideas were not limited to those appliances in which gaseous oxygen under pressure could be carried about, but that he had already fully considered the employment of a material for the simultaneous absorption of carbonic acid and evolution of oxygen, in the form of hydrated barium peroxide, in a similar way to that employed in the pneumatogen of Prof. M. Bamberger and Dr. Fr. Boeck.* It is difficult to understand why the Schwann apparatus had for so many years been entirely forgotten, although it had been twice publicly exhibited, and why the same appears to have been the case with the apparatus of Mr. H. A. Fleuss, which was designed on similar lines. This latter apparatus, exhibited in the year 1880 in Great Britain, was much discussed at the time; it was practically employed in the Seaham Collieries in the county of Durham, and subsequently modified at the German Government mines at Saarbrücken.

The employment of the Schwann apparatus was vehemently opposed by Prof. Paul Bert, who maintained, that the respiration of pure oxygen was injurious to man. Prof. Schwann was able completely to refute this view by a series of exhaustive experiments upon men and animals. The refutation was not, however, very strongly believed in, and the belief in the injurious effects of breathing pure oxygen exists even at the present date, a circumstance upon which I will touch subsequently. One circumstance, which must have hindered, in a great measure, the employment of the Schwann apparatus in general mining practice is, that it did not supply the quantity of oxygen really necessary for men undergoing muscular exertion. Prof. Schwann assumed that the quantity of 30 cub. in. (0·3 litre) of oxygen per minute was sufficient for the wearer of the apparatus Whether he considered this amount really sufficient for a man engaged in active work, or whether he set the figure so low in order to diminish the weight of the apparatus to be carried by the operator, I am unable to say. It is, however, clear to-day that it is not possible to maintain human breathing satisfactorily with the above quantity of oxygen, when there is violent muscular exertion. This matter has been made clear by the physiological experiments of various investigators, amongst whom I may mention Dr. Leo Zuntz. In his "Investigations upon the supply of air and the conversion of

* See this *Journal*, vol. vi., p. 197, by A. Prister.

energy in cyclists" (Untersuchungen über den Gaswechsel und Energie-Umsatz des Radfahrers, 1899, Berlin), the consumption of oxygen during the period of rest of the human body is given as 16·1 cub. in. (263 c.c.) per minute, as compared with the value, for rapid movement upon the bicycle, of 143·4 cub. in. (2,331 c.c.) per minute, so that violent exertion requires about 8·9 times as much of this gas as is absorbed when the body is at rest. The speed attained on the bicycle with the above high consumption of oxygen amounted to about 13·294 miles (21·394 km) per hour, which can be looked upon as an ordinary speed for an experienced cyclist.

Experiments performed at the Shamrock mines in Westphalia have led to the conclusion that, in a breathing appliance, the regular supply of 122 cub. in. (2 litres) of oxygen per minute is necessary, and that this is amply sufficient for vigorous exertion. These tests do not pretend to have the value of experiments such as might be carried out in a scientifically equipped laboratory by the aid of trained experimenters. Through the above-mentioned experiments of Dr. Leo Zuntz and other investigators, the experiments at the Shamrock mines received a most valuable confirmation, and these experiments laid the foundation for the principles controlling the design of the magazines for oxygen under high pressure for breathing-appliances. The modern breathing-appliance differs in the following notable points from that devised by Prof. Schwann, besides the above noted modification in the quantity of gas:

1. Valves have been done away with and replaced by the automatic circulation of the gases through the regenerating vessel without making any demands upon the respiratory muscles; and by bringing the fresh gases direct to the mouth of the bearer of the apparatus.

2. The mechanical purification of the regenerated gas, together with its simultaneous cooling and removal of moisture, by a porous absorbent placed close behind the connecting pipe in the regenerating vessel, the pipe being placed behind the regenerating vessel.

3. The automatic unloading of the air bag containing respirable air, carried on the wearer's breast, by means of a spring escape valve.

4. Closing the nose by application of the smallest possible surfaces, namely, by plugging the nostrils.

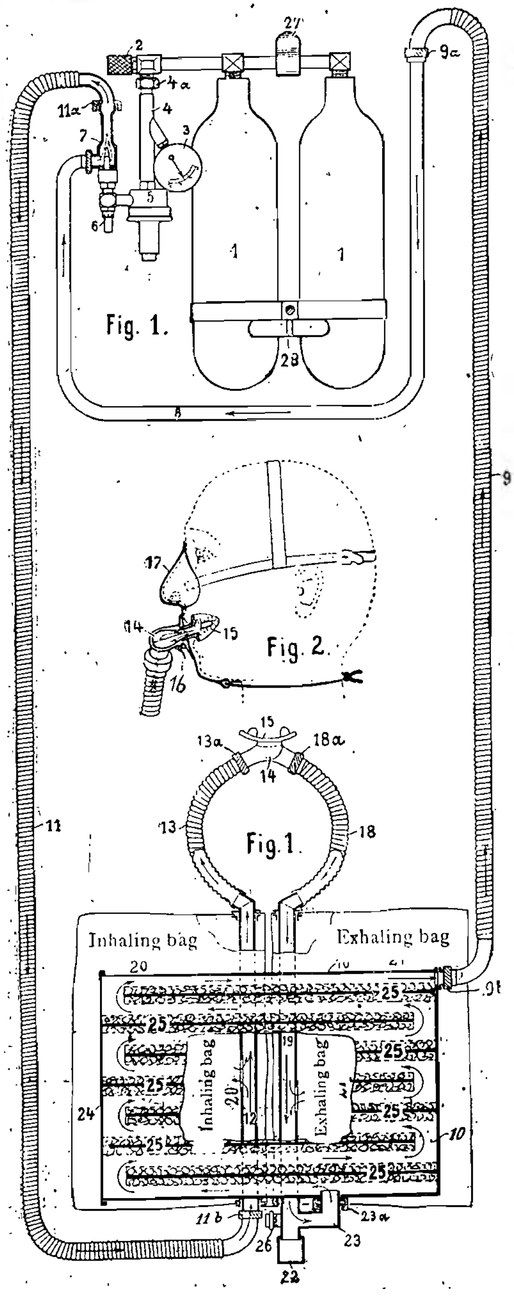
5. By adapting the outward form of the entire appliance to the narrow space generally available in accidents of the kind here referred to, and the protection of the apparatus against external injury.

How these ideas have been worked out will be shown by the construction of the "Shamrock" apparatus, which, I may say, was exclusively employed by the rescue party in their work at the Courrières mines. The idea of doing away with the valves was already worked out in the year 1896, in the pneumatophore, which was brought out by Messrs. Rudolf Walcher von Uysdale and Prof. Gustav Gärtner.

I do not propose to enter upon the question of valve defects, which have been exhaustively referred to in papers upon the subject. Various engineers have, at different times, arrived at the conclusion that the power contained in the highly compressed oxygen is sufficient to cause the expired air to traverse the vessel, wherein it is freed from carbon dioxide. This object has here been attained by injector 7, delineated in the diagram. The oxygen in the two bottles is compressed to 1,764 lb. per sq. in. (120 atm.)

The "Shamrock" rescue apparatus exhibits very considerable improvements as compared with other existing constructions. In particular the so-called automatic device and the injector have beeu improved, so that the apparatus is now capable of yielding a guaranteed circulation up to 60 litres (about 15 gallons) of purified air per minute. The mouth jet of this apparatus is unique, since every possibility of dead space is avoided. The purified air, rich in oxygen, is introduced directly into the mouth of the wearer of the apparatus, while the exhaled breath is also sucked off at that point, so that no exhaled air can be inhaled again. A very noticeable and very appreciable advantage lies in the fact that the usual nose clip is done away with, the use of which had the disadvantage that it could be knocked off, thus entailing great danger to the user. The clip is replaced by a nose cap, which not only securely retains the plugs of cotton which, greased with vaseline or the like, are inserted into the nostrils, but also makes it impossible for the mouthpiece to drop out of the mouth. The mounting of the regenerator has been retained on the chest and as near as possible to the mouth in view of the great advantages of this arrangement. The construction of the regenerator, however, has been completely altered, and it ensures a more perfect absorption of the carbonic acid than has ever been attained before. The regenerator is so arranged that it can be easily changed. The same is manufactured in two different types. In the one type the regenerator may always be refilled, while in the other type the complete regenerator is thrown away after use. The air bags, which act as reservoirs, are mounted between the regenerator and the chest, so as to protect them and also to prevent their being compressed. They are of such a size, and are connected to the circulating current of air in such a manner, that even in the event of the hardest work being done, a sufficient supply of fresh air is available, and they also contain sufficient room to permit of comfortable exhalation.

The mode of operation of the apparatus is briefly as follows:—After the check valve 2 has been opened, the compressed oxygen, contained in the two steel bottles 1,1, passes through the T-pieces 4, which is provided with a pressure gauge 3, to the reducing valve 5, which is provided with a safety valve 6. The pressure of the



oxygen is hereby reduced to about 1 atm., and it then enters into injector 7. The injector, by means of the high velocity of the flowing oxygen, sucks the air (purified from carbonic acid) coming from the regenerator 10 through the pipe 8 and hose 9. The purified air is then mixed in the injector with fresh oxygen and is pressed by

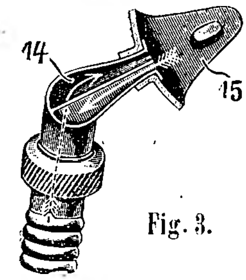


Fig. 3.

the same through the connecting hoses and tubes 11, 12, 13 and the mouth jet 14 into the mouth of the wearer as good, wholesome air, rich in oxygen and purified from carbonic acid.

The mouth jet 14 is divided into two chambers by a partition wall, as shown in figure 2. Through the upper chamber the purified air, enriched in oxygen, is forced directly into the mouth of the wearer of the apparatus, while the exhaled air is sucked off through the lower chamber. Thus, in this arrangement, any possibility of dead gas space is avoided. Any saliva which might be formed, flows through the tubing 18 and the pipe 19 directly into the saliva trap 22, which is closed with a screw cap. The nose of the wearer is closed by plugs of cotton, which are inserted into the nostrils and which are greased with vaseline or the like. They are prevented from dropping out by the nose cap 17, so that a perfect and comfortable means of closing the nose against the access of the surrounding noxious gases is afforded, the mouth jet 14 being at the same time securely retained with the mouthpiece 15 by the strap 16. The exhaled air is carried off directly from the mouth, as already mentioned, by the mouth jet 14, hose 18 and tube 19, and is admitted into the regenerator 10. The exhaled air passes through the elbow pipe 23 into the lower part of the regenerator 10, through which it flows in the direction indicated by the arrows, being then sucked off at 9b. As shown by the drawing, the regenerating substance, caustic potash and kieselguhr, is arranged in several layers 25, 25, in the regenerator 10. These layers consist of wire cages, there being this great advantage in their construction, that both the upper and the lower surface of the carriers of the regenerating substance are rendered available. In view of the comparatively large surface created thereby an exceptionally good absorption of carbonic acid is effected. In the middle of the several boxes 25, 25, an impervious mass of absorbing substance is arranged, which prevents the air to be purified from passing through the regenerator in any other but the predetermined manner and absorbs at the same time any moisture that might be formed. The regenerator is furnished either completely filled and is thrown away after use, or it is provided with a removable cover 24 and may be refilled at the mine by the insertion of a new charge 25, 25, so as to become again available for service. This arrangement possesses the advantage that it is possible to control the condition and quality of the regenerating substance and by this means accidents are avoided. The regenerator is easily exchangeable.

The pipes 12 and 19 pass through the inhaling bag 20 and through the exhaling bag 21 respectively, and are in communication with these two bags by suitable openings. The inhaling bag 20 serves as a storage receptacle for the purified air enriched with the oxygen, in order to be able to dispose of a sufficiently large supply for inhaling purposes when an extraordinarily large amount of air is needed. The exhaling bag 21 serves as a compensator when quicker exhaling takes place.

Inasmuch as the apparatus furnishes considerably more purified air, enriched with oxygen, than is required under ordinary operating conditions, the lower end of the pipe 19 is provided with a blowing-off valve 26, through which the excess can escape. In order to keep the apparatus always ready for use, the regenerator must be protected against the entrance of atmospheric air, while it is not in use, arrangements being provided for this.

The contents of the two bottles of oxygen are sufficient for fully two hours' work, pressure gauge 3 indicating exactly the number of minutes the oxygen contained in the bottles will suffice for. The hand of the pressure gauge must point to 120 after charging.

The construction of the apparatus is such that the different parts are distributed both upon the chest and back. The part which rests upon the back is completely protected, if desired, by a flat knapsack, and as there are no projecting parts the possibility of it getting caught and being injured is almost impossible. The wearer of the apparatus is not hindered in any way in his movements and is able to enter with the apparatus into the most difficult and narrowest places of the mine. The covered opening provided on the knapsack permits of the pressure gauge being observed.

The range of vision is not interfered with in any way in this apparatus, smoke goggles being needed only when inconvenience or injury to the eyes, by fumes or the like, is to be feared; in most cases it is impossible to work without goggles.

The same apparatus may be used in connection with the helmet, and in this case the two hoses 13 and 18 are screwed directly on to the helmet.

As regards the analysis of the samples of air taken in certain experiments with the Shamrock apparatus, I wish only to refer to those which were taken from the tube leading to the mouth and close to the mouth during the period of inhalation of the wearer. These analyses have been published in "Die jüngste Entwicklung der Atmungsapparate unter besonderer Berücksichtigung der auf der Zeche 'Shamrock' 1/11 neuerdings ausgeführten Versuche," by Mr. O. A. Meyer, in *Glückauf*, 1904, vol. xl., p. 1123. Seven samples were taken, and the average analysis showed :—

Carbon dioxide... 3·87% Oxygen ... 31·3%

After an uninterrupted period of one hour seven minutes 3·2% of carbon dioxide was recorded, being notably beneath the above-named average contents. Thirteen minutes later, however, the carbon dioxide rose to 3·6%, whilst an hour and 37 minutes after the commencement of the exercises, the carbon dioxide had risen to 7%. Although these results were not in every respect satisfactory, they, nevertheless, showed a notable improvement over the injectorless pneumatophore.

The result of scientific investigation, that the supply of an excess of oxygen would not do away with the evil consequences of a simultaneous excess of carbon dioxide, was of the greatest importance in the design of the breathing appliances and in the regulation of its mode of working.

It was recognised that it was necessary to construct the apparatus so that the exhaled air should be removed as easily and as rapidly as possible from the mouth and delivered to the regenerator, whilst fresh air should take its place. These investigations led to the construction of the mouthpiece as shown on the diagram, from which you can see that there are two different passages, one for the inhaled air and one for the exhaled air. After this modification had been made, the composition of the gaseous mixtures present within the apparatus was again determined by the analysis of numerous samples of gas. The results showed that the desired object was attained.

The regenerator should always be freshly charged with caustic potash before starting exploring work. The regenerator charges are packed and kept in air-tight closed tins. It has been considered advisable to prepare the charges in the form of cartridges. The mechanic in charge of the rescue apparatus should protect his hands from the action of the caustic potash by wearing india-rubber gloves when charging the regenerator.

The fact that the charging of an apparatus of the Shamrock type can be performed upon the mine is of the greatest importance, and the charging of the regenerator requires only a few seconds. A charged apparatus of the Shamrock type has been kept for about six months at the Shamrock mine, and analyses have shown that the caustic alkali had lost practically none of its power for absorbing carbon dioxide.

In the lower portion of the absorbing regenerator a certain quantity of kieselguhr is charged, the object of which is to absorb the moisture condensed from the exhaled air. The amount of moisture given off from the human breath may be calculated for a period of two hours at about 3·77 oz. (107 grammes). In addition to this quantity, an amount of saliva, differing widely with differently constituted people, has to be added, so that it may be certainly assumed that about 4 oz. of water have been given off by the wearer of the apparatus. As stated already in the description of the apparatus, the saliva is collected in the collecting vessel No. 22. Furthermore, the system of hoses and tubes already described presents the valuable subsidiary effect, that the gas, which is considerably warmed by the action of regeneration, is thoroughly cooled. The above-named tubes can easily be cleaned by unscrewing the stoppers.

A small piece of apparatus is combined with the breathing sack, which, although apparently very unimportant, is nevertheless indispensable. It is the relief escape valve No. 26 on the diagram. It has already been proved that the consumption of oxygen varies very widely in accordance with the muscular activity of the human body. If the appliance delivers a uniform quantity of oxygen, periods of deficiency and of excess of oxygen must ensue, as was foreseen in the construction of the Schwann appliance.

If the quantity of oxygen supplied is as abundant as it is in the Shamrock type, the presence of an excess of oxygen will naturally occur at those periods when the physical powers of the wearer of the apparatus have the least demands made upon them. At such times, so great a pressure is produced in the breathing bag and the tube leading to the mouth that the power of the lung muscles no longer suffices to discharge the air after respiration. The consequence of this is that gas, rich in carbon dioxide, accumulates in the lungs, and this might lead to asphyxiation by carbon dioxide. In order to avoid this, the blow-off or relief valve No. 26 is provided. It is an easily movable spring valve.

The leather nose cap has no relation to the exclusion of the air, but, on the other hand, it fulfils the very important object that it prevents the mouthpiece from dropping out. It is, therefore, impossible that sneezing or coughing of the bearer can cause the mouthpiece to drop out of his mouth, and at the same time he has not the feeling of being shut in, as occurs with helmet appliances, which is apt to make him nervous in critical moments. By distorting and opening his mouth very widely, he can also make direct communication with the external air. This is an immense advantage, for one has to deal in this matter so largely with questions of personal sensation.

A notable speciality of the Shamrock breathing apparatus is that it has been adapted in all its parts to the conditions existing in a mine damaged by accident, and it is the result of practical experiments. From various places the management of the Shamrock mine has received communications, giving the experience derived from various types of breathing appliances, under the most varying conditions of mining, and all the material so collected was employed for the further development of the apparatus. It is in this way that the external shape of the Shamrock has been derived.

The apparatus now in use at the Shamrock colliery, has a small electrical contact, which is in communication with an electric bell and the pressure gauge. As soon as more than half the oxygen is exhausted, the wearer is reminded by the bell sounding at intervals of five minutes that he must think of making his way out the danger zone. This warning arrangement makes the wearer easier in his mind.

A few words may be added about the protection of the eyes. Only in exceptional cases as, for instance, in fighting fire in a mine is it necessary. If, however, this exceptional case should arise, goggles are by far preferable to a helmet. It is possible to take the goggles off without interfering in the least with the breathing apparatus, and so wipe off perspiration, which accumulates in the angles of the eyes; this cannot be done when the face is covered with a helmet.

It was a strange coincidence that the first Shamrock apparatus in this country arrived about a fortnight before the Glencoe disaster occurred. About three weeks ago I went down to Glencoe with the "Shamrock" and the reviving apparatus, and I have pleasure in relating my experience there.

When I arrived at the mine and unpacked my apparatus, the apparently intricate construction created a somewhat unfavourable impression, but

I at last persuaded the mine captain to use it; and I can assure you, that he is at present a staunch believer in the Shamrock. At Glencoe I made the acquaintance of the Vajen-Bader helmet, which was tried there for rescue work. This helmet is, in my opinion, quite unsuitable for coal mines or for any kind of underground work in connection with serious accidents. The helmet is a leather cover, which the wearer puts over his head, and which is fastened to the body by means of straps. At the back of the helmet there is an air cylinder with pressure gauge. This air cylinder has to be filled on the surface with fresh air by means of an ordinary bicycle pump, and the air is compressed to about 25 lb. per square inch. The wearer of the apparatus is able to regulate the inflow of the air into the helmet by means of a small valve which he can easily reach. It is supposed that the air cylinder contains sufficient air for one hour, but I do not believe that there is sufficient air for half an hour, when there is violent muscular exertion. Another great drawback in connection with the use of this helmet in mining rescue work, is that the wearer is compelled to breathe over and over again the already respired air. You will find that the miner in rescue work will prefer a breathing apparatus without a helmet.

The lesson arising from Glencoe for the different Governments and collieries of South Africa, is the immediate creation of central rescue stations in the different coal districts. I believe that if an exploring party had been equipped with rescue apparatus they could have gone forward immediately after the third explosion and saved several of the valuable lives which were lost by the effects of the after damp.

The finest rescue station in existence is at the Shamrock mines, in Westphalia. The Shamrock mines have installed in a special room ten Sham rock appliances of the mouth-breathing type, and one of the helmet type. The latter is kept so that the rescue parties may be perfectly familiar with this form of the apparatus, and, in case of need, may be able to use it and render help at some mine where only helmet appliances are kept in store.

I now beg to submit to you my views regarding rescue stations for coal mines in South Africa. Each rescue station should be provided with the following appliances :—

Five circulation appliances; 2 oxygen reviving appliances; 5 to 10 safety lamps, of the electric dry battery and accumulator type; 2 or 3 light stretchers.

To these appliances should be added :—

(*a*) 1 or 2 steel bottles of large size, filled with oxygen; (*b*) the necessary pressure pump to transfer the oxygen from the large bottles into the smaller ones of the rescue apparatus; (*c*) smoke goggles, or helmets, for use in smoky atmospheres; (*d*) all necessary spares, such as pipe connections, spare hoses, spare mouthpieces, and especially spare rubber joint rings.

At the Shamrock mines a notice is posted in the rescue room, reading as follows :—

"Before using, test the pressure of oxygen by means of the pressure gauge, also the suction of the jet at the water gauge. Do not forget your electric lamp. Enter the mine only in parties of four men and a leader."

The leader is not allowed to work; his duty is only to control the men, to give them signals, and to carry in his hand an oxygen reviving-apparatus.

Though attempts may be made to produce artificial respiration in the well-known manner, by moving the arms, etc., of the patient, this will fail to accomplish the desired results in most cases. First of all, a person who is well experienced in this work is needed, and in the second, this artificial breathing by movement of the limbs of the patient, is absolutely out of the question in cases where the patient has also received such injuries as fracture of the arm or the like.

An apparatus, which in similar cases is always ready for use, and which is very well adapted for the purpose, is the oxygen reviving apparatus (patent of Dr. Brat). The operation of the apparatus is absolutely reliable, and the manipulation is simple, so that anybody can use the apparatus without difficulty, the emptying of the lungs and the exhalation taking place by the production of a kind of vacuum by means of an ejector, which acts upon the lungs.

It would be as well to have a transportable telephone apparatus in the rescue station, ready to be taken down the mine in cases of serious accidents. This apparatus could be carried by the rescue party through the gas-laden atmosphere and communication with the surface maintained. Everyone, I am sure, will acknowledge the great advantages of such an arrangement; it enables the manager, after he has seen what the position of affairs is, to keep strict control of the exploration of the mine. Rescue appliances have a real value only when the men are trained in the handling and use thereof.

Whenever any defect is discovered in the apparatus, due to an unsufficient supply of oxygen, excessive heat in the regenerated air, or any other cause, the wearer must, without delay, return to the shaft or safety station, accompanied by one fellow explorer. It is better to be sure than sorry. I think it is also absolutely necessary to keep one reviving apparatus underground, in case of unexpected gassing.

Proceedings AT Special General Meeting, April 18, 1908.

Prior to the ordinary meeting a special meeting of members was held for the purpose of considering, and if approved, adopting with or without amendment, the following proposal brought forward by the Council:—

The Council, having had under consideration the annual cost to the Society of the *Journal* and the general expenses of administration, etc., per member,* finds that Associate Members do not bear their fair proportion of the cost, and recommends:—

(*a*) That on and after the 1st day of July, 1908, the annual subscription for all Associates be increased from One Guinea (£1 1s.) per annum to One and a Half Guineas (£1 11s. 6d.) per annum; and

(*b*) That the necessary steps be taken to amend the Constitution and Rules accordingly.

The Chairman (Dr. J. Moir): You have heard the resolution read, and I have much pleasure in moving that it be adopted.

Prof. J. A. Wilkinson seconded.

Mr. W. Taylor: There is just one point that occurs to me, though I suppose that it has already been carefully considered. I know of one man—and one only—who says that if the Associate subscription is raised he will not continue to be one any longer. The reason is, that he does not take much interest in the Society, but he likes to read the *Journal*, and he thinks that is worth the guinea, but if the subscription is raised to one and a half guineas he will not think it worth his while to continue his connection with the Society.

The Chairman: I think there must be others in the same frame of mind. Of course, our attitude as a Council is that we cannot run the Society as a charitable institution, and so long as we are five or six shillings short of the actual cost of producing the *Journal* and carrying on the work of the Society we must cut the *Journal* down to correspond. Under the new conditions we hope and expect to be able to improve the *Journal*.

Mr. W. Taylor: It just occurred to me whether it would be better to have a smaller number of members at the proposed increased subscription than a larger number at one guinea.

The Chairman: This resolution is, of course, a recommendation of the Finance Committee, which considers that it is sound financially.

* The word "member" is here intended to mean also Associates and Students.

The resolution was then put and carried, *nem con.*

The Chairman: I wish to draw the attention of members to resolution 29a, as follows:—

That the Council shall have power to elect "Corresponding Members of Council" resident abroad, provided that the member of Council so elected be a full member of the Society and has paid his subscription up to and for the year during which he is elected as a Member of Council; to whom matters of local importance, that is for the district for which he is elected, may be referred for consideration.

This is the form of the recommendation as originally drafted by the Council. To this, however, an amendment has been proposed by Messrs. W. A. Caldecott and S. H. Pearce, as follows:—

"29a. That the Council shall have power to elect each year 'Corresponding Members of the Council' from among full Members of the Society resident abroad. Each such official shall hold office during the year for which he is elected, provided, however, that his tenure of office shall cease as soon as he shall cease to reside and be in the country which he represents. The Council may refer to such officials matters concerning the country they respectively represent for consideration and advice."

The Secretary: The President, who is unfortunately absent, wished me to express his regret at being away, and his agreement with the amended proposal submitted.

Mr. W. A. Caldecott: This amendment was drafted by a sub-committee, consisting of Mr. S. H. Pearce, Mr. Ralph Stokes and myself, with the courteous assistance of our hon. legal advisers as to wording, and has been unanimously adopted by the Council in place of the original formal motion. By the amendment it will be possible for the Council to appoint at once a successor, in case of any "Corresponding member of Council" leaving the country he represents, so that the Society's work may be carried on without any break. It is to be hoped, that official representation of the Society in the chief gold and silver mining districts of the world will result in an increase of membership and likewise of papers and contributions to discussion from a standpoint, other than that with which we are familiar here. The appreciative references made to the Society's *Journal* and work, by those metallurgists whom I had the pleasure of meeting in Mexico and the Western States of America, were naturally a source of great pleasure to me. I trust that the endorsement by the Council and the Society of the suggestion made some months ago, to appoint representatives abroad, will result in still further extending the reciprocal benefits, which are available to all who are associated with our Society in its world-wide scope.

Mr. Ralph Stokes: I do not think it is necessary to add anything to what Mr. Caldecott has said. The proposal commends itself at once to anyone who knows what an interest is taken in this Society in all parts of the world, especially in the countries where there are big goldfields. I know that in Australia and New Zealand the *Journal* is very carefully read and followed, and I may say if we could get this Society represented there, they would take even more interest in our proceedings.

Prof. J. A. Wilkinson, on behalf of the Council, proposed that the original recommendation be withdrawn in favour of the amendment.

Mr. T. Lane Carter seconded, and the amendment as the substantive motion was carried unanimously.

It was also unanimously decided that the Council should be empowered to take the necessary steps to amend the Constitution and Rules accordingly.

The meeting then closed.

The Annual Dinner.

The annual dinner of the Society was held at the Carlton Hotel, on Saturday night, April 11th, the President, Professor Yates, presiding.

After the loyal toasts had been duly honoured, letters of apology for absence were read from His Excellency the High Commissioner, the Prime Minister, the Colonial Secretary, Sir George Farrar, M.L.A., Sir Percy Fitzpatrick, M.L.A., Mr. F. D. P. Chaplin, M.L.A., Mr. J. G. Hamilton, M.L.A., and others. There were also present:—

Messrs. A. Aiken (Hon. Auditor), F. F. Alexander, G. S. Burt Andrews (President of S.A.A.E.), W. H. Angus, R. W. R. Atkin, R. C. Atkinson, S. G. Bartlett, Dr. B. Bay, S. Beaton, C. A. Bevington, R. G. Bevington, F. Blaikie, H. C. L. Bloxham, S. H. Boright, W. Bradford, A. Brakhan, H. G. Brickhill, H. Briggs, M.L.A., J. W. Buckley, D. Buckeridge, T. P. E. Butt, W. A. Caldecott (Past-President), W. McC. Cameron, T. Lane Carter (Vice-President), P. Cazalet, J. S. Cellier, F. W. Cindel, R. Clarkson, A. C. Cochrane, W. F. Cosser, G. L. Craik (Secretary, Chamber of Mines), E. H. Croghan, W. Cullen (Past-President), J. S. Curtis, R. Curtis, Hon. W. Dalrymple, M.L.C., G. A. Darling, W. H. Dawe, A. Dewar, C. L. Dewar, J. H. Dinwoodie, W. R. Dowling, A. L. Edwards, P. L. Edwards, W. M. Epton (President, Transvaal Institute of Mechanical Engineers), S. Evans, J. F. Ferguson, J. S. Fisher, J. A. Frerichs, W. H. T. Frost, J. Gau, D. Gilmour, K. L. Graham, J. Gray, J. C. Greery, Jr., Thos. Greig (Secretary, Transvaal Institute of Mechanical Engineers), W. A. A. Hahn, H. Hamel, H. L. Harland, J. Hawthorne, H. Hay, H. Hellman, R. Henderson, A. J. Herald, S. H. Herbert, A. Heymann, J. Higham, C. H. Hilditch, C. B. Hilliard, W. G. Holford, E. Hollis, E. Homersham, R. Hosken, W. Hosken, M.L.A., A. G. Hoyer, — Hurlbatt, J. Hussey, C. E Hutton, J. I'Ons, Dr. L. G. Irvine, E. H. Johnson (Past-President), J. N. de Jongh, W. E. Kimber, C. B. Kingston, A. Kinkead, M. Knight, R. N. Kotze (Government Mining Engineer), Dr. F. E. T. Krause, M.L.A., W. F. Lance, M.L A. (Chairman, Transvaal University College), G. A. Lawson, H. Lea, J. Lea, Q. J. Leitch, C. D. Leslie, A. Lichtenstein, J. Littlejohn (Hon. Treasurer), Dr. Loeser, Dr. C. Lyons, Dr. J. McCrae, Q. C. McMillan, A. McNaughtan, J. N. Meeser, W. W. Mein (President, Association of Mine Managers), J. T. Milligan, A. Mitchell, J. T. Mitchell, W. E. C. Mitchell, D.S.O., Dr. J. Moir (Vice-President), P. T. Morrisby, Rev. J. O. Nash, S. Newton, R. Niven, H. Owen, S. H. Pearce (Past-President), Lionel Phillips (President, Chamber of Mines), R. G. Campbell Pitt (President, Rand Pioneers), Dr. C. Porter (M.O.H., Johannesburg), C. J. Price, T. R. Price, C.M.G. (General Manager, C.S.A.R.), J. F. Pyles, *Rand Daily Mail* Reporter, A. Rennie (President, Pharmaceutical Society), A. Richardson, G. C. Richardson, J. Robinson (Registrar, Transvaal University College), H. Rosendorff, Fred. Rowland (Secretary), C. B. Saner, Dr. J. Schlesinger, E. R. Schoch, A. D. Scott, G. O. Smart, Gordon Smith, B. C. T. Solly, B. Southwell, Prof. G. H. Stanley, *Star* Reporter, S. H. Steels, A. F. Stewart, R. Stokes, W. H. Stout, H. F. Strange, C. R. Stringer, H. Taylor, J. Telford, A. Thomas, C. K. Thomas, J. F. Thomas, W. S. Thomas, J. Thompson (Mayor of Johannesburg), S. C. Thomson, H. T. E. Thorpe, W. E. Thorpe, *Transvaal Leader* Reporter, W. K. Tucker, M.L.A., J. A. Vaughan, Hon. J. de Villiers, M.L.A. (Minister of Mines), W. H. Visser, J. H. Vivian, J. F. Walker, R. C. Warriner, T. Watson, G. E. Webber, E. M. Weston, A. Whitby, H. A. White, Prof. J. A. Wilkinson, E. Williams, J. R. Williams (Past-President) and L. J. Wilmoth.

Dr. F. E. T. Krause, M.L.A., in proposing the toast of "The Chemical, Metallurgical and Mining Society of South Africa," said:—

"It is not the first time that I have had the pleasure of gathering round the festive board with you. It was quite in the infancy of your Society that I first came to Johannesburg, and I was the invited guest of one of your first Presidents. To-night I assure you I appreciate most highly the compliment you have paid me, and not only myself but I think also the Mining Regulations Commission, of which I have the honour to be chairman, in asking me to propose this most important toast, yourselves, the Chemical, Metallurgical and Mining Society of South Africa. Your Society, as far as I can gather, is one of the most important and largest in South Africa. Your objects are to a very great extent scientific and technical, and you are in the happy position that you have absolutely nothing to do with politics. The latter are, I understand, absolutely tabooed, and I congratulate you on that happy position, and I only wish that I myself belonged to such a Society. But on the occasion of an annual dinner politics seem to creep in merely because they seem to be everywhere, and if political as well as economic questions, are not discussed by you, are at any rate listened to by you in the form of addresses on those particular subjects. Anyhow, to-night I am not going to discuss politics, nor am I going to discuss economic questions. I think there are other speakers from whom we expect to hear more about those subjects than from me.

In going through the addresses last year I was struck with the pessimistic forebodings in the speech of the gentleman who proposed the toast of "The Prosperity of South Africa," and what specially struck me was, that the gentleman who spoke seemed to think that we were not yet at the end of the long lane of depression. He spoke also of the native labour supply, and I have taken down a few of his words. He said, 'There was at the present time a momentary surplus, but experience teaches us that it is only a passing phase, and that this condition of affairs will not continue for long.' I am glad to say that in reading the other day a speech of Mr. Perry's at the annual meeting of the W.N.L.A., that these gloomy forebodings have not been realised. Mr. Perry thought that they would not be realised, and that we are in the happy position that our native labour supply is more than sufficient for the requirements. I only mention this, because I understand that most of the members of your Society are directly or indirectly connected with mining, and, of course, you cannot carry on your work, unless you have the unskilled labour available. In going through the Proceedings of your Society, I was struck by the cordial relations which exist between the members. One finds, that while the criticisms passed on the papers are severe—in fact, though there is some very hard hitting in some of those criticisms—there is an absence of personalities, and the fair and reasonable nature of the criticism is obvious. It indicates, that those who take part in the discussions are not concerned with the personality of the speaker but merely with his opinions. It has been through the efforts of this Society, that the metallurgy of gold mining has reached such a high state of perfection in this country. It is not very long ago that the cyanide process was one which, it was thought could not be developed to the extent that it has been. And I take it that it has been through the efforts of your Society that we can say to-day that the cyanide process has reached its highest development in South Africa, a development which it has not attained in any other country in the world. What was formerly considered a good residue fit for the dump is now an original sand worth working in a profitable manner. But had it not been for a kindred society — the Engineers' Society — I do not think you would have been able to have worked so efficiently. When you devised improvements and new inventions it was through the engineers, who devised the necessary machinery to carry out your ideas that everything was brought to such a successful issue, and I think some recognition is due to them for the assistance they have given you.

I think also that the heads of the mining industry have shown that they recognise the good work that you have done. I am glad to say, that the impression I had, that the heads of the mining industry were only concerned with extracting the last grain of gold out of the ore was an erroneous one, and that they also are capable of recognising the good work done by others. We need not go into the details of the improvements your members have introduced, which have not been concerned alone with the useful side of mining, but you have considered what was of a wider and broader nature, your duty not only to the mine owner but also to the mine worker. I hardly think it is necessary for me to remind you of the papers, which have been read on safety measures in mining—miners' phthisis, noxious gases, and the compulsory introduction of cyanide antidote. All these things indicate and clearly show that your members are also humane people, and look on the humane side of mining. Your Society has gone further than that, its scope of activity is still wider, because I also find that you busy yourselves with the educational side of mining. I find, for example, that papers have been read on the education of miners. I think your President is very much concerned with that particular subject, judging from the evidence he has given before my commission, and your Society by busying itself with that subject is doing a great and noble work for this country. Members of your Society are also doing public work. I need hardly remind you that members of your Society have done good work on many of the commissions appointed by the Government, notably the Miners' Phthisis Commission, the Safety Catch Commission, the Single Outlet Commission, and at the present moment the Mines Regulation Commission. I am wedged in here by two of them, and therefore I think it shows that not only from a private but also from a public point of view you do work which is recognised not only by the mine owners but by the Government of this country. The educational work that members of your Society are doing is, I assure you, of a very useful nature. During the last few months I have been sitting on the commission I have learnt more about CO_2 than I ever knew before, and when I came into the room to-night the first thing one of your members did was to try and pump CO_2 into me. I do not think that the usefulness of your Society is to be entirely confined to gold mining. There is a much larger industry in my opinion, which is going to be developed in this country. The more we look for tin and other base metals the more we seem to find them. I quite admit that some of these metals are only found in the imagination. Some are only found in prospectuses, others again you will only find in shares, and others again you will only find in the Stock Exchange. At any rate, you come to the conclusion from these indications that tin, for instance, must be somewhere. And you find other base metals about if you only look for them in a proper manner. You are quite aware of the fact that the processes of reducing these ores are in a very imperfect state, and much is required of you in order to assist us to properly develop this industry. There is no reason, as far as I can see, why we should send our base-metal concentrates to Europe. If you consider the larger requirements of the mining industry as far as tin and lead are concerned, I think it will be patent to every one that it is worth while for the capitalists to go in for that particular class of investment. And at once I may say that, as far as the educational factor of your Society goes, it is time to teach our young people that branch of the industry, too. I see the Chairman of the Transvaal University College Council is present, and I think it is time they got the necessary equipment for this branch of work. Once you have taken on responsibilities they lead to others, and that is the case with your Society. Do not rest satisfied with the work that you have done, do not be satisfied with your past laurels, but look to the future, and in the future gain other laurels, laurels that I am certain you will gain, and your Society will in the future be a greater success than in the past.

The President, replying to the toast, said: As your President it falls to me to thank Dr. Krause for his eulogistic toast to our Society. We have made steady progress since our foundation in 1894, and our membership of over 1,100 includes, I am pleased to say, most of the departmental heads along the reef, as well as the majority of our managers, consulting engineers and financiers. We have members in most of the world's mining camps, and as an illustration of the far reaching nature of our work I would point out that during the past twelve months we have received papers and other contributions from the South Pacific, Great Britain, Western Australia, Austria, the United States, the Malay Peninsula, and the Arabian desert. It is a very great pleasure to the Council to frequently receive from many lands tributes to value of our discussions, discussions which continue to be noted for their freedom and thoroughness, and in this connection I may say that I am inclined to think that, after all, the warmth which is introduced into our meetings by our members taking off their coats, metaphorically speaking, is advantageous. To my predecessors, and to the past and present members of the Council, and last, but not least, to our Secretary, Mr. Rowland, is due the credit for making the Society what it is to-day. It gave me especial pleasure to hear Dr. Krause's remark that we, as a body, give considerable attention to the welfare of the workers along the reef. During one of our recent Saturday excursions Mr. Dalrymple, whose guests we were, remarked that he did not think scientific societies were sufficiently appreciated by the community. I agree with him. I do not think the value of their work has been properly gauged. Take this Society for example. Dr. Krause has mentioned that that wonderful process, the cyanide process, was largely developed by our members. Our papers and discussions have largely taught our millmen and cyaniders, and now they are teaching our underground workers. Our business is to elicit information and distribute it broadcast for the good of all concerned, thus educating them and increasing their efficiency, and this we do by means of our papers and discussions which keep them in touch with the latest ideas and practice, and thus enable them to keep abreast of the times. The technical societies of Johannesburg supplement the work of the Transvaal University College; they pick up the tow rope of education when the College throws it overboard, and they help workers to make headway, and avoid shipwreck on the rocks of ignorance and inefficiency. We must have efficiency on these fields, and efficiency is synonymous with education. Of what use is it spending £10,000 to discover the best rock drill if you cannot provide competent men to operate it? Already we are finding what an important factor is the man at the handle of the machine. I submit that those prominent countries, the United States, the United Kingdom and Germany, owe their position in the world largely to the high standard of education and efficiency of their people. I submit that education makes better men, better citizens, and cheaper workers, and it is largely to the credit of the Transvaal Government that it is displaying such an interest in this direction. Our farmers must be taught how to do justice to the land, and our miners must be taught how to break ground. The latent resources of this country are truly enormous, but a skilful people is needed, if we are to benefit to the full. I am afraid that I have drifted into preaching the gospel of education and efficiency, but I submit as my excuse that education has been a power in the past, that it will be a greater power in the future, and that the influence of this and other Societies, as educational factors, will increase as the years progress.

Hon. J. De Villiers, M.L.A. (Minister of Mines), in proposing the toast of South Africa, said: When I saw the distinguished company that is here present to-night, men who are eminent in science, and who have made the Witwatersrand what it is, the greatest gold producer in the world, I feel that it is a great honour and privilege indeed for me to have been asked to propose the toast that has been entrusted to me. It is on occasions such as these that one wishes, not indeed that one had the power of speech possessed by Demosthenes, as was wished by my friend, Mr. Neser, the other night, but that one had the command of language and the power of expression, which a brother scientist recently showed when he lucidly explained that the determination of sex was due to the anabolism and catabolism of the protoplasm. I shall have to content myself with less lofty and less formidable language. In proposing this toast the orthodox way of handling it is for the speaker to trace the causes of the depression through which South Africa is passing, and then to attempt to find a remedy according to the taste and fancy of the speaker. As a rule, he paints the depression in more or less lurid colours, generally I find that it is rather more than less lurid, and South Africa is usually painted as being at death's door. Now I wish most emphatically to protest against that view. To my mind, South Africa is sound to the core, and as a matter of fact, I think it may be said to be at the present time convalescent. A few years ago we had an attack of great extravagance and folly. We mistook that attack for signs of exuberant health, whereas, as a matter of fact, that was the real disease. Now we have come back to our sober senses, and South Africa, as I said before, is convalescent. I am not going to suggest any remedies. I find in my experience that the man who has a sure cure for anything is generally a quack. I am not going to attempt that impossible task to-night, but I do wish to discuss one or two points with you, which are of especial importance to you as residents of Johannesburg. The first point is the question of the unemployed. I wish to say here that it has been a great pleasure to the Government to see the hearty co-operation that was evinced by the public of Johannesburg through the Mayor, and by the Chamber of Mines through its President in assisting the Government to solve this very knotty problem. It is one of those questions, which one might almost call insoluble. I do not expect that we shall be able to solve the unemployed problem entirely, but what I do expect, and what I think I have fair grounds for believing is, that we shall be able to grapple with this problem and come to close quarters with it. So that finally we can sift the "Weary Willies" who will not work from the men who will work. A white man who wants to work is a great asset to this country, and we want to do everything in our power to keep that asset here. But we must also make those people, who will not work, understand, that they will meet with no sympathy from any of us. There are two directions in which the Government is working at the present time and where we expect the hearty co operation of everyone who is here to-night. You have all heard that the Government intends to start a mining school, to acquire a mine and to train boys of this country, no matter what their origin, whether they are British, Dutch, French or Germans, to become skilled miners. The Government feels that the mining industry has been in this country for 20 years, but the boys of this country have not had that share in the development of the mining industry that they are fairly entitled to claim, and the Government wants with your co-operation to give the young men of this country, who want to go in for mining, the opportunity of becoming skilled miners in time. We propose to acquire a mine and to make young men of 16 years and upwards go through a thorough course of training of three years, so that at the end of that time they can be turned out as skilled miners. But there is another direction in which the Government would like your co-operation. You will see that this is a very slow process, and the Government is very anxious that you should catch the young men who are now growing up and prevent them from also being on the streets in time, that you should give them the opportunity of going on your mines at present, and if they do not become skilled, they may become semi-skilled and be able to do some work on the mines. If the mine managers would assist the Government and take the youths who are growing up on to the mines they will be doing this country a permanent good, because they will absorb all the young men who want to come in and prevent them afterwards from walking about the streets in the shape of unemployed in the future. I do not propose to touch upon the question of white labour, but I wish to say this, that the old idea that used to be prevalent on the Rand, that work is derogatory to a white man, is past; it has been exploded. There is no kind of work that is derogatory to the dignity of anyone. If a man takes off his coat and works, he is bound to become a better man than if he loafs about the streets. And if we realise in time, that there ought to come a class of workers here who are somewhat skilled, and even unskilled, if we realise that and help it on, we shall be doing a great good to this country. I have been told, that amongst a certain portion of the workers of the Rand, there is hostility to this scheme of the Government. For the life of me I cannot see what the objection of the skilled miner can be to this. The Government does not propose, that he should be ousted from his position. He ought to welcome any competition, and he ought to welcome the fact, that the Government wants to train other skilled miners, because that certainly will not diminish his pay. And, moreover, if it is understood that the mines will also employ other men as somewhat skilled workers and still others who are unskilled at a less wage I do not see how it can possibly affect any skilled miner on the Rand. There will be an incentive, of course, for every man to work himself up, and in the course of time, if it is a man who will do his best, he will become a skilled miner, and he will naturally command the highest wage. But I want to say this to-night, that, whether there is opposition to the scheme or not, the Government means to go through with it. The other point is a question of the very greatest importance to you as South Africans. I address you advisedly as South Africans, because that is the point of view that is growing every day, and that is the point of view that I would like to impress upon you. Your President to-night has used a word which came home to me. He spoke of Johannesburg and other places, where mining is carried on, as mining camps. Johannesburg has long ago grown out of that. It is now the home of a permanent population. I shall leave this idea to be developed by Mr. Lionel Phillips, who will respond to the toast, but I want to say one or two words about it. You will have noticed that there are gradually forming two schools in South Africa upon this question of Unification or Federation. The one is for Federation and the other is for Unification. It always seems to me advisable in matters of this kind to take the larger view, to go for the highest, and if you find eventually that that is impossible of attainment, then do the next best thing, but at any rate strive to attain the highest. What I want to warn you against is this. Do not let us in the heat of debate gradually make these two schools oppose one another, because that will do the cause of closer union, which we all have at heart, more harm than good. If we cannot see eye to eye, if some are for Federation and some are for Unification, do not let us quarrel with one another about it, but let us try to understand each other's point of view. To my mind, we should go for the larger view, and strive for Unification. I think the question is not impossible of solution, if we go by gradual stages. Even if we federate on customs and railways, as I hope we are going to do, or with a court of appeal, then we shall be working in the direction of that high ideal for which we are all striving. I only want to say a few more words. I have been, as you know, for the last few days in the Congress of Het Volk in Pretoria and what has struck me more than anything else there, was the feeling which was evinced amongst the people, who come, most of them, from the country, towards the population in Johannesburg. That is, to my mind, one of the most hopeful signs of the times. There is a new spirit abroad in this country. There is a spirit of co-operation and of toleration, and it is for us, gentlemen, to take advantage of that spirit. Do not let us do anything now that will retard the progress of South Africa.

Mr. Lionel Phillips (President, Transvaal Chamber of Mines), replying to the toast, said: I do not propose to follow the Minister of Mines in his scientific excursion, but I will come down, more particularly, as I am responding for South Africa, to some of the other matters to which the Minister has referred. He has spoken to you of the unemployed question, and I do not propose to follow him at length on that subject, because to me this is hardly the occasion, and, in addition to that, it will be my duty in the course of a few days and in another place to make reference to that subject. But this I may say to-night, that the mines will do their best. We want the men who are taken on to do their best. We want the men who are in the mines to-day to give the other men a chance to do their best. And if we all work in that spirit, I think much can be done to alleviate the distress which, unfortunately, for the moment exists in this place. I believe it is only transitory, and I believe we merely have to study it, to deal with it with discretion, and we shall find, that it will pass. I am going to turn at once, with your permission, to that which is much deeper in my heart, and which, I believe, will be much deeper in your minds, a subject that the Minister of Mines merely referred to—the subject of closer union. Speaking for South Africa, it is at the moment the question of all others that occupies the minds of those who have the welfare of this great sub-continent at heart—those who think. I believe that there is a consensus of opinion in favour of Unification over Federation. It appeals to the imagination, and it is a higher ideal. Everyone, who speaks, hopes that we might have Unification if the difficulties are not too great, if it can be done—as they generally say. Well, I admit that the difficulties, either of Unification or of Federation, are supreme. They are so difficult, indeed, that I believe, on the whole, the easier thing to accomplish is the bigger one of Unification. I have studied, as many of you no doubt have done, a series of articles that was written recently by Mr. Hofmeyr, the Clerk to the Legislative Assembly. I think, in writing those articles, Mr. Hofmeyr has rendered a public service, for he has treated the matter in a thoughtful and dispassionate spirit. Mr. Hofmeyr exposes the difficulties in the path, difficulties of a stupendous nature, but I think that very exposition of the difficulties is an argument in favour of Unification. Mr. Hofmeyr suggests that we should have the stepping stones of Federation. Now, for my single self, I think that stepping stones in questions of this kind are exceedingly dangerous instruments to use. If we put a stepping stone in mid-stream we shall find every Colony in South Africa having other stepping stones to put beside it. Some of these stepping stones must be removed and replaced by others, and the result may be, that we will get a pile of stepping stones in the middle of the stream that might be washed away by the first flood that comes down. It is one of those cases, I think, in which we require a little boldness and spirit. Of course, we must examine with care the width of the stream that has to be crossed,—we must examine the respective banks. But when we have done that, I say it is a case of taking our courage in both hands and leaping over, as the intrepid horseman does in the hunting field. I propose to drop metaphor, because this is a subject which should be dealt with in very plain language. Any act of confederation, that we can conceive, must leave to the Colonies, as they exist to-day, a certain measure of power, and that means that it must give to the supreme Parliament only a certain degree of power. For example, if one Colony should say it desired to reserve in its own hands the native question, another the subject of education, another the manner in which the land laws were administered, and another still the control of the mining industry, then natives and education and land and mining would have to be excluded from the control of the supreme Parliament. I leave out for a moment, and advisedly, those questions of customs and railways which, we can take it as a *sine quâ non*, every Colony, as it at present exists, would like to have the control of in its own hands. If we can imagine a federation with certain things excluded, who so venturesome as to say that the various Colonies, who are parties to the Federation, will be prepared as time goes on to divest themselves of further of their powers to be entrusted to that central authority? I believe it is the experience of the world, that they would rather endeavour to take away from that central authority something that had been given, than invest it with still further powers. The division, for instance, of customs and of railway revenue, the basis upon which taxation is to be raised, may in the course of time, if we have Federation, prove that one particular Colony is gaining an advantage, and if that Colony did gain an advantage, the other Colonies would find that they suffered a disadvantage. This alone would be a fruitful source of friction. If the revenue had to be raised separately, each of their Colonies would desire to expend that revenue separately. It seems to me, therefore, when we face the problem, as we must do, as a whole, we shall find, that we either have to raise our taxation separately and spend it separately, or raise it unitedly and spend it unitedly. And this is the fundamental difference between Federation and Unification. I do not propose to address you on the very difficult and important native question, but let us take it as an example, and ask ourselves, if we hope to solve it as a South African rather than as a colonial question, why we should not solve it now? Are we likely later on to find the views of the inhabitants of this country less divergent than we were to-day? It seems to me that it is a supremely difficult question, but we might just as well face it now as at some future time, and it is quite conceivable that a central Parliament, established with Unification, would find it desirable to frame regulations applicable to different portions of South Africa, as far as the natives are concerned, in accordance with the degree of civilisation that they, in those particular parts, may have attained. One of the very serious difficulties which was raised in a personal conversation with me by a well-known statesman in the Cape Colony was this; he said: "How do you propose to bridge over the interim between the abolition of the existing State Parliaments and the time when the central Parliament will be able so to decentralise that it can take the government of the distant parts of South Africa in hand?" I admitted that it was a difficult question, but I did not believe an insoluble one. Let us for a moment imagine that, previous to the abolition of the existing Parliaments, a council should be formed, consisting of, say, two members on the Government side, two members of the Opposition, and a judge of the Supreme Court, preferably the Chief Justice, entrusted with authority to carry on the government of the country under the laws as they exist. It seems to me that that might be a workable system. I offer it merely in the humblest of spirits, but I offer it as a possible means of bridging over the interim. We must remember that this council would not have to undertake any legislative work. It would be carrying on the administration of the country. In fact, it would merely be a representative institution to see that the heads of departments acted in accordance with the law as it stood at the time. And assuming that this Council found itself faced with some knotty or difficult point, it could always refer in that case for the decision of this central executive. I, therefore, think that although the difficulty is great, it is not beyond the scope of human ingenuity to frame some means wherby the interval could be satisfactorily provided for. Of course, men of Cabinet rank would probably be found—as I am sure they would be—in the central Parliament, so that they would not be available as members of that council. But assuming it is difficult to bridge the interval, I say that, however complex it may be, it pales into insignificance beside the infinitely greater difficulty of apportioning revenue and expenditure between the various Colonies in South Africa in a federation. We have many warning lessons before us. In the United States of America we see litigation and constant friction between State Parliaments and the Senate. We have in Australia the heartburning and ill-feeling, that exist between the Federal authority and the State Governments. And I say, let us in South Africa take warning by these examples and let us endeavour to avoid similar conditions The proposition to put to members is this: Do we desire to coalesce? have we got the ambition to see the united Colonies of South Africa established? are we imbued with the idea of the big nation versus the small communities? It is a much more inspiring object, and anyone whose mind is not pervaded by the parochial instinct must have little hesitation in making his selection. There are people who say, "You will leap in the dark into unification and give a blank cheque." Well, personally I think that is a false description. It is quite true, that in the first years of unification it might be desirable to protect the hinterland in some measure.

It is conceivable, when we hold in view the disparity between the population, for instance of the Cape Colony and the population, say, of the Orange River Colony and the Transvaal combined, that a combination of the representatives of the population in the Cape Colony might do something in the central Parliament that would be detrimental to the interests of the hinterland, and that being the case, it is probably desirable that some special representation should be accorded to the hinterland Colonies in the first instance. But though this may be a desirable thing, it does not mean that we should not at once fix the basis upon which every one is to have rights in the future, which should automatically come into being in the course of a given number of years. We must remember this: once we have expunged these Colonial boundaries, then Colonial patriotism and Colonial interests will cease to exist. We shall have the one paramount South African interest, which will pervade the minds of the whole of the people of the sub-continent. And, of course, as the potentialities of this vast continent are developed we shall find population gradually shifting, or, I hope, a new population coming to those centres where commodities can best be produced. That in itself, of course, would alter the centre of power in South Africa as a whole. But about unification one thing is certain: that it will produce a stability we do not enjoy to-day, it will tend to promote economy in government, it will be the means of our having a general broad policy of government, it will improve the credit of South Africa as a whole, and it will inspire people with confidence to come into this country and invest their money.

There are those gentlemen—we read of them daily in the newspapers—who desire to see built round the Transvaal a ring fence. These gentlemen desire to have protection. They desire to see certain industries established here before there is any system of union. Well, it seems to me that the reply is very simple. If we put customs houses round the Transvaal and do damage to our neighbours—who are three times as numerous as ourselves—our neighbours might suffer it for a time. But as surely as we are present in this room, if we damage our neighbours enough, we will either have to pull these customs houses down at their instigation or our neighbours will pull them down for us. We are a part of South Africa, wedded beyond recall, and divorce is out of the question. The question is, Are you going to be happy partners or are you going to be fractious neighbours?

I wish you for one moment to imagine South Africa vivified. Speaking of the past conduct of civilised man since he passed the frowning heights of Table Mountain, and I wish I had the voice to speak as it would be spoken, if these words came through the mouth of a swollen Orange River, I imagine the torrent of unanswerable reproach that would be heard. What has man done in the arts of peace? I am afraid the record is a tale of ignorance and lazy indifferemce. I am not speaking, mind, of the causes but of the effects. We all know that there is every reason why the first settlers who came into South Africa finally found themselves upon the best pieces of alluvial soil producing the bare necessaries of life in the easiest possible manner. We know it was due to the pests, the wild beasts, the savages, the various difficulties and the absence of markets, and that no matter what people had been brought here, or from what part of the world, the results would have been precisely the same as they were under the conditions of those men brought here in the first instance by the East India Company. I am not, therefore, saying anything against the early settlers in this country, but I am speaking of the facts as they are. In the arts of peace but little progress was made. Of course, to-day we have the assistance of highly trained intelligence in agriculture, and so much demonstration has been made already that it is safe to say we shall see an enormous development in the surface of the land—a development perhaps in which energy and industry will be as great as, or greater than, that which has been bestowed on the mining industry in seeking out the wealth of nature buried beneath the surface. And that is something in regard to which my scientific hearers may also assist, because the chemistry of the soil is one of those things, that has to be studied minutely. When, therefore, they have a little spare time from those arduous duties which I am afraid I am connected with imposing on them, perhaps they will also direct their attention to some of those problems which may help to make the surface of this country more productive than it is to-day. I want to turn for a moment to another side, to leave the arts of peace, and ask you to think of the record we have from the earliest days in another direction. And what do we find? We find practically from the days of Van Riebeek men's thoughts were turned against each other, that they from time to time burst into open conflict, the result of which was that the fair surface of the land was drenched with human blood. It was a record of which everyone need be heartily ashamed. The blame rests not with one Government in this country or with one Government across the sea, nor does it rest upon one, but upon both the principal representative European races that settled in this country. I do not rake up the past, because but little useful purpose can be served by that, except with one object in view, and that is that we may learn the lesson and act differently in the future.

The Minister of Mines has spoken of the better spirit, and I am sure he is right. There is a spirit of fraternity about that certainly did not exist in South Africa in years gone by. Perhaps we may wipe out the past in time. Anyhow, we can do our best to atone for it, and there is one direction more than any other in which we can do that, and it is by forcing on, by using our very best energies and powers to bring about the union of all the Colonies of South Africa. Let us begin by blotting out the boundaries and by destroying those divisions which were senselessly and wrongfully built up in the past. They have caused most of the past suffering, and if they are left in being they will very likely repeat that sinister rôle and produce more suffering in the future. Union is a delicate plant, and its seed must be sown in faith. We are not going to achieve union by an ignoble squabble upon the relative interests of persons in the country, nor shall we get it by floundering in a quagmire of details. We shall have to approach the question upon a high plane and in the spirit of fraternal amity. The foundations must be laid in principles that are sound. There must be a guarantee to all civilised men in this country of equal rights, and preferential treatment of any one must be avoided as the plague. The day we set the seal upon the union of South Africa will be the birthday of a great nation. It can be done and must be done, and it will be done if men's minds are not accursed with a puny spirit and are tuned to the requisite heights. There are a few splendid lines I wish to conclude with, and I hope you will ponder over them, and that the words will sink deep into your hearts. They are these:—

"It takes a soul to move a body,
It takes a high-souled man to move the masses to a
cleaner sty,
It takes the ideal to blow a hair's breadth off the
dust of the actual."

Mr. T. Lane Carter next proposed the toast of "Our Guests" and "Kindred Societies." In doing so he said:—There is one thing that we have to be thankful for in regard to our kindred societies, and that is the friendly spirit that pervades the members. We all have one object in view, and that is the advancement of this great industry. Every member of every society always has done and always will do his level best to advance that cause. I have also to propose the health of our guests. We are very glad to have with us to-night Mr. Lance, who, as you know, is Chairman of the Transvaal University College. Kindred societies are bound to take a very great interest in the work that the College stands for, as the future success of kindred societies rests to a very great extent on the kind of men that they turn out at that University. May I say that it is the hope of kindred societies that there may grow up in this Colony not small schools in several different centres but a great University, which will be able to hold up its head amongst the best in the world. We also have with us Mr. Burt Andrews, our Town Engineer, who, as you know, is also President of the South African Association of Engineers. I have been told, that he has been affected with a microbe, which seems to be permeating the Transvaal very thickly, and that is the *bacillus amalgamationis.* I do not wish to say that he has any idea of amalgamating the city of Johannesburg with any of the surrounding mines or anything of that sort, but I understand that he is very anxious to amalgamate his association with a kindred society. That has been discussed for a long time. Many of us have sympathised a great deal with Mr. Andrews in the many serious and difficult problems that he has had to tackle, and one of them has been unskilled labour. I think we can call Mr. Andrews the geologists' friend, for during the last few months the most beautiful prospecting trenches have been cut in the streets, and I firmly believe that the geologists instead of walking up the streets have gone up through those trenches and investigated the strata which underlies this great metropolis.

Mr. W. F. Lance, M.L.A.:—On behalf of the guests present I have to thank you for the genial way in which this toast has been proposed and received to-night. I wish also to express our high appreciation of the honour conferred upon us in the invitation to be present at this very interesting function, and also for the generous hospitality we have received at the hands of our hosts, one of the oldest and most influential of the scientific societies of the Witwatersrand. It has been often said that we are nothing if not scientific, and where indeed should science find a home if not in Johannesburg, where the overwhelming importance of applied science as a factor in the development of our mining industry comes home to every one of us. Reference has been made to-night to the educational factor in the work of this Society, and I claim a very close connection between this Society and the college which I have the honour to represent, not only on account of your own most able work in both directions, but because the one stands for the best or some of the best of scientific thought and work, while the other stands for that scientific and technical work which necessarily leads up to and waits upon the higher work. And I hope that this close connection will shortly be emphasised in a more material form in the new buildings now in course of erection on Plein Square, where we hope to provide, at all events, a certain amount of accommodation for the different scientific and technical societies together with a suitable lecture hall for their requirements. And whatever may be the future of higher education amongst us—and these matters are still under consideration, and it is difficult to say what may be ultimately evolved—but whatever that may be, and whatever may become of what we regard as more strictly University work, yet the trusts upon which the Plein Square site is held will always, if properly carried out, ensure that that will remain permanently a centre for science and scientific thought, and a home for technical education of every grade and a centre which will radiate the best of these things for the benefit of this country. I have referred to the close connection of applied science with our mining industry, but our thoughts naturally turn, as has indeed been suggested already, this evening, in other directions. We talk of closer settlement of the land and we recognise what has already been done in the way of the application of science to the pursuits of agriculture and stock raising. We know the excellent work that has been done by our experimental farms and our bacteriological institute, but we recognise at the same time with regret that we have not as yet provided for scientific and technical education in that direction, and those of our youths who to-day would make the land their life occupation are driven, either to start upon that walk in life insufficiently equipped with scientific knowledge, or are forced to go to other places, within our own knowledge, as far as Canada and the United States to get that scientific education which should be better given on the spot. This question of an Agricultural College has been brought to the notice at different times not only of the present Government but also of its predecessor by the Director of Agriculture and by the University College, and it is with regret that one finds that nothing has so far been done towards a practical solution of the matter. I feel that no excuse is needed for drawing attention to the matter to-night, and I do so in the hope that it will not be long before our Government takes the initiative in this important matter.

Mr. G. S. Burt Andrews, replying on behalf of kindred societies, said :—I feel that one of the most difficult tasks in connection with the presidency of the association is to follow on after a flood of eloquence, such as that we have listened to to-night with the greatest interest and pleasure. It is a great pleasure to kindred societies to know that your Society has made such excellent progress in such a comparatively short time. I think that kindred societies have to agree, whether they like it or not, that this is one of the strongest on the Rand at present, and we feel that the strength of this Society is likely to improve the position of the other institutions and societies on the Rand, because I think I can safely say that there is a rivalry and a healthy rivalry in connection with the different associations in Johannesburg. There can be no doubt as to the usefulness of these societies. A great deal of interest is taken by scientific men on the Rand in the different problems, which they have to deal with, and I think that everyone will realise that there is a greater scope for originality in Johannesburg than there is in older established countries. In Malthus' work on lost arts, he says that the best steel is the greatest triumph of metallurgy, and metallurgy is the glory of chemistry. I do not know whether any of you are prepared to contradict that, but I believe it is a solid fact. At the same time, although the metallurgy of gold is not perhaps so difficult or so interesting as the triumph brought about by the best steel, still I think we can say that the metallurgy of gold on the Witwatersrand is second to none in any part of the world. I think that is largely due, not only to your Society, but without wishing to pat kindred societies on the back, to the kindred societies themselves. It has been said more than once that very little interest is taken in the scientific societies of Johannesburg. I should like to contradict that in the very strongest manner, because I think, there are very few towns in the world where more interest is taken by the scientific societies than in Johannesburg. I think I am right in saying that more than one meeting a week takes place here of a scientific society, which means 52 papers or more on scientific subjects during the year. These papers are discussed in a whole-hearted manner and, as a previous speaker has said, without any personality. I think a good deal of the success, which has been achieved in Johannesburg, is due to the discussions which have taken place in the different societies. You have been hearing about Unification and Federation, and I should like to talk about amalgamation. For some years past it has occurred to me, that a great deal more good could be done in this town, if some of the big societies would amalgamate. There is a scheme on foot just now to amalgamate the South African Association of Engineers and the Transvaal Institute of Mechanical Engineers. One of the chief reasons for this is, that their interests are very much the same. Many of our scientific gentlemen on the Rand belong to all the societies, and when they want to read a paper it is not an uncommon thing for them to turn over in their minds to which society they will bring it. Now, that is altogether wrong. The societies should be brought into closer union. We could save administrative expenses and other things, and so bring the whole thing into one homogeneous institution. I think if the societies amalgamated we should have greater recognition on the part of the Government, and on the part of the public. I am quite sure that when anything has to be referred to any particular society, it must be very difficult for anybody to make up his mind as to which society to refer it to. If all the societies were amalgamated this difficulty would be overcome.

Hon. W. Dalrymple, M.L.C., proposed the health of the Chairman, of whom he spoke as one filled with vitality, capacity and enthusiasm, to which Prof. Yates briefly replied, and the proceedings ended.

Obituary.

It is with regret that we have to report the death of Mr. W. V. Hunt, an associate of this Society, which occurred at the Salisbury Hospital from enteric fever on the 19th February. The deceased gentleman, who was a native of Ireland, had been in Rhodesia for some time, and until recently was battery manager of the Surprise mine, Selukwe. A few months ago he went out to the Kimberley Mazoe mine as manager, and was brought into hospital about three weeks before he died. Mr. Hunt was 37 years of age and leaves a wife and four children. He was admitted an associate in October, 1904.

It is also with regret that we announce the death of Mr. John Grove Johnson, F.C.S., an associate of this Society, which occurred suddenly towards the end of March. Mr. Johnson, who was well known to many of the older members of the Society, was the senior director in the firm of Johnson & Sons' Smelting Works, Ltd. (formerly Johnson & Sons).

Notices and Abstracts of Articles and Papers.

CHEMISTRY.

THE ASSAY OF SLIMES RESIDUES.*—"As the result of much experimental work KCy is now used as a reducing agent, in preference to any of the carbon compounds, for the assaying of residues resulting from the roasting and subsequent treatment of ore from the mine. This practice has been found to yield better results than the usual methods employed, and particularly is this the case with residues containing a large proportion of soluble gold. The gold in the slags from the usual method of assaying can be recovered by fusion with KCy and litharge, and the advantageous use of this reagent in assaying the various products of a gold mine, and in the smelting of zinc-box sludges, is being actively investigated.

The following assay results were obtained operating with a specially prepared residue containing much soluble gold. A filter press was charged with current pulp, and the resultant cakes of residues were dried with compressed air.

1. The smelting charge used was :—

Residues (dried at 100° C.)...	100 parts.
Soda ash...	50 ,,
Borax glass	12 ,,
Litharge...	150 ,,
Flour	8 ,,

2. The smelting charge used was :—

Residues (dried at 100° C.)...	100 parts.
Soda ash...	50 ,,
Borax glass	12 ,,
Litharge...	150 ,,
Sodium cyanide	17 ,,

3. The residues were triturated and washed on a suction filter, the smelting charge for the dried residues resulting from this treatment being the same as in 1; the gold in the solution being recovered by evaporation with some zinc shavings, followed by the usual scorification, etc.

Grains Gold per ton:

1.	2.	3. Insol. + Soluble.
27·9	34·49	6·31 + 28·2 = 34·51.

The above results are the averages of a series of determinations made by the different methods enumerated."—*Journal of Chamber of Mines*, Western Australia, Sept. 30, 1907, p. 841, and Oct. 31, 1907, p. 901. (W. A. C.)

* See Proceedings, vol. ii., July, 1898, pp. 372 and 803; also this *Journal*, vol. vi., March, 1906, p. 270.

GASEOUS NITROGEN TRIOXIDE. — "A special interest is at the present time attached to the chemistry of the oxides of nitrogen owing to the important part played by these substances in the commercial process for the utilisation of atmospheric nitrogen by its conversion into the nitrates of the alkalis and alkaline earths. There has always been a certain doubt as to the existence of nitrogen trioxide in the gaseous state, although this oxide is known at low temperatures in the liquid condition. In 1885 Sir William Ramsay and Mr. Cundall showed that in the main the gases derived from this liquid trioxide consisted of nitric oxide NO, and nitrogen peroxide partly in the complex form N_2O_4 and partly in the simpler form of NO_2. Later, in 1899, Prof. H. B. Dixon and Mr. Peterkin succeeded in demonstrating that such a mixture does contain a small proportion of gaseous nitrogen trioxide, N_2O_3, and that accordingly the reaction $N_2O_3 \rightleftharpoons NO + NO_2$ is a reversible one. This reversibility affords an easy explanation of the behaviour of the mixed gases towards various reagents. For example, these gases dissolve in cold concentrated sulphuric acid to form nitrosulphonic acid. In this reaction, which occurs in the Gay-Lussac tower of the sulphuric acid plant, the mixture of nitric oxide and nitrogen peroxide behaves as if these gases had combined to form nitrogen trioxide. In 1905 Raschig showed that the combination of nitric oxide and oxygen occurs in two distinct stages, the first giving rise to the production of gaseous nitrogen trioxide, which then undergoes further oxidation to nitrogen peroxide. Any further doubt as to the possibility of this trioxide existing in the gaseous state has been dispelled by the experiments described before the Chemical Society on November 7, by Dr. and Mrs. H. B. Baker who have demonstrated that liquid nitrogen trioxide can be converted into the gaseous state if it is dried completely. In this condition the gaseous trioxide shows no tendency to dissociate into nitric oxide and nitrogen peroxide; on the contrary, it exhibits the phenomenon of association, for the determination of its vapour density indicated the presence of more complex molecules corresponding with the double formula N_4O_6. This fact brings the substance into line with the corresponding oxide of phosphorus, which also has the double molecule P_4O_6. The liquid trioxide is green at the ordinary temperature, but becomes blue at −9° C. It remains liquid at −80° C., but solidifies to a mass of dark blue crystals in liquid air. These results furnish another interesting example of the influence of moisture on chemical change. Ordinary moist nitrogen trioxide dissociates almost completely in the gaseous state, but when thoroughly dried the substance may be vaporised without showing any sign of dissociation."—*Times Engineering Supplement*, Dec. 18, 1907. (J. A. W.)

CORROSION OF PLATINUM CRUCIBLES.—"Chemists are aware that employment of platinum crucibles involves precautions, without which the metal is rapidly destroyed. The author describes a new source of deterioration. When a platinum crucible is placed in the higher cone of the flame of a Bunsen burner, a part of the free hydrogen, always in the flame, is diffused through the platinum, and exerts a reducing action on the substances in the crucible. If by reduction substances can be formed which attack platinum, the latter is destroyed. Diffusion takes place with great rapidity. In less than five minutes the pressure increases 1½ mm. of mercury inside a platinum vessel in which a vacuum has been made. Removing the recipient from the flame, the vacuum is immediately re-established, and when placed in the lower cone of the flame for two minutes the pressure rises 4·5 mm., and the bottom becomes coated with soot. There is no diffusion if the bottom of the crucible is placed 2 cm. above the exterior cone of the flame. If a substance reduced by hydrogen at the temperature of the experiment is in the crucible, hydrogen again enters gradually as it is consumed for reduction. Iron oxide (4 gm.) is reduced to metallic iron, which renders a very thick crucible useless in five hours' heating. Magnesium sulphate is reduced to a sulphide, and sodium sulphate to the state of sulphite. Finally, magnesium pyrophosphate (produced by calcination of ammonium magnesium phosphate in the quantitative analysis of phosphates) is reduced, producing phosphorus, which distils and attacks the less hot parts of the crucible. In all these cases, when a high temperature is required, heating in an electric resistance furnace should be preferred to the use of a Bunsen burner."—M. GEIBEL, *Zeitschrift für angewandte Chemie.*—*London Mining Journal*, Jan. 4, 1908, p. 5. (A. R.)

METALLURGY.

Slime Treatment at Kalgoorlie. — "At the Associated Northern mine the ore is of a schistose nature, with quartz and calcite; the valuable ore carries tellurides and iron pyrite, there being very little free gold.

The treatment consists of breaking the ore with a No. 5 Gates crusher, grinding through a 27 mesh screen in three No. 5 Krupp ball mills, roasting in six Merton furnaces, mixing with weak cyanide solution, grinding to slime, and amalgamating the coarse gold in eight Forwood - Down (improved Wheeler) 5 ft. pans, settling the slime in V-shaped boxes, agitation of pulp in five vats 22 by 6 ft., filter-press treatment in three Dehne presses, and disposal of residue by belt conveyor.

The following is the treatment in detail of the pan product. Average screen tests of this are as follows:—

Mesh.	Percentage.
On 30	Nil
40	Nil
60	0·5
80	2·5
100	4·3
150	4·9
Through 150	87·5

The slime from the settlers is run into the agitators with a consistence of about 1 to 1, it taking between 7 and 8 hours to fill one vat holding, say, 36 tons of dry slime. The cyanide solution is made up to 0·07%, and the consumption averages 1 lb. per ton treated. Agitation is continued as long as possible, but after 16 hours the pulp may be taken for filter-press treatment. For filling the press a Pearn pump having three plungers, 12 by 10 in., running at 20 rev. per min. is used. This is a powerful pump, and with good thick pulp it will fill a press in 10 minutes, lifting in this time about 10 tons of pulp, and charging against a final pressure of 60 lb. per sq. in. The time taken in filling may be divided as follows:—

Pressure.	Minutes.
Up to 25 lb.	4
,, 50 ,,	3
,, 60 ,,	1
Finishing with safety valve blowing off at 60 lb.	2
	10

The presses are of the well-known Dehne make with fifty 3-in. frames for the slime, the usual cloth-covered high and low pressure plates for filtering and hand-screwing gear. They hold about 4·5 tons of dry slime each. After a press is filled, the slime is washed for 25 minutes with weak cyanide solution, and a water wash of 5 minutes at 100 lb. pressure, during which time each ton of slime is washed by 2 tons of solution. The washing is done by a similar pump to that used in filling, only that it runs at 13 rev. per min. A mercury gauge is used on this pump. It sometimes happens that there is plenty of mill-water on hand, so the final water wash is dispensed with, the press then getting 30 minutes with solution. The decrease in the assay values of the solution during washing is:—

Period.	Assay.
At start of wash	$12·50
After 5 minutes	6·60
,, 10 ,,	1·50
,, 15 ,,	1·50
,, 20 ,,	1·00
,, 25 ,,	1·00
,, 30 ,,	0·80

After washing, the contents of the press are dried for 10 minutes with air at 80 lb. pressure. The press is then opened ready for discharging. Two men empty 11 presses per shift of 8 hours, say, 50 tons, on to a travelling horizontal belt conveyor 18 in. wide, which feeds an elevator belt inclined at 27°, in turn discharging on to a motor-driven swinging boom distributor.

The time taken in the different press operations is as follows:

	Minutes.
Filling press	10
Washing	30
Drying	10
Discharging..	30
Screwing-up, etc.	10

The rich gold solutions from the filter press, after being clarified in a small press, pass through three zinc boxes, and the gold (running about 890 fine) is recovered in the usual manner. Most of the solution used in washing the presses, passes into the mill again to be used in the pans, etc. An average of three months' costs of slime treatment are as follows:—

	Cost per ton.
Agitation and cyaniding	$0·34
Filter pressing	0·41
Precipitation, etc.	0·12
Disposal of residues	0·04
Total	$0·91

The mill has a capacity of about 3,700 tons of raw ore per month (say, 3,200 of roasted ore) and with another 1,300 tons (previously roasted) from the re-treatment of old residue; altogether some 4,500 tons pass through the three presses monthly.

Monthly returns average about:—

Ore milled, tons	3,700
Re-treatment, tons	1,300
Total value recovered	$70,500
Profit	$48,500

M. W. von Bernewitz.—*Mining and Scientific Press*, Dec. 14, 1907, p. 743. (K. L. G.)

The Hardinge Conical Mill.—"As in almost any other improvement along any needed line, there is a diversity of opinion as to the best size of mill, quantity and size of pebbles or balls to be used, speed of mill, size of material to be fed, method of feeding, manner of lining and similar questions developed by the actual practical use of the mill. These are points which economic requirements, if not actual necessity, suggest. In my own case I had occasion to question the knowledge possessed by the manufacturers as to the actual work performed by the mill.

Their recommendation was generally for long mills of small diameter (4 to 5 ft. diameter by 15 to 22 ft. in length). Investigation developed the fact that they were often better salesmen than practitioners. Hence, when I had occasion to install one of my earlier tube mills, I reverted to a previous experiment with a comparatively short mill of large diameter, and finally carried the idea still further, by installing a mill 6 ft. in diameter, and only 8 ft. in length; in reference to which I wrote a short article on the action of this mill published in the journal of June 8, 1905, from which I quote the following, as it has bearing on a mill subsequently built, and mentioned in that article, the results of which are given later:

'The tube mills now being adopted are generally longer and of less diameter than the one I use for wet grinding, which is 8 ft. long by 6 ft. internal diameter, less the silex or flint-block lining, which reduces the actual internal diameter to about 5 ft. 6 in.; this mill, loaded with 2,500 lb. of flint pebbles about 2 in. in diameter, at 21 r.p.m. receives 6-mesh, ball-mill crushed material, and pulverises it to the sizes shown in the last column given herewith, at a rate of 3 tons per hour, which is really more than the capacity to which the rest of our plant is adapted. In view of the fact that 2,500 lb. of pebbles is not more than one-third of the supposed or theoretical load, the real capacity of the mill is undetermined.

	Ball Mill Product. Per cent.	Tube Mill Product. Per cent.
Through 6 mesh on 20 mesh	25·9	0·0
Through 20 mesh on 40 mesh	13·5	2·0
Through 40 mesh on 60 mesh	9·0	8·5
Through 60 mesh on 80 mesh	8·0	14·0
Through 80 mesh	40·0	75·5
	96·4	100·0

A few tons of quartzose ore gave a greater grinding capacity. Tests for consumption of pebbles showed less than 1 lb. per ton of ore treated. The wear upon the lining is also slight, compared with the results obtained. Based upon my present experience I have placed an order for another tube mill still further from the general practice, *i.e.*, 6 ft. long and 6 ft. in diameter.

Experiments and discussion are needed to determine the most effective diameter and length of mill; revolutions under different loads; size of pebbles; whether pebbles should be of uniform or different sizes; what relation size of feed may have to diameter of mill and of pebbles; what is the most efficient feed and discharge; whether the action is percussive crushing, or crushing-grinding, or a combination of both. The capacity and small load of pebbles in the mill I now have in use would suggest a percussive effect; certain it is that much less power is required to operate than when a larger load of pebbles is used, which would lessen the useful duty of the mill, and cause a needless attrition of pebbles and lining.'

As stated in the preceding, I then put in operation a mill, the internal diameter of which is 56 in. by 66 in. in length. This mill takes the product of the 'quartzose' ore above mentioned direct from a 14 × 27 in. roll, without screening or returning to the roll, giving the following results:—

RESULTS OF 56 × 66 IN. TUBE MILL.

Mill charged with 1,500 lb. of pebbles; consuming 15 h.p.; running 21 r.p.m., crushing 2 tons per hour.

Mesh.	On 10.	On 20.	On 40.	On 60.	On 80.	On 100.	Thro'gh 100.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent
Heads	42·5	22·0	13·0	5·0	2·2	2·7	12·0
Tails	0·0	0·0	2·0	4·7	8·0	4·2	79·8

The above result was fully up to my expectations, considering the horse-power consumed and the pulp produced, when the coarse material fed to the mill was taken into consideration. It was results we were looking for, and we had no objection to their being more satisfactory than was anticipated; but I realised that we were producing a much larger relative quantity of fines or slimes than was desired for straight concentration.

For that reason I turned my attention to rectifying these undesirable accompaniments of the regulation tube mill. With this end in view (while never having been so unfortunate as to be within the mill while it was in operation) and forming my own 'theory of the action of the tube mill,' I set about to construct a mill which would do away with the necessity of retaining material in the mill already crushed to size desired, which greatly adds to the internal friction, and prevents the crushing action between the pebbles by their working in a medium of more or less thick mud already reduced as fine or finer than required. My object was to have the new material fed into comparatively clear water, thus the coarser pebbles or balls would act upon the coarser material, and not waste their efficiency and the power by grinding upon the smaller pebbles, which are gradually reduced in size by the work performed, and should be discarded or made to work on correspondingly small material.

This I accomplished by having the mill built with a cone outlet, or preferably two cones placed base to base. In my smelter practice I had encountered the difficulties realised by smelter men in the feeding of a furnace by having the larger portions of the ore always seek the lower point in the furnace through the momentum of a larger body falling through space or on an incline. My model was easily constructed from two laboratory funnels of 5 to 7 in. in diameter, ribbed on the inside. First filling one of the funnels about half full of fine dry sand to coarse gravel, joining the funnels with adhesive tape, and revolving the whole on a horizontal axis, immediately a displacement of the fine material by the coarse was observed, such as might be readily anticipated. It was not, however, easy to anticipate the result obtained when the same apparatus was held at a slight inclination from the horizontal and then revolved. Herein lies a curious experiment, and a result that will not be readily understood, although it is positively apparent to the eye; let the reader try it and explain it if he can.

The results produced will be seen to be more or less of a perpendicular stratification of the ground material; which stratification, passes up the inclined outlet of the mill, from the larger pebbles working on the coarsely fed material through the smaller pebbles working upon the already partially ground material. This stratification from a metallurgical standpoint, has such a decided sizing action, that its utility will be readily appreciated, and is the basis for patents granted and applied for. In fact, gradation of size is dependent upon the amount of feed, the inclination of the mill and the rapidity of discharge. To produce a finely ground material a larger load of pebbles would be required, and the mill set more approximately to a horizontal axis.

The results just obtained from a large mill constructed for fine grinding are illustrated in the following tabulation, which, considering the coarseness of the feed, the amount of pebbles used and the horse-power required, shows capacity difficult to understand although not so difficult to appreciate. Just what the maximum capacity of this mill will be, is at present unknown, as the present test was limited to the ability to feed the mill. The results are as follows:—

RESULT OF TEST OF CONICAL MILL.

Mill charged with 2,000 lb. of pebbles; consuming 15 h.p., running 25 r.p.m.; crushing 3 tons per hour.

Mesh.	On 10.	On 20.	On 40.	On 60.	On 80.	On 100.	Thro'gh 100.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Heads	25·3	38·2	12·2	6·6	5·5	2·3	9·5
Tails	0·0	0·0	0·0	1·4	5·4	2·5	90·8

This result was obtained upon ore brought over 1,000 miles for the test, as the conditions for installing the mill were based upon the capacity, and the actual ore under consideration. The results obtained more than met the requirements. Those mills can be used singly, combined or in tandem.

I predict that it will be but a comparatively short time before stamps will be considered an obsolete method for crushing ore. It is, however, clearly evident to the metallurgist that at least a proportion of the ore fed to the long regulation tube mill of to-day must receive a crushing upon entering the first portion of the mill which would be sufficiently fine to make a satisfactory tailing. If this is the case, why necessitate this desirable product to work its way through 20 to 25 ft. of additional length of mill? The principle of reduction in a tube mill should be the same as that employed by any other system of gradual reduction, and not permit of its interfering with subsequent work to be performed by the mill.

Of course, the question will be asked, 'can the sizing desired be accomplished in a pebble mill?' It can. The reader may convince himself by trying the above mentioned experiment."—H. W. HARDINGE. —*Engineering and Mining Journal*, Nov. 16, 1907, p. 925. (A. R.)

MINING.

CAST IRON SHAFT TUBBING.—"It had been usual to calculate the thickness on the supposition that the compressive circumferential or hoop stress was taken entirely by the cylindrical shell. The number and dimensions of the ribs appeared to be chosen arbitrarily. An accurate theory must correctly apportion the stress between the flanges, ribs and shell. In an average segment of fairly heavy tubbing more than one-third of the area of the face of the tubbing had behind it a thickness of metal which was greater than the nominal thickness of the plate. It might frequently happen that the weight of metal having the thickness of the shell was only about one-third of the weight of the complete segment. The author was forced to the conclusion that the importance which the cylindrical shell theory had attained was quite artificial. The great sources of strength of tubbing lay not in the shell, but in the flanges, ribs and brackets. For rapidly determining the dimensions of cast iron tubbing for any given external pressure and diameter of shaft, he recommended the adoption of (*a*) if the stiffening rings are to be closely spaced, first the formula

$$t=kr^3\sqrt{p\text{F}},$$

where t=the thickness, and F the factor of safety, taking various values of k for different proportions of w and l, the width of stiffening ring and the vertical distance between the rings respectively; afterwards testing the result by the plate formula

$$f=\frac{1}{2}\frac{pa^4b^2}{2t^2(a^4+b^4)}$$

where a, b and t are respectively the length, breadth and thickness of the plate in inches, a being greater than b, and f the greatest stress in pounds per square inch; (*b*) if the rings are far apart, use the plate formula first and then find the size of the stiffeners by the ring formula. The writer, in speaking of the pressure, said that experience with retaining walls appeared to show that Prof. Rankine's theory considerably overestimated the magnitude of the pressure. As a rough rule, it might be taken that the pressure in pounds per square inch rarely, if ever, exceeded one-half of the depth of the shaft in feet." —JOHN MORROW.—*Colliery Guardian*, Oct. 18, 1907, p. 718. (A. R.)

ADDENDUM TO PAPER ON EARTH TEMPERATURES ON WITWATERSRAND GOLDFIELDS.*—In the paper which I read before the Institution on this subject, a point in the discussion was left indeterminate, viz., the mean earth temperature at the surface in the vicinity of the Rand. A recent examination of the Report of the Transvaal Meteorological Department for 1905 has furnished me with the final figures required on this point. The conclusions arrived at, taken from a mass of detailed records, are as follows:—

Mean average air temperature, taken in hourly records throughout the year, 58·2° F. Another result, arrived at by a different method of calculation, 59° F.

The latter figure may be taken as more generally representative of the true conditions in the vicinity of my experiments.*

The mean earth temperatures, taken over a period of eight months, are as follows:—

1 ft. below the surface	...	64·92° F.
2 ,, ,,	...	67·987° F.
4 ,, ,,	...	67·837° F.
8 ,, ,,	...	67·63° F.

My records indicated an earth temperature at the surface of 63·95° F. In the discussion which followed the paper, in the absence of definite data on the surface temperatures, a doubt was expressed as to the accuracy of the estimate, as this amount was considered abnormally high. From the above records now quoted, it is seen that the more permanent surface earth temperatures are some 3° F. still higher than my original estimate. These results will doubtless account for the line of temperature shown on the chart in my paper in excess of the mean average, and they go to prove, that the temperatures taken at different depths have only a relative value within close limits of distance.

If any close analogy can be made between earth temperatures at the surface and those taken at depth, then any application of these official results to my records will tend to reduce still further the ratio of increase of temperature with depth in the locality under discussion, and will emphasise still more strongly the conclusion that no universal rule can be laid down for a general average rate of increase of temperature with depth, but that the ratio for each district must be estimated from purely local observation."—HUGH F. MARRIOTT. —*The Institution of Mining and Metallurgy*, Bulletin No. 43, April 2, 1908. (J. M.)

* See this *Journal*, vol. vi., 1906, p. 389.

* Since the Observatory is more than 300 ft. above the Rand, the mean average air temperature of the Rand is probably 62° or 63° F.—ED. COMM.

Reviews and New Books.

(We shall be pleased to review any Scientific or Technical Work sent to us for that purpose.)

A TREATISE ON CHEMISTY. By ROSCOE and SCORLEMMER. Vol. II.—THE METALS. 4th Edition. Revised by Sir H. E. Roscoe and Dr. A. Harden. 30s. (London: Macmillan & Co., Ltd.)

"Sentimental reasons alone would justify a careful review of the new edition of this work, whose value has been so fully recognised since the first edition appeared, just thirty years ago, and whose pages have been so much consulted by most chemists and many metallurgists since it was first issued. One can scarcely expect a new edition of any treatise to possess the same freedom from out-of-date matter as an entirely new work should show, and the authors are to be congratulated on having brought the subject fairly into line with recent discoveries without destroying the old arrangement, with which we are so familiar. Many of the special portions have been re-written, an excellent section on radio-activity has been added, and the parts relating to alloys and crystallography have been most efficiently dealt with. Probably no work on the metals is so rich in references to early researches and ideas, and it is to be regretted that, although, as already stated, much of the matter is brought fully up to date, much has been left in which should be eliminated or replaced, and many inaccuracies have been left uncorrected.

Descriptions of obsolete processes and illustrations of plant which has been abandoned for generations are by no means infrequent, and although of some interest, are not sufficiently differentiated from descriptions of modern practice to be of benefit to the layman. In many cases the processes actually in present use are totally ignored.

The magnetic separation of the ores, now of such general use, is not even mentioned, nor has the writer seen any reference to the extremely important subject of magnetic separation throughout the book.

The subject of lead smelting is very cavalierly treated, and one might search the civilised world in vain in the hope of seeing some of the processes which are described as though in actual use.

The section on gold, although by no means short, leaves much to be desired. The assay of gold ores rightly receives but little attention, but as the method described on p. 517 as being 'usual' has probably never been employed by an assayer, it would have been better to omit it entirely.

Altogether, this work may be strongly recommended to the metallurgists as one of the best which has been published on the chemistry of the metals, but not to the chemist as a guide, or even as an introduction, to metallurgical practice."—*London Mining Journal*, Feb. 15, 1908, p. 194. (A. R.)

THE METALLURGY OF STEEL. By F. W. HARBORD, Assoc.R.S.M., F.I.C. $8\frac{3}{4} \times 6$ in. 3rd Edition. Price 25s. (London: Chas. Griffin & Co., 1907.)

"This book, of nearly 800 pp., is a veritable encyclopædia of knowledge on all that appertains to steel, its manufacture, treatment, chemistry, its special alloys, its testing—in fact everything that the engineer or metallurgist must know. It is well illustrated with furnaces, rolling mills, and other machinery and general layouts. Every man interested in steel should possess this book."—*Cassier's Magazine*, Feb., 1908, p. 501. (A. R.)

ENGINE ROOM CHEMISTRY. By A. H. GILL. $6\frac{3}{4} \times 4\frac{1}{2}$ in. $1. (London and New York: The Hill Publishing Co., 1907.)

"The substance of this excellent little book appeared in our contemporary, *Power*, in a series of articles intended for enginemen, and to enable them to gain a familiarity with fuel, water, and oil, with which he must deal. The author gives a preliminary chapter in explanation of the elements of chemical and physical science. This is well done, and indeed the whole book should prove most useful to any man having to do with steam-power plants and wishing to understand the chemistry of combustion, of water softening, and so on."—*Cassier's Magazine*, Feb., 1908, p. 501. (A. R.)

THE MINER'S GEOLOGY AND PROSPECTOR'S GUIDE. By GEORGE A. CORDER. 5s. (London: E. and F. N. Spon, Ltd.)

"Many attempts have been made to combine in a brief space those scientific principles and formulæ which are essential to the successful prosecution of mining work. Of these the most valuable represent, like the work before us, the embodied results of actual experience in the field. Mr. Corder has carried out a large amount of prospecting work over thousands of miles of territory in several continents. In addition to furnishing an exposition in little of such geological, mechanical, and mathematical matters as seem indispensable to the prospector, the book contains a large number of hints on practical questions, which, while they are almost certain to confront the actual prospector in the field, can hardly be expected to occur to the academic scientist. This is the consideration which lends such great value to essentially practical books, and befits them to occupy a useful niche in the knapsack of the traveller with mining ends in view. The book contains nothing which the miner and prospector will not be the better for having learned by heart, and represents the highest measure of ingenuity and experience in the attainment of the multum in parvo."—*London Mining Journal*, Feb. 15, 1908, p. 194. (A. R.)

NOTE ON A PROCESS FOR EXTRACTING GOLD FROM AUROCYANIDE SOLUTIONS. By P. DE WILDE, Hon. Professor at the University, Brussels.

This pamphlet, which has suffered somewhat severely in translation, communicates Prof. de Wilde's new discovery with reference to the precipitation of gold from cyanide solutions by means of cuprous salts. As a reference to the back numbers of this *Journal** will show, the method, which the learned professor first originated, demanded an excess of cuprous chloride for the total precipitation of the gold. He has now discovered, to quote from the pamphlet, "by acidulating the solutions aurous cyanide and cyanhydric acid are set at liberty. Very small quantities of cuprous cyanide are sufficient to absorb and fix by molecular attraction the whole quantity of aurous cyanide. By treating this precipitate with hydrochloric acid the cuprous cyanide is dissolved; the aurous cyanide remains free and by heating and melting yields pure gold without loss. It is obvious that this method is a great improvement upon the old plan, and it is possible that the idea would repay investigation. The professor's experiments seem to have been performed with fairly pure solutions, and under these circumstances complete extraction of the gold was attained. The presence in our working solutions of thiocyanates, ferrocyanides and thiosulphates would possibly have a modifying influence, and anything far short of complete precipitation would put the new process completely out of court on these fields where nothing more than a trace of gold† is allowed to leave the zinc boxes, and the process in use is almost automatic in its working. Prof. de Wilde's new process is admitted to be too expensive with slimes solutions because of the necessity for rendering acid such alkaline material and the formation of insoluble lime salts thereby caused. The chief difficulties unattacked in this pamphlet (besides the questions of capital expenditure for new plant and the necessity for a separate process for slimes solution) are involved in the assumption made that loss of cyanide is entirely caused by the zinc precipitation methods in vogue, and that any method of precipitation however perfect should be able to increase the extraction by so much as $\frac{1}{4}$ dwt. per ton of sand. It is now admitted that practically no loss of cyanogen‡ takes place in the zinc boxes, and that the loss of dissolved gold in a modern plant could hardly amount to more than $\frac{1}{40}$ dwt.** per ton of sands, and even this small amount would be scarcely affected by absolute perfection in the precipitation department.—(H. A. W.)

* Vol. ii., p. 337.
† Vol. vii., p. 410.
‡ Vol. iv., p. 637.
** Vol. vii., pp. 243 and 411

Selected Transvaal Patent Applications.

RELATING TO CHEMISTRY, METALLURGY AND MINING.

Compiled by C. H. M. KISCH, F.M.Chart.Inst.P.A. (London), Johannesburg (Member).

(N.B.—In this list (P) *means provisional specification, and* (C) *complete specification. The number given is that of the specification, the name that of the applicant, and the date that of filing.)*

(P.) 115/08. Cyril Causton (1), William M. Neilson (2). Rock drill. 1.4.08.

(P.) 116/08. William Horton Fletcher. Improvements in mills or apparatus for crushing or pulverising ores, minerals or the like. 1.4.08.

(P.) 117/08. Thomas Maxhay Hack. Improvements in jockeys or rope grips for use in mechanical haulage arrangements. 1.4.08.

(P.) 118/08. James Patrick Holmes. Improvements in and relating to reversible turbines, rotary engines or motors. 1.4.08.

(P.) 119/08. George Ridgway. Improvements in filtering machines. 2.4.08.

(C.) 120/08. Wilbur Alson Hendryx. Combination agitator and decanting filter. 3.4.08.

(P.) 122/08. William Thomas. Improvements in means for elevating granular, material, liquids or mixtures of liquids and solids. 4.4.08.

(C.) 124/08. William Cumming. Guide block. 6.4.08.

(P.) 125/08. Michael Neilson. Improvements relating to the dumping of trucks or like vehicles on similar depositing sites. 6.4.08.

(P.) 126/08. Charles Hansen. Improvements in the safety brake arrangements for mine cages and other hoisting apparatus. 6.4.08.

(C.) 127/08. Herbert Lansing Merrick. Integrating apparatus. 7.4.08.

(C.) 128/08. Bruce Edward Tennant. Improvements in assay furnaces. 21.11.07.

(P.) 129/08. Alexander McNamara. Improvements in means for connecting the tube rod to the cord barrel and sediment drill of rotary boring apparatus. 8.4.08.

(P.) 130/08. Ivor Bevan (1), Frederic Anderson (2). Improvements in straightway valves. 10/4/08.

(C.) 131/08. Donald Donald. Improvements in wire strainers. 10.4.08.

(P.) 132/08. Isaac Frames Taylor (1), Samuel Pick (2). Improvements in cranes, fire escapes and similar apparatus. 10.4.08.

(P.) 133/08. John Hudson Hughes. An improved machine operated by compressed air for drilling holes in rock or other material. 10/4/08.

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