

THE JOURNAL
OF THE
Chemical, Metallurgical and Mining Society
OF SOUTH AFRICA.

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VOL. VIII.

JUNE, 1908.

No. 12.

Proceedings
AT
Annual General Meeting,
June 20, 1908.

The Twelfth Annual General Meeting of the Society was held in the Chamber of Mines, on Saturday, May 16th, Prof. J. Yates (President), in the chair: There were also present:—

60 Members: Dr. D. Macaulay, 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, H. A. White, Prof. J. A. Wilkinson, W. A. Caldecott, W. Cullen, R. W. Atkin, S. G. Bartlett, W. Beaver, F. W. Cindel, M. H. Coombe, G. A. Darling, A. D. Gilmour, J. Gray, F. G. Guthrie, A. G. Hoyer, M. Inglis, Dr. L. G. Irvine, H. R. Jolly, J. A. Jones, E. J. Laschinger, G. A. Lawson, Hy. Lea, Jas. Lea, W. D'A. Lloyd, W. P. O. Macqueen, G. Melvill, J. E. Metcalf, H. Meyer, J. T. Milligan, A. Mitchell, P. T. Morrisby, F. B. Ogle, Prof. J. Orr, J. F. Pyles, E. T. Rand, W. H. Roe, O. D. Ross, A. Salkinson, W. Sharp, F. L. Simmons, S. H. Steels, R. Stokes, W. H. Stout, J. A. Taylor, W. Taylor, J. E. Thomas, A. D. Viney, J. F. Walker and J. P. Ward.

15 Associates: Messrs. H. G. Brickhill, W. M. Coulter, J. Cronin, C. L. Dewar, A. L. Edwards, J. H. Harris, C. B. Hilliard, H. A. Owen, H. B. Powter, B. Southwell, A. Thomas, W. E. Thorpe, C. Toombs, W. Waters, and L. J. Wilmoth.

14 Visitors and Fred. Rowland, Secretary.

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

NEW MEMBERS.

Messrs. W. Beaver and W. Taylor 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:—

BROWNING, EDWARD, Robinson G. M. Co., Ltd., P. O. Box 1024, Johannesburg. Mining Engineer.

COCKBURN, PAUL ALEXANDER, Gaika Mine, Queque, Rhodesia.
CULLEN, MATTHEW, Cyldesdale Collieries, Ltd., Wolvehoek, O.R.C. Colliery Manager.
HARRIS, J. H., P. O. Box 30, Cleveland, Transvaal. Amalgamator. (*Transfer from Associate Roll.*)
MACDONALD, PETER ARCHIBALD, Etna Development Co., Ltd., Gatooma, Rhodesia. Mill and Cyanide Manager.
WILMOTH, LESLIE JAMES, Simmer and Jack Proprietary Mines, Ltd., P. O. Box 192, Germiston, Transvaal. Assayer. (*Transfer from Associate Roll.*)
WAY, EDWARD JOHN, Kleinfontein Group, Benoni, Transvaal. Consulting Engineer.
WESTON, EUSTACE MORIARTY, Rand Collieries, Ltd., P. O. Box 13, Brakpan, Transvaal. Mine 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:

POWRIE, DONALD E., Rose Deep, Ltd., P. O. Box 6, Germiston, Transvaal.
PRICE, WALTER SAMUEL VINCENT, P. O. Box 1001, Johannesburg. Miner.
REECE, FREDERICK BENNETT, Homestake Mining Co., Ltd., "The Smead" Lead, S. Dakota, U.S.A. Assistant, Refinery Department.
WHELER, AUBREY STUART, c/o S. W. Jameson, Esq., 52, Ashley Gardens, Westminster, London, S.W. Mining Engineer.

The President called upon the Secretary to read the Council's Annual Report and the Statement of Accounts.

ANNUAL REPORT OF COUNCIL.

Your Council has much pleasure in submitting its Report upon the work of the past year, together with a Statement of Accounts and Balance Sheet for the twelve months ending the 1st June, 1908.

The depression, alluded to in the last Report, has not yet passed away, and its results are again reflected in the accounts before you. It is only by the exercise of much care and attention to detail that the Society is still in an excellent financial position. The revenue for the year shows a decrease of £33 2s. 2d., a decrease which

would have been much greater but for the unremitting efforts of the Finance Committee in successfully dealing with the outstanding subscriptions, although at the cost of a great deal of extra correspondence and appeals to the members in arrear. In this connection it is necessary to point out, that according to the rules all subscriptions become due on the 1st July in each year, and are payable in advance, and your Council would earnestly impress upon all the desirability for compliance with that rule. The Society does not, as yet, enjoy any revenue from invested funds, such as is the case with the majority of Home Societies, and the non-payment of subscriptions on the due date renders it extremely difficult for your Council to carry on the work of the Society towards the end of the financial year, and to give the amount of matter in the *Journal* which it could and would give if the requisite funds were available. On the other hand, it will be noticed that, despite a slight increase in general expenditure, principally due to the reprinting of the rules, an allowance of £3 a month for clerical assistance, and depreciation on furniture, the total expenditure has been decreased by nearly £160.

The Balance Sheet shows that our immediate liabilities are exceeded by our cash assets by over £170, an eminently satisfactory position. The stock in hand of the Society's Transactions shows an increase in value of £276 1s. 7d., due to the cost upon completion of Volumes IV. and VII., and the addition of Volume VIII. The actual receipts from the sale of the several volumes amounted during the year to £218 18s. 8d., which amount has been applied to reducing the debit balances against each volume. Sundry debtors (of which £201 16s. 10d. is at our credit at Edinburgh, and is being drawn upon) show a decrease of nearly £100 compared with last year, and it is hoped during the coming year to eliminate this. There is a slight increase in the amount of provision for doubtful debts, due to the recovery of an outstanding account.

As usual, nothing has been taken into account for the unpaid subscriptions, amounting to £279 6s. for the past year. It is difficult to estimate how much of this is likely to be recovered, but it may be mentioned here that the Council has, with great regret, been compelled to erase the names of 77 members, 31 associates, and 1 student from the roll for non-payment of arrears. The Council desires to point out that in no case has anyone been struck off, until he was over two years in arrears with his subscription.

Turning from the financial aspect to the practical work of the Society, it is pleasing to record that 62 members, 72 associates and 14 students have been elected and admitted during the year,

nine of the new members being associates who have transferred. The Council regrets that 42 members, 22 associates and 2 students have found it necessary to resign, while the Society has suffered the loss from death of the following 8 members and 4 associates:—

Members: Messrs. R. Camerer, E. D. Chester, T. Francis, C. Gluyas, F. G. Knox-Little, H. T. Pitt, W. Roff, and H. A. Tilghman.

Associates: Messrs. W. V. Hunt, C. L. Johnson, J. G. Johnson, and J. Perrin.

The tables with reference to yearly membership and its world-wide distribution are to be seen on the opposite page.

Twelve Ordinary General Meetings and one Special General Meeting have been held in the past year, at which the usual business of the Society was transacted, including the reading and discussion of many interesting and important papers.

The attendance at the monthly meetings has been maintained, the average attendance being 66.

Several interesting visits to mines have taken place during the year under review, and the educational and practical value of these excursions has been highly appreciated. These visits will be continued during the coming year.

The Annual Dinner was one of the most successful which the Society has yet held, the attendance being large and the speeches of considerable political and economic importance.

The *Journal* continues to be one of the best of its kind published in the mining world, and, according to reports received from various members while travelling in the United Kingdom, Australia, America, and elsewhere, its value to the mining and metallurgical profession is very highly spoken of.

The meetings of the Council have numbered 13, and the average attendance has been 13.

The attendances of the members of Council are as follows:—

Mr. F. F. Alexander	8	Dr. D. Macaulay	—
„ R. G. Bevington	10	„ J. Moir	10
„ W. A. Caldecott	4	Mr. S. H. Pearce	4
„ A. F. Crosse	1	„ A. Richardson	9
„ W. R. Dowling	10	„ G. O. Smart	9
„ K. L. Graham	7	Prof. G. H. Stanley	9
„ A. Heymann	10	Mr. A. Whitby	11
„ E. H. Johnson	4	„ H. A. White	13
„ A. McA. Johnston	10	Prof. J. A. Wilkinson	12
„ J. Littlejohn	6	„ J. Yates	12

Monthly meetings of the Publications and Finance Committees have taken place, at which the members of those committees have been most regular in their attendance. The Editorial Committee has also met when required, and the members of these committees have done a large

TABLE I.

	June, 1895.	June, 1896.	June, 1897.	June, 1898.	June, 1899.	June, 1902.	June, 1903.	June, 1904.	June, 1905.	June, 1906.	June, 1907.	June, 1908.
Hon. members ...	5	5	5	8	14	9	13	18	18	16	17	18
Life members ...	—	1	1	1	1	1	1	2	3	4	7	7
Members ...	49	81	101	197	281	291	441	639	680	680	683	618
Associates ...	—	—	—	180	238	243	281	338	321	314	342	357
Students ...	—	—	—	—	—	—	—	4	8	4	7	18
	54	87	107	386	534	544	736	1,001	1,030	1,018	1,056	1,018

TABLE II.

DISTRIBUTION.	MEMBERS.			ASSOCIATES.	STUDENTS.	TOTAL.
	Honorary.	Life.	Ordinary.			
Transvaal (Witwatersrand)	5	2	416	157	16	596
Do. (outside districts)	—	—	34	25	—	59
Rhodesia	—	—	53	42	—	95
Cape Colony, O.R.C., and Natal ...	1	1	6	3	—	11
British East & West, French W. & Portuguese E. Africa	—	—	4	3	—	7
British Isles ...	9	2	48	30	1	90
Australasia ...	—	1	7	22	—	30
Dominion of Canada	—	—	—	3	—	3
India and Burma ...	—	—	—	6	—	6
Europe ...	—	—	5	5	1	11
United States of America ...	3	1	21	28	—	53
Central and South America	—	—	5	1	—	6
Mexico ...	—	—	1	13	—	14
Borneo ...	—	—	—	2	—	2
Dutch East Indies	—	—	6	5	—	11
China and Korea ...	—	—	—	5	—	5
Federated Malay States	—	—	2	1	—	3
Addresses Wanted	—	—	10	6	—	16
TOTAL ...	18	7	618	357	18	1,018

amount of work, which the Society cannot too highly recognise.

At the beginning of the year your Council, in accordance with the resolution passed at the last Annual Meeting, transmitted to the Government a petition from the Society, praying that the *status quo* of the Patents Office be maintained. This petition, which was forwarded along with one from our sister society, the Transvaal Institute of Mechanical Engineers, did not, however, have the desired effect, but it brought from the Attorney-General a declaration, that the whole matter would be reconsidered later, possibly during the ensuing session.

The Seymour library still continues its career of usefulness, a large number of books having been added during the year, which will make its value much greater. In this connection our thanks are due to our representative on the Book Committee, Dr. Moir, and also to those members of the Society

who have so willingly given their services voluntarily in sending in proposals for new books and journals. With the completion of the permanent building of the Transvaal University College, on Plein Square, the library will, during the year, be removed to special rooms provided for this purpose.

During the year many Commissions were appointed by the Government to investigate and report on matters connected with the gold industry. The Mining Regulations Commission, in dealing with the regulations obtaining on our mines, entered into a detailed and instructive investigation of ventilation, first aid work, sanitation, education, and the question of certificates, and much important evidence was laid before the Commission by members of the Society, including Prof. Yates, Dr. Moir, Dr. Irvine, and others. We were also well represented by our members before the Mining Industry Commission, which entered very largely into the labour question on

these fields, and whose majority and minority reports are now before the public.

The President was appointed judge in the underground trials of the *South African Mines Stope Drill Contest*, recently held on the property of the Robinson G. M. Co., a competition which has resulted in a similar, one being projected under the joint auspices of the Government and the Chamber of Mines, and to be known as the "Transvaal Stope Drill Competition, 1909." The President and many others of our members have been appointed on the Committee of these trials, and in many quarters it is expected that, as the result of the liberal prize scheme, amounting to £5,600, a satisfactory stope drill capable of largely supplanting hand drilling will be secured.

In view of the number of members outside South Africa the Council decided to recommend the appointment of representatives of the Society in the chief mining centres of the world. This recommendation was unanimously endorsed by a general meeting of members, and the election of suitable corresponding members of Council is now in progress. Besides marking the international scope of the Society's operations, it is hoped that this departure will serve to increase our membership, and to add increased interest and variety to our proceedings, by securing papers and contributions to discussion from the widest possible field.

Your Council is also co-operating with the Transvaal Institute of Mechanical Engineers and other institutions in the formation of a joint Standardisation Committee for the purpose of considering the advisability of altering the British Standard Specification for cement testing to suit local conditions. The question as to whether such committee might also deal with advantage with other materials affected by local conditions, such as local building material, timber, stone, etc., will also be considered.

In conclusion, the Society has once again to express its grateful thanks to the Transvaal Chamber of Mines for the use of the Council Chamber for our monthly meetings; to your Hon. Treasurer, Mr. James Littlejohn; to your Hon. Auditor, Mr. A. Aiken, for again auditing the Society's books and accounts; to your Hon. Solicitors, Messrs. van Hulsteyn, Feltham and Fry; and to the local Press for the space and publicity given to the proceedings of the Society, and notices of its various activities.

The President: I formally move the adoption of the report and accounts, and in doing so I should like to congratulate the members upon the strong position the Society is in to-day.

Mr. R. G. Bevington: I beg to second the resolution. In doing so I should like, as a member of the Finance Committee, to refer to the

matter of the payment of subscriptions. As the Society has no revenue from invested funds, it is necessary that subscriptions should be paid at the commencement of the financial year in order to place the Council in the possession of money to work upon. I am sure it is only necessary to bring this matter to the notice of members in order to obtain their co-operation, and also to avoid the expense and trouble of many reminders. I also wish to impress upon members the fact that every consideration has been given before a member's name has been removed from the roll, more especially when a member has been in straitened circumstances. There are, however, quite a number of members who have not even replied once to the many notices issued, and there are also many who have gone away and left no address.

The Report and Accounts were adopted unanimously.

ELECTION OF OFFICERS.

The President then announced the election of officers, as contained in the following report from the scrutineers:—

Johannesburg, 20th June, 1908.

THE CHAIRMAN,

ANNUAL GENERAL MEETING OF MEMBERS.

Dear Sir,—We hereby certify that we have this day examined 147 voting papers, handed to us by the Secretary, three of which were invalid for one reason or another.

The following is the result of our scrutiny:—

PRESIDENT:

Unanimously Elected. Mr. R. G. Bevington.

VICE-PRESIDENTS:

	<i>Elected.</i>	Votes.
1. Mr. A. McA. Johnston	95
2. Mr. T. Lane Carter	80
3. Dr. J. Moir	70
<i>Not Elected.</i>		
4. Mr. W. R. Dowling	62
5. Mr. H. A. White	58
6. Mr. A. Whitby	46

HON. TREASURER:

Unanimously Elected. Mr. James Littlejohn.

MEMBERS OF COUNCIL:

	<i>Elected.</i>	Votes.
1. Mr. W. R. Dowling	120
2. Prof. G. H. Stanley	119
3. Mr. H. A. White	115
4. Mr. A. Whitby	114
5. Mr. K. L. Graham	112
6. Prof. J. A. Wilkinson	110
7. Mr. C. B. Saner	101
8. Mr. G. O. Smart	100
9. Mr. A. Richardson	96
10. Mr. C. B. Kingston	83
11. Mr. J. E. Thomas	83
12. Mr. E. H. Croghan	72

THE CHEMICAL, METALLURGICAL AND MINING SOCIETY OF SOUTH AFRICA.
(INCORPORATED MAY, 1907.)

Dr. REVENUE ACCOUNT for year ending 1st June, 1908. Cr.

1906-7. EXPENDITURE.				1907-8.				1906-7. REVENUE.				1907-8.								
£	s.	d.		£	s.	d.		£	s.	d.		£	s.	d.						
(225	5	7	To CHARGES (including Postages, Attendance, Bank Charges, etc.)	202	9	4		(1,220	16	0	By SUBSCRIPTIONS—									
120	7	2	PRINTING AND STATIONERY	159	15	11		332	17	0	Members	1,174	6	0						
107	3	6	RENT AND LIGHTING	90	12	0		2	12	6	Associates	353	6	6						
353	0	0	SALARIES...	386	0	0					Students	6	16	6						
6	16	4	DEPRECIATION ON FURNITURE	11	2	0		1,556	5	6					1,534	9	0			
812	12	7					849	19	3	85	1	0	ENTRANCE FEES			59	17	0		
			SOCIETY'S MEDALS				15	5	7				SURPLUS RECEIPTS OVER EXPENDITURE—Annual Dinner and Nigel Visit					13	18	4
			SOCIETY'S JOURNAL—																	
			Cost of Reporting, Printing and Sundries	918	6	11														
(1,162	11	11	less Received for Subscriptions and Advertisements	408	11	10		509	15	1										
442	18	0						233	4	5										
719	13	11																		
109	0	0	BALANCE, surplus on year's working					£1,608	4	4										
£1,641	6	6		£1,608	4	4		£1,641	6	6										

BALANCE SHEET, as at 1st June, 1908.

1906-7. LIABILITIES.				1907-8.				1906-7. ASSETS.				1907-8.							
£	s.	d.		£	s.	d.		£	s.	d.		£	s.	d.					
(106	10	8	To SUNDRY CREDITORS	3	16	2		(231	15	4	By CASH AT BANK	203	15	6					
30	19	6	SUBSCRIPTIONS paid in advance	53	11	0		15	3		CASH IN HAND	4	11	0					
35	0	0	PRIZE FUND	27	0	0									208	6	6		
172	10	2					84	7	2	232	10	7	OFFICE FURNITURE			15	0	0	
			REVENUE ACCOUNT—							20	0	0	TRANSACTIONS, VOL. II.—Stock in hand	99	19	0			
(889	2	10	Balance at May 31, 1907	998	2	10		(110	10	4	VOL. III.	32	8	8					
			Add surplus as per Revenue Account, June 1, 1907	233	4	5		82	5	3	VOL. IV.	226	10	0					
109	0	0					1,231	7	3	128	2	8	JOURNAL, Vol. V., Stock in hand	119	3	5			
										154	11	0	VOL. VI.	138	11	9			
998	2	10								92	17	0	VOL. VII.	145	15	0			
													VOL. VIII.	82	0	0			
										568	6	3	SUNDRY DEBTORS	263	16	7			
										(358	13	2	less Provision for Doubtful Debts	15	16	6			
										8	17	0							
										349	16	2							
£1,170	13	0		£1,315	14	5		£1,170	13	0									

I have examined the foregoing Statements of Account, compared them with the Books and Vouchers of the Society, and I find the statements to be true and correct, as shown thereby.

Sgd. ALEX. AIKEN, } Hon. Auditor.
Incorporated Accountant, }

(Signed) J. LITTLEJOHN, Hon. Treasurer.

(Signed) FRED. ROWLAND, Secretary,
Fellow Chartered Inst. Secretaries.

JOHANNESBURG, JUNE, 1908.

Not Elected.

13.	Mr. A. Heymann	...	...	52
14.	Mr. G. Melvill	...	...	46
15.	Mr. W. Beaver	...	...	42
16.	Mr. J. T. Milligan	...	...	39
17.	Mr. W. Taylor	...	...	34
18.	Mr. J. P. Ward	...	...	29

Yours faithfully,

Sgd.	JAS. GRAY,	} <i>Scrutineers.</i>
"	JAS. LEA,	
"	P. T. MORRISBY,	
"	A. L. EDWARDS,	
"	W. E. THORPE,	

The President: I think we are to be congratulated on the new officers. I really do think we have done remarkably well in our selection, and on your behalf I extend a hearty welcome to the new President and the other members of the Council.

Mr. R. G. Bevington: I am deeply sensible of the great honour which has fallen upon me in becoming President of this Society. I hope, with your co-operation, I shall be able to go through with it, and hand the office over to my successor as Prof. Yates does to me. I trust that during the ensuing year you will assist me in every possible way, so that our Society may continue to be the success it has been in the past, and, if possible, to make it a greater success.

The President: In connection with the elections, we would be lacking in our duty if we did not propose a vote of thanks to the scrutineers who have devoted most of the day to the ballot. I move a vote of thanks to those gentlemen for their work.

Mr. Jas. Gray: On behalf of the other scrutineers and myself I would state that it was a pleasure for us to do the work, and we desire to record our thanks for the hospitality extended by the Society through the Secretary.

AUDITOR.

Mr. Aiken was appointed auditor on the motion of Mr. W. Cullen, seconded by Prof. J. A. Wilkinson.

PRESENTATION OF MEDALS.

The President: It is nearly two years since Drs. Macaulay and Irvine gave us their paper on "Safety Measures in Mining," the discussion on which you remember continued about twelve months, in fact, so long that it tided over the last annual meeting, and therefore it was not possible to present the medals at that meeting. Then Dr. Irvine went home for six months, and on his return Dr. Macaulay left us for four months. This explains the somewhat belated presentation, which is about to be made. It is a very great pleasure for me to-night to present

these medals to Drs. Irvine and Macaulay, and I think they are well entitled to this reward. It is, as I have said, sometime since this room witnessed that notable discussion, but although the paper has become a matter of history, yet every one who goes along the reef sees daily the result of that paper and the discussion thereon. We see it in the improved conditions which are obtaining at present. It is indeed a great work this looking after the health of our miners, and our friends Drs. Macaulay and Irvine are well entitled to all that we have given them. I have also to refer to Mr. Whitby, who, I am sorry to say, has just been undergoing an operation, but is progressing very favourably. He is one of the hardest workers on our Council, and the diploma which he is about to receive is a small token of our recognition of his work and of his paper "Routine Assaying on the Rand." We all hope he will have a speedy recovery and that he will come along as frequently in the future as in the past. I have the honour and pleasure of presenting you, Dr. Macaulay and Dr. Irvine, with these medals and diplomas, and we express the hope that you will long continue in the good work that you have so well begun.

Dr. D. Macaulay, M.L.A.: We have talked so much and to such good effect in this Society, that is unnecessary for me to say very much on this occasion, except to thank you for this appreciation of the little work which we were enabled and privileged to do for the Society, and also for the mining industry in this country. If I were going to dilate on this topic I might say that this might be reckoned a memorable occasion in the history of your Society as well as in the history of the mining industry of this country; that is to say, you have found occasion to present your highest award to two humble workers in a field which is only apparently remotely associated with the work which you are engaged upon, but which you found, when brought to your notice, was intimately associated with the welfare and condition of work of the men on these fields. Dr. Irvine and myself have found our chief satisfaction in the fact that the work which we have done with your assistance and the criticisms which you were able to make has brought to the notice of the powers that be a very important aspect of mining, and we hope that the result will be to prove what we asserted in our second paper, namely, that mining in this country can be made as healthy as any other kind of work.

Dr. L. G. Irvine: I have little to add to what Dr. Macaulay has said. We both thank you very warmly for this mark of your appreciation. I think it is a very great tribute to the catholicity

which animates your work in this Society that you, as Dr. Macaulay has said, have given these diplomas and medals to the writers of a paper which was quite non-technical, which was really more medical than technical, but which, nevertheless, you recognised as being intimately associated with the work which you are carrying on. Since we came into this Society we have always recognised this catholic spirit which you especially showed by the welcome you gave us when we brought forward that particular aspect of mining work. Reform comes very slowly. It is a very long time since we discussed these things, and there is still a good deal to be done, but I hope, that as a result of the work of the Commission which is sitting now, we shall get a step or two further in advance. Dr. Macaulay and I want to see the leaders of the mining industry and those associated with the work of the mines taking these matters to heart. We want to see the initiative in health reform come, not from the Mines Department, but from the mining industry and from the mine officials themselves. Because we are quite convinced that it only wants really serious and earnest co-operation between mining officials from the highest to the lowest to make an immense improvement in the conditions which now obtain. That would be to us the greatest reward for the little work we have done, to see the people connected with mining take these matters to heart, and do them off their own bat, and not be compelled to give effect to the measures which are so necessary to make the conditions of mining here as perfect as they can be.

The President: In connection with these medals, I move a vote of thanks to Dr. Kirke Rose of the Royal Mint, London, who rendered us such valuable assistance in connection with the procuring of these medals.

This motion was carried by acclamation.

GENERAL BUSINESS.

Mr. E. J. Laschinger: Under the heading of general business there is a matter which I should like to bring forward, and which I have very much at heart, not only as a member of this Society, but as a member of other technical societies on the Rand. The opening for the matter which I am about to bring forward was very aptly given me by the new President, who referred to co-operation. It is on occasions of this kind that matters of policy are properly discussed, and at the last annual meeting quite a lot of matters of policy were brought forward. What I want to see is more co-operation between the technical societies of the Rand. I wish no one to be under any misapprehension as to what I mean. I do not mean amalgamation or affilia-

tion, or anything of that sort. But there are various matters on which the technical men of the Rand can co-operate, because they are equally interested. One aspect is the social aspect. We have here quite a number of technical societies, of which this is numerically the strongest, and I, therefore, wish to bring this matter before this Society especially.

There are more technical men concentrated in a small area here than in any other centre in the world, and we do not come enough into contact with each other. There is too much separatism. We ought to know each other better, and the only way to do that is to have some kind of social intercourse in rooms set apart for the purpose, rooms open all day and into the evening, with some one to look after them. We would have a library there, and men from the mines all along the Reef could at any moment look at the exchanges of all the technical journals of the world. If a suggestion emanated from the Chemical, Metallurgical and Mining Society, I believe it would be warmly welcomed by other kindred bodies, and I hope that this year will see inaugurated more of the co-operative spirit. In conclusion, I should like to refer to the very fine report which the Council have presented to-night. There is nothing in the report which indicates that the Council have got "swelled head," and there is nothing there upon which the Council congratulate themselves too highly or inflate themselves with pride, and it is quite possible that they had in mind one of the sayings of the Old Book, "Pride goeth before destruction, and a haughty spirit before a fall."

Prof. J. A. Wilkinson: Has Mr. Laschinger any motion to bring forward on this matter, because we have heard of this before in the Chemical Society, and I must say, I am surprised that this stalking horse has been led in again by Mr. Laschinger.

The President: Possibly you regard this as too serious a matter to be discussed to-night. The new Council will bear it in mind.

Mr. E. J. Laschinger: With regard to the question raised by Prof. Wilkinson, I have no hesitation in putting it to the meeting as a simple proposition. I should like to put it forward in the positive sense, "That it is the feeling of this meeting that a greater amount of co-operation amongst the various technical societies on the Rand will be to the benefit of the technical professions here."

The resolution was duly seconded.

Prof. J. A. Wilkinson: Is this motion in order?

The President: I believe it is quite in order.

Mr. C. T. Gardiner : I think there should be more notice given of a resolution like this. I am rather inclined, with all deference to Mr. Laschinger, to think that this approaches amalgamation. There are difficulties which I will not dwell on now, and I think this resolution should be brought up at another meeting, after due notice, and then the feeling of the meeting can be tested.

The President : I would like to point out that the resolution really commits the Society to nothing, and it is therefore for you now to either move an amendment or accept the original motion.

Prof. J. A. Wilkinson : I do not wish to raise an obstruction to the spirit of the motion which Mr. Laschinger has brought forward, but, as I said, this is not the first time such a proposition has been discussed here. If it has not been discussed in open meeting, it certainly has been discussed for some long time past in Council. This matter of co-operation is purely a matter of finance. Now, we are not financially strong. Every member of the Finance Committee knows that we have had to struggle hard to present the balance-sheet, which has been placed before you to-night. You all know this is a time of depression, and, therefore, I do not think any member of the Council can look forward to the coming year with any sense of assurance in his mind, that at the end of the year we are going to come out square. There is another point. If you pass this motion this evening, you practically tell us that there has been a lack of co-operation in the past amongst the scientific societies. Now, I for one, deny that. When any motion has come forward from any one of the other societies, it has been accepted and discussed by your Council in the most hearty and unanimous spirit. A recent example of that has been the request of the Transvaal Institute of Mechanical Engineers to join with them in altering or, at any rate, revising the British standard specification for cement, a request with which we readily complied. One other fact which seems to have been forgotten I wish to mention. You all know the new building of the Transvaal University College, which is now approaching completion, and all of you, who have taken any interest in that scheme, know that it was in the minds of those who promoted it, that part of that building should be used to house the scientific societies. There are certain rooms in that building which have been set apart to house scientific societies. I do not know what it is that Mr. Laschinger wants, but a motion such as this in such general terms does not appeal to me. I am with the spirit of it, and, as one of the Council, I will do all in

my power to further this spirit of co-operation. I ask you not to pass this resolution now, because I feel with the last speaker, that it would be an instruction to the Council to do something which they are assumed not to have done in the past.

Mr. C. T. Gardiner : I move that this matter be discussed six months hence.

Prof. J. A. Wilkinson seconded.

Mr. E. J. Laschinger : I do not wish it to be thought that I am bringing this forward as something new. I am well aware of the facts which Prof. Wilkinson has brought forward about these rooms, but you will see at once that even if these rooms are set apart, unless the societies co-operate there is going to be a discussion as to who is going to have the best room and so on. It is simply a matter, which I thought should be brought up at a meeting of this kind. There are so many ways in which co-operation can be to the advantage of each society in lessening expenditure instead of increasing it. The object of the motion is simply to test the feeling of the members.

Mr. A. McA. Johnston : I would put it to Mr. Laschinger whether he is willing to let it go forward to a future meeting of the Council, and ask them to bring it forward to a general meeting.

Prof. J. A. Wilkinson : I would be in favour of that.

Mr. E. J. Laschinger intimated that he wished his resolution to go to vote.

The President then put the amendment, which was lost, and declared the motion passed.

I wish to remind you that Mr. Lane Carter, one of our esteemed Vice-Presidents, is going home for a well earned holiday. He has the good fortune to be the manager of the French Rand G. M. Co. This mine is not exactly a Bonanza, but it is one of those mines where one can obtain a heap of experience, hence Mr. Carter's good fortune. We shall miss him very much, but in the meantime we wish him a very pleasant holiday and a safe return.

Mr. T. Lane Carter : I thank you very much for your kind expressions. If anyone wants experience, the French Rand is the place to go and get it. I can assure you I will not forget this Society in the many wanderings I expect to take during the next six months. I shall keep my eyes open, and if there is anything I see that will interest you, I hope that in the intervals of travelling about from place to place, I shall be able to jot down a few notes, and send them forward. I also hope to take part in the discussions and, generally, to keep in touch with you as much as possible. I will not promise to do what our friend, Mr. Caldecott, did when he

returned, namely, give you a paper, but, at any rate, I hope I shall come back full of ideas, and it will always be my pleasure to give them to this Society.

The President: It is not my intention to give you a valedictory address, for I feel sure that the review of the past year's work can very well be left in the hands of Mr. Bevington, who is a well tried member of the Council, and who for many years has been doing very valuable work on behalf of the Society. I feel sure that during the coming year he will maintain the high standing of the Society.

The next item on the agenda is the paper by the late Mr. Harry Pitt, which Mr. Bevington will read.

NOTES ON THE STAMP MILL WATER FEED AND PACKED UP DIES, INTRODUCING THE SHALLOW FRONT MORTAR BOX.

By the late HARRY T. PITT (Member.)

A great deal has been said lately for, and (by some who have not tried it) against, the back water feed for stamp batteries, and the packing up of dies, so as to maintain a level discharge and even crushing throughout the life of the dies.

I am, therefore, inclined to think that the following figures (though somewhat incomplete through loss of data during the war period), will interest members of this Society.

They are the results of trials made by me at the Rose Deep mill in August, 1899; both with the back water feed and with packed up dies. To trot out figures collected in 1899, savours of ancient history; as a matter of fact, we are pre-war with our mortar boxes, if not prehistoric. At any rate, little has been done to strengthen them or to shape them so as to help up the number of tons crushed per stamp. Practical millmen will, I am sure, admit that there is room for improvement.

The old method of introducing the water at the top of the mortar box, delivers the water on top of the stamp heads. It then falls on to the dies like a rain shower, and consequently does not assist in forcing the crushed pulp to the screens. When water is fed through the ore feed chutes, that which does not strike the heads or shoes, shoots over the dies and lands on the bottom of the screen frames or chuck blocks, thereby causing a back-wash which has a tendency to keep back crushing, by checking the free discharge.

Water let in at the back of the box, level with the top of the dies, as in trial No. VI., forces the uncrushed rock to bank up against the screens

and causes the shoes to drop on bare dies; further, the water inlets will frequently become choked with small rock. If water be let in through five pipes, two at each side of the feed chute, and one pipe under the feed chute, so as to deliver on to the back plate vertically and strike the back end of the dies at an angle of about 50° , as shown in sketch, then the water striking the back plate, comes off on to the dies in a fanlike stream, not strong enough to force the uncrushed rock to the screens, while having sufficient force to carry all crushed rock and slimes to the screens, to be helped out with the splash caused by the dropping of the stamps. This water striking the dies at an angle of about 50° will follow the die down as it wears. This fact is of considerable advantage, especially where deep mortar boxes are used.

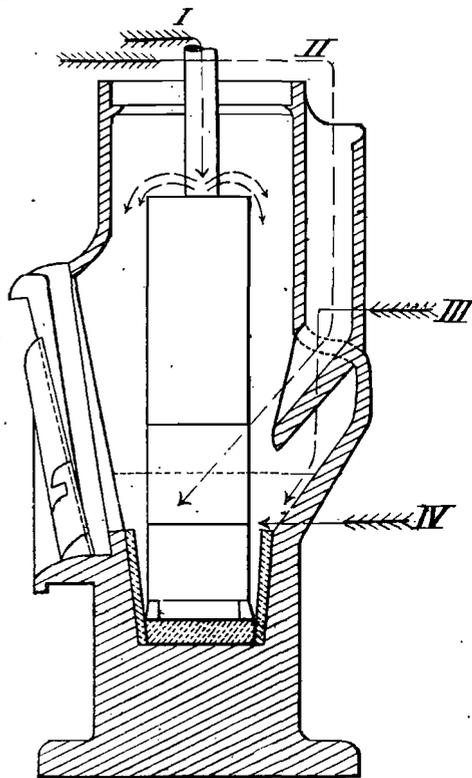


FIG. 1.—SKETCH SHOWING VARIOUS METHODS OF SUPPLYING WATER.

I advocate the style of water feed as in trial No. III., not only from results obtained through experiments, but from close observation of operation on a large scale.

By packing up the dies with false bottoms and using different sized chuck blocks (as the dies wear down) an even crushing throughout the life of the dies can be maintained. Another method to attain the same end is to use Mr. Chew's false dies. But to change false dies and false bottoms

takes up time and causes stoppages and is costly in spares. I take it that all millmen are endeavouring to crush a large quantity of rock, and to crush it cheaply in the shortest space of time. I make the above fact my excuse for introducing the following sketch of a "shallow front mortar box." With such a box the dies can be worn down to the flange which holds them in position and the discharge maintained evenly all the way down by simply changing the chuck block as the dies wear.

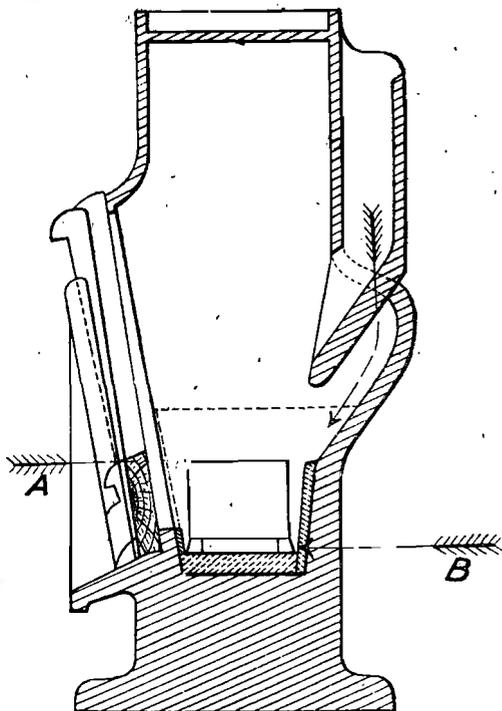


FIG. II.—SKETCH OF BOX.

A shallow front mortar box will not cost any more to construct than those at present in use, and no extra spares are required. The chuck blocks can be changed at any convenient time as

easily as a screen is changed. For this box I would advocate the use of a 15-in. screen instead of 12 in., so as to take full advantage of the splash. This box will cost less in liners, as will be seen on reference to the sketch, and there will be less iron or steel used in casting them.

Water let into box, as shown by arrows, will follow dies down to the bottom of the box. With liners made as per sketch, it will not be necessary to take out false bottoms when changing liners.

By decreasing the height of chuck blocks A as the die wears, a level discharge can be maintained until the die is worn down to the flange B (which holds the die in position).

Unfortunately, I was not allowed to spend any money in partitioning off the mill bins and equipping boxes so as to carry on my experiments with back-water feed and raised dies. However, Mr. Caldecott, of the Consolidated Goldfields, took the matter up and carried out trials at the Knights Deep mill with and without the back water feed, and he can, I am sure, give some very interesting figures on results obtained. There are several mills on the Rand now equipped with back water feed, amongst them being, the Knights Deep, Rose Deep, Glen Deep and others. Of this, I am certain, the duty per stamp is increased thereby, and the cost of installation is no more than the ordinary feed. In conclusion, I would say, if this little paper only succeeds in drawing milling and other members of the Society into a discussion on the water feeds in use in the many different mills on the Rand, so as to bring us to some definite decision as to which is really the most beneficial water feed to use, it will have served its purpose.

TRIAL No. I.—*Working Conditions.*

Weight of stamp ...	1,150 lb.
Height of drop ...	7 in.
Number of drops per minute ...	105
Size of screening ...	500 light mesh
Screen area ...	520 sq. in.
Water supply let into top of mortar box.	
Discharge level with the face of dies.	
Dies packed up on two false bottoms.	
Chuck blocks decreasing in height as dies wear.	

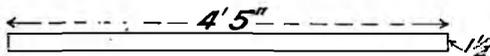
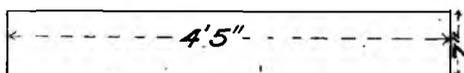
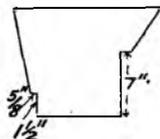


FIG. III.—SKETCH OF FRONT, BACK AND SIDE LINERS.

Results.—Coarse Rock.—Five stamps took 39 hours 47 minutes to crush 51 tons of 2,000 lb. = 6.153 tons per stamp per 24 hours net.

Screened Rock (passed through $1\frac{1}{2}$ in.).—Five stamps took 27 hours 38 minutes to crush 36 tons of 2,000 lb. = 6.253 tons per stamp per 24 hours net.

TRIAL No. II.

All conditions exactly the same except the discharge was not level, but 1 in. above the die level.

Results.—Coarse Rock.—Five stamps took 15 hours 56 minutes to crush 19 tons of 2,000 lb. = 5.723 tons per stamp per 24 hours net.

Screened Rock ($1\frac{1}{2}$ in. mesh).—Five stamps took 35 hours 36 minutes to crush 43 tons of 2,000 lb. = 5.797 tons per stamp per 24 hours net.

TRIAL No. III.

All conditions exactly the same as in trial No. II. except the water supply, which was let in through four $1\frac{1}{2}$ in. holes, level with the ore feed chute at the back of mortar box. Dies 1 in. below discharge level. Two false bottoms.

Results.—Coarse Rock.—Five stamps took 9 hours 12 minutes to crush 11 tons of 2,000 lb. = 5.740 tons per stamp per 24 hours net.

Screened Rock (all fines).—Five stamps took 11 hours 5 minutes to crush 20.5 tons of 2,000 lb. = 8.878 tons per stamp per 24 hours net.

TRIAL No. IV.

All conditions exactly the same as in trial No. III. except that the discharge was level instead of being 1 in. above the die level.

Results.—Coarse Rock.—Five stamps took 190 hours 4 minutes to crush 236 tons of 2,000 lb. = 5.941 tons per stamp per 24 hours net.

Screened Rock ($1\frac{1}{2}$ in. mesh).—Five stamps took 84 hours 43 minutes to crush 106.5 tons of 2,000 lb. = 6.034 tons per stamp per 24 hours net.

TRIAL No. V.

All conditions exactly the same as in trial No. IV. except the screen, which instead of being straight was made to give 173 sq. in. more area than the straight screen.

Results.—Coarse Rock.—Five stamps took 33 hours 16 minutes to crush 400 tons of 2,000 lb. = 5.771 tons per stamp per 24 hours net.

Screened Rock ($1\frac{1}{2}$ in. mesh).—Five stamps took 73 hours 13 minutes to crush 97.5 tons of 2,000 lb. = 6.390 tons per stamp per 24 hours net.

TRIAL No. VI.—Battery No. 20.

All conditions exactly the same as in trial No. I. except the water supply, which was led in through five $1\frac{1}{4}$ in. holes in back of mortar boxes, level with the top of dies and discharge on box lip. Two false bottoms.

Results.—Coarse Rock.—Five stamps took 191 hours 29 minutes to crush 264.5 tons of 2,000 lb. = 6.630 tons per stamp per 24 hours.

Screened Rock ($1\frac{1}{2}$ in. mesh).—Five stamps took 324 hours 51 minutes to crush 448.5 tons of 2,000 lb. = 6.627 tons per stamp per 24 hours net.

The President: There is a melancholy interest attached to this paper, because of the death of Mr. Pitt. The Railway Pioneer Regiment, which was raised from among the employees of Rand Mining Companies, largely through the efforts of the late Major Seymour, you will all remember well. You will also remember the disastrous day at Sand River, in the O.R.C., when Major Seymour, one of the finest engineers that the Rand has ever seen, Lieutenant Clement and others, were shot. It was in the same engagement that Mr. Pitt received the wound which recently necessitated an operation, and unfortunately that operation has ended fatally. I move a vote of thanks to Mr. Campbell Pitt, his brother, for sending forward these notes and allowing them to be read.

Mr. R. G. Bevington: I will second the vote of thanks. Mr. Pitt has placed before us some very interesting notes, and I know it was his intention, had he been spared, to have pursued those investigations further. So that we have not only to deplore the loss of a valuable member of our Society and a man whose heart was in his work, but also the fact that we are denied a further contribution from him on this interesting subject. As there can be no reply, I do not see how we can discuss this paper in the ordinary way, but there are one or two points which strike me and which I should like to allude to. Firstly, you will see from the sketch that his experiments were carried out with the pattern of mortar box which has a recess at the back for the purpose of holding a copper plate, when such is used, with inside amalgamation, and I gather that it was Mr. Pitt's plan to admit the water by pipes fitted through the roof of this recess. Now as I do not use inside amalgamation, I have, as many others have also done, filled up this recess with a block of wood faced with an iron plate so as to convert the boxes, as nearly as possible, to the straight back pattern. In this case, in order to obtain as closely as possible, the results of the method of application of water, as favoured by Mr. Pitt, it has always been my practice to admit the water by means of two 1 in. pipes at the top of the box between stamps 1—2 and 4—5 so placed as to direct the stream of water against the back of the box over which it spreads itself and runs down gently in a sheet, tending to wash the crushed rock and slime from the back of the box

towards the screens. The shallow front box seems quite a good idea and well worth trying. Perhaps some one of the manufacturers of these articles will be prepared to make one and get it tried as an experiment. Turning to the table of trials, you will notice a very important point when trial No. III. is compared with the others. This trial is the only one in which the stamps were fed with "all fines"; in the other trials the finest rock fed having been fed through $1\frac{1}{2}$ in. mesh sieve. Now the increase in the output in crushing the "all fines" as against the other trials is so enormous as to, I think, dispose of the theory so often advanced that it is no good crushing rock too fine before sending it to the stamps.

Mr. W. A. Caldecott (contributed): The discussion on the paper written by the late Mr. H. T. Pitt affords a welcome opportunity of paying a tribute to his memory, as one of the pioneers upon these fields, and even earlier at Barberton. His sterling work, both in the field of ore treatment and during the war, is known to us all, and in losing him we have lost a typical representative of those members who constitute, by their steady devotion to duty and to the companies they serve, the true backbone and strength of our Society.

As mentioned by Mr. Pitt, I adopted, upon his suggestion, the method of back water feed in some experimental work proceeding some years ago at the Knights Deep, and the suggestion has since been acknowledged.* Besides serving as a good method of introducing water into the mortar boxes under any circumstances, this feature is especially valuable, when fine crushing with high discharge, and it has been incorporated in the structure of over a hundred mortar boxes cast for the Consolidated Gold Fields, since the experiments above referred to. At the Homestake, crushing with a 10 in. height of discharge, some ten or twelve tons of water per ton of ore are required with the ordinary method of supplying water, for creating sufficient agitation to wash out the particles of ore. At the Simmer East we are able, when fine-crushing in the battery with the same height of discharge as above, to employ the ordinary water ratios (say, seven to one), because the gently uprising current of water introduced near the die level serves to carry upwards, by a process of elutriation, particles fine enough to pass the screen. The importance of a not excessive water ratio becomes evident when it is considered that upon the volume of pulp depends, the plate area, cost of elevating pulp, number of classifiers, launder and collecting vat capacity, and cost of pumping water back to the mill.

*See Proceedings of the Institution of Mining and Metallurgy, vol. xiv., 1904-5, p. 164.

A LABORATORY COMPARISON OF TUBE MILL PEBBLES.

By Prof. G. H. STANLEY, A.R.S.M., M.I.M.E.,
M.I.M.M. (Member).

With an Appendix on Liners, by M. Weber.

The following brief account of a comparative examination of samples of local and imported pebbles, will, I am sure, be of interest to those members of the Society who are concerned in running tube mills and, doubtless, to others as well, even though the increasing use of blanket lumps as a substitute renders the subject of pebbles less important, at any rate in Rand gold milling practice.

The local pebbles examined were rather smaller than the imported, and of more irregular shape, their colour being grey, with white and yellowish white patches, that of the imported being greyish white. The local pebbles were more easily broken under the hammer, and considerably easier to grind on the bucking plate; their interior colours varied from light brownish grey to nearly black in different pebbles, and their fractures, although conchoidal like the imported, and fine grained, were obviously to the naked eye much coarser in grain than the latter, the fracture of which was of the same colour as the interior, and very fine grained. Very little difference in hardness was noted by the test of relative ability to scratch one another, but it was rather easier to scratch local by imported pebbles than *vice versa*, and this was confirmed by the amounts of iron, removed from the bucking plate during grinding and taken up by the sample, subsequently removed by a magnet. The local pebbles took up about 2%, and the imported considerably more.

In order to ascertain whether chemical composition could in any way account for these observed differences, fair samples of each type of pebble were taken and analysed with the following results:—

	Local Pebbles. %	Imported Pebbles. %
Loss on ignition (H_2O , CO_2 , etc.) ...	0.46	1.00
Silica (SiO_2) ...	97.20	96.78
Iron oxide and alumina (Fe_2O_3 and Al_2O_3) ...	1.95	1.86
Lime (CaO) ...	0.22	0.26
Magnesia (MgO) ...	0.16	0.07

The composition of the two classes, therefore, was practically identical, and furnished no clue to the different properties or behaviour. As already stated, the local pebbles were evidently of comparatively coarse structure, so that the next step

was to have thin sections prepared for microscopic examination in order that the internal structure could be studied, and this, as shown in the photographs, furnishes, I think, the explanation sought for.

Both photographs were taken with polarised light and show a magnification of 75 diameters. In No. I., a local pebble, it is seen that the



FIG. I.—LOCAL PEBBLE $\times 75$.

section is not only composed of comparatively coarse grains with nearly smooth edges (as distinct from photo III.), but that the grains are not of uniform size, in fact, the mass is composed of mosaic secondary quartz with a few specks of other minerals, and is really a quartzite. The grains do not appear to be cemented together, but are held together, though not strongly, mainly by interlocking, thus creating difficulty in preparing the slide as they easily separated during grinding. This accounted for the comparative brittleness of these pebbles, as the difference in sizes of grains may account for uneven wearing.

In No. II., on the other hand, an imported pebble, the structure is crypto-crystalline and homogeneous, and in places distinctly radiating. It is probably composed therefore of the Chalcidonic variety of silica, *i.e.*, a true flint, and no difficulty was met with in making the slide. This greater brittleness and slightly inferior hardness of the local pebbles, of course, influences their wearing qualities, the imported pebbles lasting longer, though the difference, I believe, is not very considerable and may be offset by the lower cost. It is, however, obvious, that considering only the local pebbles, the more the quartz grains interlock the less easily will they be separated and the less brittle will the pebble be. In some quartzites this interlocking is very marked, and

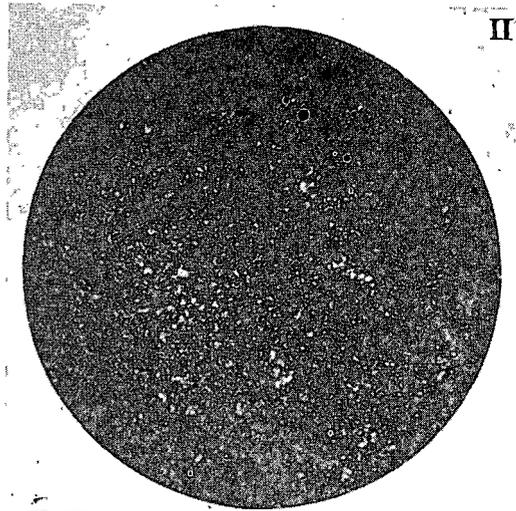


FIG. II.—IMPORTED PEBBLE $\times 75$.

the rock is in consequence comparatively tough and strong, and it would seem, therefore, that the microscope may furnish valuable information as to the suitability of proposed pebbles, and also liners, for employment in tube mills.

With regard to liners, Mr. Weber has kindly furnished me with the appended note embodying some of his observations, and, in conclusion, I may perhaps offer an opinion, that in tube mill pebbles and liners the important properties are three in number; hardness, toughness, and homogeneity, the order of importance in the case of pebbles being as given, and in the case of liners, hardness, homogeneity and toughness.

Hardness is a *sine quâ non*; homogeneity results in even wear, of great importance with liners; while pebbles particularly require toughness to resist breaking when tumbling about in the mill. The imported pebbles and liners apparently excel in each of these qualities.

Liners (by M. Weber).—During the last twelve months, I had on several occasions to study and compare rocks which, either had been used, or were to be used in mining tube mills. I can only confirm what Prof. Stanley says with regard to the structure and its bearing on the tenacity of the rock. I have seen some local chert sections which had a fine and uniform grain, but I never found a piece of more than 2 in. in diameter in which there were no zones of coarse crystallisation, like those shown in photograph No. I. of a local pebble.

I was recently asked to determine which of two local specimens would probably last longer as a tube mill liner. The one I selected was to all outward appearance a hard glassy quartzite, which the microscope, however, showed had

originally been a sandstone. The original quartz grains are best seen in ordinary light. They are small, well rounded, and comparatively far apart. The general appearance of the rock, under magnification, is that of a somewhat gritty sandstone. The interstices between the quartz grains are filled with clear quartz, and the outlines of the quartz grains are marked by dustlike opaque inclusions. Polarised light reveals the fact that the interstitial filling, which usually in a quartzite consists of a mosaic of optically differently arranged minute secondary quartz grains, disappears, *i.e.*, the original round quartz grains have grown at the expense of the secondary cement, which ultimately has been altogether replaced by extended portions of the quartz grains, each individual grain having grown until it was met and stopped by the extending portion of the next grain. In polarised light, therefore, no cement is seen, but the whole of the rock consists of angular elongated crystals of quartz dovetailed and interlocked tightly together on account of their serrated edges, and inside which one still recognises the outline of the impure original quartz grain. This structure is shown in photograph No. III.,

III



FIG. III.—LOCAL LINER $\times 85$.

and it is to this that I attribute largely the exceptional wearing quality of the rock. During examination uniform wavy extinction, due to molecular rearrangement produced by pressure was noticed and suggested that the hardness of the rock might have altered. On polishing a face I actually found that an ordinary quartz crystal did not make any incision into the polished face, *i.e.*, the hardness was more than seven, and obviously increases resistance to wear. A lining of this material was put in and has been used up to the

present for 85 days, behaving quite satisfactorily and appearing likely to last 120.

The other specimen was a dark coloured chert with white rims surrounding crystalline quartz. Applying the same test to a polished piece I found that the black portions were easily scratched by quartz. The white rims surrounding the crystalline quartz were found to be harder than quartz, so that the face of this rock in use as a liner will necessarily, after a short time, become uneven and the harder portions will obviously break off when the softer material around them is worn away. The microscopic characters were similar to those shown in photo I.

There is still one more point in favour of the quartzite as a liner. The rock has to be dressed to a certain shape, and a rock which has in all directions the same hardness and tenacity lends itself ever so much better to this operation than the chert.

The President moved a vote of thanks to Prof. Stanley for his interesting discussion of the important subject of tube mill pebbles. This was agreed to.

ASSAY OF BATTERY CHIPS AND SCREENS.

(Read at February Meeting, 1908.)

By LESLIE J. WILMOTH (Associate).

DISCUSSION.

Mr. H. R. Jolly: In answer to Mr. White's question regarding the addition of sodium sulphate direct instead of sodium bisulphate, I wish to say that sodium sulphate was tried repeatedly, but it did not have the effect on the fluxing of the large pieces of iron that sodium bisulphate had. There was no apparent evolution of gas in the earlier stages of fusion, such as might arise from interaction between the free acid of the bisulphate and the soda, and, in fact, the fusions took place in a very ordinary manner. That the bisulphate exerted some powerful action on the fragments of iron is evident, as no attempts to slag these without it were satisfactory. The method appears to Mr. White round about and unscientific, but I fail to see how he arrives at that conclusion. He evidently has overlooked the remarks I made at the beginning of my paper, when I said that it was not my intention to theorise, but to give a few notes embodying the practical results of some experiments. My critic has seized a well-known wet reaction, applied it to bodies undergoing fusion, and, in fact, theorises without practice. No doubt,

if he will take the trouble to make a few experiments on the flux suggested by me in a practical manner, he may see reason to modify his views.

Mr. H. A. White: It is rather late to again intervene in this discussion, but I cannot allow a question like this to go against me by default. It must be clear to most of us that the reaction between bisulphate and carbonate of soda is not only a wet one, but also obtains at the heat of dry fusion. It follows that Mr. Jolly's method amounts to the addition of sodium sulphate, and no amount of practical tests showing a certain difference in effect under special and varying circumstances can get away from this difficulty. However, my chief reason for again emphasising this point is that I deplore the introduction of fresh empiric methods into assaying more than is necessary. Even at the present time the process is not so scientific as most wet analytical methods used commercially and I, therefore, think that when any new practical method like this is introduced, the theoretical basis of it should not be ignored. In the original paper the new method there introduced is well supported by consideration of reactions involved as well as by experimental demonstration of the results obtained.

REPLY TO DISCUSSION.

Mr. L. J. Wilmoth: In reply to the query of Mr. McKeown, I should think that the storage of old battery screens would affect their value owing to dilution by the oxygen taken up during oxidation. Mr. Jolly evidently finds the matte assay a little difficult, but I think a little more perseverance would have overcome his difficulties. A button, such as he obtained, certainly points to a serious defect in his assays. It is evident that he saw the weak point from the remark "that there must have been a large quantity of iron or iron sulphide carried down with the lead." It is unfortunate that he did not attempt to get over this difficulty, which is due not to any defect in the method but to a defect in its application. It would seem that the trouble lies with the metallic iron not being completely taken up into the matte. It is probable that if he had added a little more sulphur and kept his pots in the fire a little longer his difficulties would have disappeared. With sufficient heat I fail to see how the matte could be mixed with the lead button. The high values obtained in the matte are hardly surprising when the iron was left in that state. I think most people will agree with him in saying a matte in gold assaying is bad practice, but I think there are cases when we can use the matte with certain precautions to great advantage, such as in the assay of battery

chips, etc. The bisulphate assay is interesting, and I have no doubt yields excellent results, but as I have been very busy since getting the proofs of Mr. Jolly's contribution to the discussion, I have had no opportunity to test the method. I intend to do so, however, at my earliest opportunity, and until I do so hardly feel justified in criticising it at all.

Turning now to Mr. Whitby's contribution, there is not much to be said. It seems a pity that he had not tried a few experiments himself before he passed any criticism on the method. A little experience often makes us take quite another view of things. Taking the criticism from the beginning, we have just a brief reference to the functions of the ingredients of the flux I used. I think Mr. Whitby is entirely wrong in considering that the sulphur, iron, nail and charcoal all act as reducers. To begin with, the reactions are divided—to my mind—into two groups. First, we have a group consisting of the metallic iron of the charge, the sulphur and the iron nail, and the second group of the rest of the ingredients of the charge. The second group act much the same as in fluxing an ordinary basket sample, whilst in the first the sulphur mattes the metallic iron, the iron merely acting in the capacity of a safeguard against an excess of sulphur, which would give a lead sulphide. Should a lead sulphide form, it would pass into the matte and carry gold with it. The formation of this lead sulphide is what we have to guard against. Lead in the slag is reduced to metallic lead and passes into the button, so the litharge used is regulated according to the button required. I think Mr. Whitby's fear of retaining gold in the slag by an alkaline sulphide is hardly necessary, as the temperature of the fusion and the final wash of litharge and charcoal should overcome this little difficulty. An iron nail, melting into the lead button, is an experience I have not met with up to the present, and I should think the use of an iron rod of more ample proportions would overcome this difficulty. I think, in referring me to Peter's observations on the smelting, he could not have just compared in his mind the two processes of assaying and smelting in a blast furnace. As I remarked in my paper, the one essential point that has to be kept in view is to keep the lead out of the matte. Now in smelting lead ores carrying small proportions of copper, is this done? In the smelting of such an ore the copper bearing matte always contains very considerable proportions of lead sulphide, and so naturally carries values. I have no doubt the smelters would keep all the lead out of the matte if possible, but the fact remains that it is always there. It is unfortunate that Mr. Whitby raised

the comparison of the two processes, as the conditions are such as to make the comparison useless. I would like, in conclusion, to thank those gentlemen who took part in the discussion.

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

(Read at September Meeting, 1907.)

By G. B. HOGENRAAD (Associate).

REPLY TO DISCUSSION.

Mr. G. B. Hogenraad: In writing the paper it was not my intention at all to show how good the new flux was; as Mr. Guthrie remarks, the ore is simple enough, and in fact little trouble was experienced in applying the new flux. The intention really was to find out the effect of borax in assaying. I have always been taught that borax carried silver into the slag, and as far as the experience in assaying in our laboratory shows up till now, I cannot see any reason why borax should be added. The slag produced without borax contains no gold and sometimes but traces of silver, so that no cleaning of the slag is required; the lead buttons separate out very well, without slag adhering to them; the results agree satisfactorily, both for gold and silver.

Mr. Guthrie, and, in fact, everybody contributing to the discussion of the paper, agree with me that the old flux was not a good one for this ore; my point was that the fault lay in the excessive presence of borax, and I therefore regret that no one of my critics submitted a statement of results to show that borax had no detrimental effect, with especial reference to the silver. In a country like South Africa, where the silver values are, as a rule, of little importance, I can understand that the addition of borax does not make much difference. I should like to ask Mr. Guthrie to make experiments on 1 A.T. of ore with the flux he recommended on p. 75, viz., soda, 1.5 A.T.; PbO, 1.0 A.T.; borax 0.5 A.T.: and to compare the results with others, when using a flux consisting of: soda, 1.5 A.T.; PbO, 1.5 A.T. I am inclined to believe that he will find that there is a perceptible difference in favour of the latter flux, and if there were practically no difference, why not leave the borax out altogether, as it is rather an expensive article?

I made a good number of comparisons by using the two methods on the same samples and found that the figures, when using the scorification method, were always perceptibly lower than with

the pot assay, both for gold and silver (see table); I therefore believe that the pot assay is the best, but that when scorifying and cupelling the buttons, checks must be used for the silver.

Mr. White says that the difference of 5% less PbO and 5% more soda does not account for the effects observed on the pots. I should like to believe him, but I cannot help thinking these pot crackings were chiefly due to excess of PbO, as after its decrease no more pots cracked. The pots have always been stored in the furnace room all day before use and stand five to six fusions. A cold pot has never been placed in a hot fire, as Mr. Guthrie supposed, and the makers are the Morgan Crucible Co., Battersea, England.

Prof. Stanley's suggestion that the lower yield of precious metal with the old flux was influenced by the excessive use of charcoal I readily accept; undoubtedly, there was too much charcoal, but does that prove the necessity of borax in the new flux? Another important question besides that of borax is:—Why should our buttons, occurring with such an oxidised slag, need scorification? To tell the truth, I cannot give an explanation for that; I can simply state the fact, that when they are not scorified before cupellation, the results are not so good. If this is indicative of imperfect fluxing, which I honestly believe it is, I should like to ask Mr. Whitby and Mr. Wilmoth what remedy they could suggest? Most probably they would advise me to add borax to the flux, but then we return to our starting point. I would state, for their guidance, that scorification of the lead buttons is not adopted to get agreement between duplicate assay of the gold but for the silver; and I would also mention that selenium has never been found in the lead buttons.

To Prof. Stanley I wish to express my regret at being not clear enough, when stating the amount of lead reduced by 1 gm. of charcoal. In fact, I never found more than 25 gm. for 1 gm. of charcoal, so that the sentence referring to this question should read:—"This was verified by several trials, always resulting in 34 to 35 gm. for 1 gm. of charcoal, when calculated for pure carbon."

Mr. Wilmoth is wrong in saying that I am inclined to blame the borax as being the cause of "excessive" loss during fusion. I never said so, and as regards the manganese, I hope he is convinced now by the following table, showing assay results obtained by pot assay and scorification, that there can hardly be any influence from that, and that scorification only is not the way to assay our samples.

Before ending this reply, I wish to express gratitude to those contributing to the discussion

of my paper. I am quite willing to use borax in the flux, and will do so as soon as I have been convinced by figures, results from comparative experiments. Until then I will stick to my non-borax flux.

COMPARISON OF ASSAY RESULTS AS OBTAINED BY POT ASSAY AND SCORIFICATION.

Sample.	Date April, 1908.	Pot Assay Dwt.s.		Scorification Dwt.s.		Remarks.
		Gold.	Silver.	Gold.	Silver.	
Slimes	5	15.5	129.0	14.0	110.5	Pot assay carried out.
Battery pulp	5	15.0	105.0	12.8	92.2	with non-borax flux;
Sands charge	5	11.4	84.6	11.1	78.4	buttons scorified and
S. n. s. charge	5	12.2	85.8	11.7	75.5	cupelled, 2 A.T. sample
Slimes	6	16.7	166.8	15.2	154.0	taken.
Battery pulp	6	20.6	145.9	17.5	142.0	Scorification carried out
Sands charge	6	17.8	140.7	15.2	116.7	in 2 1/2 in. scorifiers with
Sands charge	7	21.8	163.2	18.7	152.8	50 gm. granulated lead
Slimes	7	20.8	189.7	16.3	162.6	and little borax to cover.
Battery pulp	7	21.5	164.5	17.5	144.4	
Average		17.33	137.52	15.00	122.915	5 gm. sample taken.
In favour of pot assay			+2.33	+14.61		

NOTES ON RAND MINING.

(Read at March Meeting, 1908.)

By TOM JOHNSON (Member).

DISCUSSION.

Mr. Tom Johnson (contributed): I have just received the March copy of the *Journal*, and I find that, by an oversight, there are a few mistakes in my paper, which I hope you will correct in the next issue:

Page 256, 2nd column, line 6 from bottom, read "1896" instead of "1906."

Page 258, 2nd column, line 4 from top, read "prevent" not "insure."

Page 259, 1st column, lines 6 and 7 from top, read, "per ton handled, as the amount is small. The value, etc."

Page 261, 1st column, line 8 from top, delete "for" before "a 200 ft., etc."

Mr. T. Lane Carter: I regret that the hour is so late, as I had intended to deal at some length with Mr. Johnson's paper. With regard to what he says about shafts, I think that very few of the shafts here are worked to their utmost capacity. They can handle a great deal more rock than they do at present. Perhaps his criticism that there has been too much money expended on the size of shafts is well founded.

In regard to the author's remark about handling water in baling skips, it is interesting to note that on some of the large mines of the world baling has been adopted with success in preference to pumps.

The author refers to the common practice on the Rand of having a large number of shafts with boilers, etc. I think if we had adopted in the past, and if in the future we go in more for electricity on the mines, that this objection will not be so well founded. It seems to me that the small use of electricity on the mines is one of the things which we have to be blamed most for. We have in the past fought a bit shy of electricity, and I must say that if, in the future, we go in for more electricity, the results will be much better than they have been in the past. With regard to the use of telephones on the mines, this, of course, is not a very expensive item, and in some cases it is warranted, but those of you who have seen how expert the skip-men and engine-drivers become in the use of bells, will realise that a great deal can be done with bells. They seem to get a code of their own, and you can almost tell the temper of the man from the way he rings the bell. They seem to have the power of holding quite a conversation with these bells, so that the use of telephones in small shafts is by no means necessary. A good electric bell system is quite ample in the majority of cases.

The author asks, are we right in keeping to the rectangular form of shafts? I say, yes. This is a much better form for our conditions, it seems to me, than the round shaft. One proof is that there are only two or three round shafts on the Rand. We have had a considerable amount of shaft sinking on the Rand; we have had engineers from all parts of the world, and if round shafts had been better for the Rand we would have found it out long ago. I need not enter into a discussion of round versus rectangular shafts. The extra cost of sinking rectangular shafts and the utilisation of all the space will readily come to your minds, so that I think that the answer to Mr. Johnson's query is that rectangular shafts are preferable to round ones.

Bends in shafts are, of course, a considerable nuisance, but, as a rule, they are necessary. I

think where the mistake has been made has been in having the radius of the bend far too small. The general practice has been to allow 50 ft. It seems to me that it ought to be at least 75 and possibly 100 ft.

His idea of endless rope haulage in the mine is a novel one, and under some conditions where we have flat stopes or flat reefs, as we are finding them on the East Rand, I think the scheme of endless rope haulage will play a most important part in the future. It is a common practice in coal mining, and the next ten or fifteen years, I think, will see this endless rope idea used a great deal in the opening up of deep level mines where the dip of the reef is small.

Mr. Johnson has given us some startling ideas, and one of them is the use of boilers underground at the bottom of the shaft. It seems to me that electricity has been proved to be so efficient and such a safe thing to use that the idea of having a steam plant underground is out of date. It might answer in collieries, but it seems to me it is out of the question on the Rand. By far the most startling scheme proposed in this paper is the placing two shafts close together. I suppose that he would take a property of 5,000 ft. long, and he would put his two shafts a few hundred feet apart, and you can figure it out what that would mean in developing the property. This is another coal idea. In fact, there is a great deal of the application of coal mining to Rand mining in this paper. The idea of those shafts close together is, of course, quite different to our present practice. The idea now is to get them as far apart as possible, and reduce the number of shafts sunk. There is, of course, difficulty in getting the connections through, but the final result is much better by putting the shafts as far apart as practicable.

The running of a 200-stamp mill from three levels is an excellent idea where it is possible, but there are not many mines on the Rand where this can be done. Only one or two mines in the Central Rand can run such a mill from three levels.

The author's ideas of stoping are sound on the whole. He seems to advocate having a gang of blasters, but I do not think that is the best policy. The contractor should have a direct interest in all the stores used, and that interest should not be spread over several parties. It should be to his interest to be economical in stores, where you have two people taking part in blasting, the greatest economy in stores will not be induced.

The idea of using tailings in the mine has already been discussed, and the fatal objection has been pointed out that the acid in the mines

would produce hydro-cyanic acid. The idea is sound if it were not for this objection.

He refers to narrow stoping widths. Of course, it is the best practice to keep the stopes as narrow as possible, but with machines the problem is how to keep up the slabs of waste rock.

The author goes in for cheap hand steel. Here I entirely disagree with him. It seems to me that cheap steel is almost invariably the most expensive in the long run. I would never dream of buying some of the cheap steel we have on the market to-day. It is much better to get a good quality of steel, even if the first cost is high.

There is a point that will come up in the future, and that is the sharpening of steel underground. I think that in a few years hardly any of the steel that is now being hoisted to the surface for sharpening will be brought up. It will be done underground by electric furnaces or some other such scheme.

The author does not mention it, but there is difficulty experienced all over the Rand in regard to the loss of steel underground. Kafirs and Chinamen have a way of hiding steel, and on every mine you will find that there are tons of steel stored away underground and lost forever. There are many ways of remedying this, but one of the best I think is to treat the hand men as we do the machine men—that is, to give them all a certain number of drills with a distinctive mark on them, and make the miners responsible. If any of the drills are lost, make them pay for them. This scheme has been tried on several mines, and proved to be successful. The expense at first is considerable in getting out sufficient steel, but eventually the saving is considerable.

Another point is machine sharpening versus hand sharpening of steel. It has been my experience that hand sharpening pays best. I have tried both methods.

With regard to guides, I think that in future, guides, to a great extent, will be of steel.

With regard to pumps, of course Cornish pumps have played a great part in mining in the past, but I think, to a great extent, the day of the Cornish pump is over, and that in the future pumps will be electrically driven.

A very important point is the use of gelignite instead of gelatine. The practice is in use on the Rand, and where gelignite can be used it is cheaper, and there is a very considerable saving in stoping. There is only one more point, and that is the extended use of white labour underground. The author seems keen on getting more white labour underground. The Mine Managers' Association has had a scheme

on foot for a long time of apprenticing youths to underground work. The scheme has not been a success so far. At the present time there are very few apprentices at underground work. We have found that the principal trouble has been this. You know it is the custom on the Rand to take a young man and put him with a driller, a machine man for a few months, and at the end of that time, if he passes an oral examination he can get a blasting certificate. He leaves that mine and goes to the next, calling himself a full-fledged miner. The majority of these men in the past have obtained this certificate in six months. Now these youths are saying why should we be apprenticed for three years and go through the mill, when we can get a certificate and become a full-fledged miner and get £1 a shift? Of course, this reasoning is sound, and this is one of the reasons why this scheme has not been a success. One way to meet it would be to have two forms of blasting certificate. In the past there has only been one form. In the future there will be two forms. The man who comes to your mine knowing nothing about mining and who works for six months and gets a certificate, on his certificate will be these words, "this certificate gives no guarantee of the mining ability of the holder." Under these circumstances the manager would know the man was not a skilled miner. This new idea, which the Government has agreed to, may, to some extent, remedy the trouble. This is a most important point in regard to white labour underground, and we must all keep pegging away at it, because the more white youths we induce to take up mining on the Rand, the less will this great industry be at the mercy of miners from oversea.

WESTRALIAN WET-CRUSHING PLANTS,
WITH SOME NOTES ON LABOUR
EFFICIENCY.

(Read at February Meeting, 1908.)

By GERARD W. WILLIAMS, F.C.S., A.I.M.M.

DISCUSSION.

Mr. H. T. Brett (contributed): Having been absent from town for some time, on my return I was interested to note, while reading over some of the past months' *Journals* Mr. Gerard Williams' article, in which the author shows that he has given the subject much thought and attention. On the other hand, I was more astonished than interested to notice in the discussion on the above paper in March, some

remarks made by Mr. H. A. White, which I think are rather overwhelming. One statement he makes is that the microscopic tube mill of 3 ft. 3 in. in diameter by 13 ft. long should be relegated to the laboratory (presumably, I suppose, to grind up chemicals, samples, etc.) and then, he continues, we should hear less of outputs of 27 tons per diem at a cost of 2s. 6d. per ton.

I would like to state for general information that the grading of sands on which this tonnage is accomplished is about as follows: 50% on 40, 35% on 100, and 15% on 150 mesh. The 13 ft. mill reduces 27 tons of this product to -150 mesh per diem. As this mill takes approximately 20 h.p. and a 22 ft. mill between 50 and 60 h.p., we can presume that three 13 ft. tube mills are equal to one 22 ft. Therefore, the 22 ft. mill to be as economical as far as horse-power is concerned should take over 80 tons of sand per diem of the grade given above, and reduce it to a slime (-150 mesh) at a cost of 2s. 6d. per ton. Personally, I have no idea in the difference in work accomplished by a 13 ft. and 22 ft. mill on Rand ore, but as Mr. White speaks with authority on the 13 ft. mill, I presume he has given the two machines ample attention to warrant the statements he has made. I am quite aware that the cost of regrinding on the Rand is about 6d. per ton milled, but as this only relates to grinding the coarsest of the sands to a finer state, it is obvious that if the whole of the sands (+150 mesh) were reduced to a slime (-150 mesh) the cost of grinding per ton milled would rise considerably, and the cost based on *per ton of sand ground* to a slime would be somewhere in the neighbourhood of that given in the cost of a 13 ft. mill—2s. 6d per ton. It is well to differentiate carefully between the cost of grinding per ton milled and the cost per ton of sand ground to a slime. At the conclusion of Mr. White's remarks, he expresses astonishment at the high cost of treatment and low extraction obtained on the Kalgoorlie mine mentioned (Golden Horseshoe). While recognising fully the excellent work done on the Rand in obtaining 95% extraction at a cost of 5s. per ton, I would like to know what would be the figures if telluride (which exists in Kalgoorlie ores) suddenly made its appearance on the Rand, and concentrating, roasting concentrates, all-sliming, bromo-cyanide, and other luxuries had to be indulged in? If Mr. White could still, under these circumstances, obtain an extraction of 95% at a cost of 5s. per ton, or even more, then I should say he has Kalgoorlie—in fact, the world—at his feet.

Personally, I have found in most cases that it is fatal to generalise on mining between two different countries.

SOME FEATURES OF SILVER ORE TREATMENT IN MEXICO.

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

DISCUSSION.

Mr. S. H. Pearce (contributed): Like many others, I must also express my appreciation of the matter contained in this paper, not only for its own intrinsic worth, but for the reminiscences of the time when I paid a visit to Mexico myself, in 1904, and had a small experience in the cyaniding of silver ore. At that time, however, I was much more concerned in the extraction of the gold contents of the ore I was working upon, and which, being of far greater value than the silver contents, were at that time of more local importance. This, I might add was in the early stages of fine grinding, and my attention being concentrated on this, I was able to give less time than I would have liked to a matter that has since proved to be one of the greatest importance in that country. To illustrate my point, when one has a residue containing 4 dwts. of gold, a question of 2 oz. or 3 oz. of silver is of less importance commercially.

At the time of my visit, however, my curiosity was aroused by the fact that they were using a small quantity of mercuric chloride in their solutions, which gave them better extractions as regards the silver contents, and, I believe, had no injurious effect on the gold extraction. The idea, I understand, was first introduced by Mr. E. M. Hamilton, a well-known metallurgist working for one of our Past-Presidents, Mr. Chas. Butters. Well, as may be supposed, I worked out innumerable equations to account for this, and finally came to the conclusion that it acted in the dual capacity of a weak oxidising agent, and a "desulphuriser," if I may use the term, in that it was first reduced to a mercurous chloride, and as such combined with and rendered innocuous the monosulphides that were probably formed. I say "probably," because the ore was oxidised and apparently free from all sulphides. I could therefore only surmise that the silver contents existed as sulphide, and on that supposition I obtained some native argentite from a neighbouring mine, and carried out a few rough experiments, more, I must confess, because the subject worried me, than on account of any scientific interest, and I feel a keen regret that I have unfortunately lost the notes I made at the time, the more so as I intended them to form the basis of a paper for your benefit. The experiments were intended to note the effect of varying strengths of KCy solution, the addition of various reagents to these solutions, and also the effect of aeration-as demon-

strated by the mineral being floated on the top of the solution as compared with being submerged. The argentite was picked out from some specimen ore kindly supplied me, and crushed to an impalpable powder. The experiments were carried out in porcelain cups, and the effects judged by the time taken to effect solution. The results, which I have to quote from memory, were to the effect that, generally speaking, the rate of solubility, when submerged in fresh KCy solution, varied as the strength of solution employed, right up to the strongest solution used, viz., 5%. When floated, the action on the ore was much more rapid, and the effect of strength of solution not so marked. This pointed to the conclusion that oxygen was more important than strength of solution.

The next step was to try the effect of various reagents, which included all those available at the time. Of the many tried, the results of but few are worth recording. Oxidising agents produced an acceleration only on the submerged experiments, as might be expected, but the crux of the whole question was observed in the behaviour of the salts of the metals of the first group, viz., mercury and lead. Of the two, mercuric chloride gave a slight acceleration in point of time over lead acetate, particularly in the submerged trials, and this pointed to a reduction of the salt used. The experimentalist loves to theorise, and upon the slender basis of the foregoing, I formulated several theories, all quite satisfactory to my mind, and I shall leave it to others to shatter them as they will. In the first place, it appeared obvious to me that something was necessary to combine with the sulphur set free by the solution of the silver sulphide in an insoluble form. I attributed the superiority of the mercury salt to the fact that the mercurous sulphide formed, was the more insoluble compound, and therefore more stable, but the effect of the lead salt puzzled me for some time, until I hit upon the probable explanation that in conjunction with aeration it was converted into sulphate, also a stable and insoluble compound, and that the time required for oxidation represented the difference in activity between the two reagents. Upon these results I recommended the trial of lead salts as a substitute for mercuric chloride on a practical scale, as being less expensive, and though I was unable to stay to see the results, its general adoption since seems to warrant the assumption made at the time.

I am afraid I am rather digressing from the point, but it all leads up to my reasons for thinking that "reaction (c)" is incomplete. It was my most laudable intention on my return here to complete my investigations on the subject, but I found myself at once fully occupied with tube milling. It may be a debatable point whether lead sulphide is converted into sulphate, but I

think it far more likely than that it should be converted into oxide as is assumed. Besides which, there is a necessary consumption of lead salt beyond that required by replacement of solution. The fact that practically no lead is precipitated on the zinc does not affect the question, as if present as sulphide it will not be in solution, and if as sulphate it would not be decomposed, whereas if present as oxide it would soon pass into solution and be precipitated on the zinc.

In conclusion, I would state that these theoretical considerations are always most fascinating, particularly for the reason that with the extremely dilute solutions of the reagents in question, accepted results, as per text book, are always likely to be upset. We have to thank Mr. Caldecott for his able demonstration of the case, and for pointing out its analogy to the work we are trying to improve upon on these fields.

Prof. G. H. Stanley (contributed): I read Mr. Caldecott's paper with great interest, because it was almost the first account I had seen of modern practice in Mexico, and I think the Society is indebted to him for bringing his observations before it, as they cannot be found in any text book. May we hope it is only the forerunner of a series dealing with other metals and processes which he saw during his journey.

The treatment described is apparently being used on ores similar in composition to those formerly treated by the Patio process, but of a lower grade, *i.e.*, containing native silver, haloid salts, and sulphide; but other ores occur carrying silver largely as sulpharsenide, sulphantimonide, and in other complex minerals, which would not yield a good extraction on the Patio, unless previously roasted with salt. Can Mr. Caldecott tell us whether these ores are being treated by the cyanide process as outlined, or by any other process?

Since the paper was read, two or three articles dealing in detail with the same subject have appeared in the technical press, one author particularly pointing out that silver metallurgy in Mexico is in a transitory stage, and from the accounts of the various plants given, it seems that agitation by compressed air in vertical tanks is now specially favoured and allows of the treatment thus of even 40 mesh material with low cost of power, these tanks are variously called Pachuca tanks, because first installed there, or "Brown" tanks, after their originator F. G. Brown, Waihi, New Zealand. New tanks are 13 ft. diameter and 55 ft. high. Time of treatment by agitation also is increasing and varies from 25 up to 150 hours, and one plant proposes, instead of selling its concentrates, to slime and treat by air agitation in strong cyanide

solution, experiments having given satisfactory results.

It is very interesting to note the large employment of various types of suction filters, necessitated by the very small proportion of solution removed at each decantation and consequent imperfect washing and long time of treatment. For instance, on one plant the treatment tanks are 10 ft. deep. After agitation for twenty-four hours, the charge is allowed to settle six hours, and then 3 ft. only of solution is decanted off: then filled up with fresh stock solution plus lime and lead acetate and agitated till mixed for half an hour, then settled half an hour to 18 in. depth and decanted. Six other similar washes are given and two washes with water also, making nine decantations in all. Finally it is pumped to tall settlement tanks, where it remains as long as possible, and here the clear solution is decanted and the residue, running 70% moisture, discharged. Here it is proposed to instal filters, in order to save time and recover more dissolved silver and cyanide. At the works from which this instance was taken—Hacienda de San Francisco—crushing is done in 0.25% KCN solution with 1,050 lb. stamps through slot screens, equivalent to 50 mesh, duty being 3.3 metric tons per twenty-four hours.

By Wilfley tables and Frue vanners, $2\frac{1}{2}\%$ by weight of concentrates are taken out of the pulp, which concentrates contain 50% of the values in the ore.

The tailings are separated by classifiers into sand 45.8% and slime 51.7% of the dry weight of ore, and treated by percolation and agitation respectively. Sands getting 14 days' treatment and slimes as above.

The weight of solution precipitated per ton of pulp treated and the strength of solution used are as follows:*

The sand treatment of 7 tons of .35% KCy, 1.4 tons of .10% KCy, and .7 ton of wash water; in slime treatment 6.4 tons of .10% KCy. Recovery 87%.

RESCUE APPLIANCES: LESSONS FROM GLENCOE.

(Read at March Meeting, 1908).

By H. KESTNER.

DISCUSSION.

Mr. Tom Johnson (contributed): If, as our President says, this is the one that was used at the Courrières mine disaster by the men from Westphalia, I would like to point out that those men were a specially trained band. Now, on the

* Bernard Macdonald, *Engineering and Mining Journal*, Apr. 4, 1908, p. 710.

Rand we want something that needs very little training to be able to use it in the gold mines; if a man was lying gassed in a winze or drive, there would be very little hope for him if he had to wait for one of these trained men to go and get the apparatus before he could be got out and taken to the fresh air. What we have to get, to enable a rescuer to get at a gassed person quickly, is something that even a Kafir can use and can also be kept underground close to where driving, winzing, etc., is being done. Being interested in these things, I have been on the lookout to see if I could find something that could be fairly handy and not need trained men, I have come to the conclusion that the smoke helmet and bellows is as good as most rescue appliances for this special purpose of getting out gassed men. I send you a cut of such an one,* which ordinarily requires two persons, one using the helmet and the other the bellows, and I fancy it would not take many minutes to make even Kafirs understand how to use it. A smart man could manage himself where compressed air was in use, by fitting the hose up to connect to the air pipes. This would not be so handy in coal mines giving off explosive gases, although the bellows supplied are good to feed the helmet through 200 ft. of hose. For greater distances a stronger pair of bellows would be necessary. For fire work, either in gold or coal mines, the liquid air apparatus, called the aerolith, would be very good; this is easy for men to handle and use, there being no taps, etc., for the man to look after. It is cool to wear and is not a great weight. I saw the aerolith at the Cockerill Collieries in Belgium, and they assured me there that they had adopted it after having tried several others, and this since the disaster in the North of France. They have a very complete rescue station there with their own air liquifying plant. Every mine would not need a liquifying plant. A small plant would serve ten or a dozen mines grouped together, and it would not cost an excessive amount per mine to instal a very complete equipment. There is a great advantage in the aerolith over most others, and that is, if men using it have to stay at a fire or in gases a longer time than the one filling of the apparatus will last, fresh supplies can be brought and emptied into the knapsack at the place without the men having to take it off, of course. The person bringing fresh supplies will be using the apparatus also. Another advantage is that the user gets cold air to breathe and is kept cooler than when using some others, and is therefore able to stick to the work for a longer period.

The meeting then closed.

* Omitted from letter.

Contributions and Correspondence.

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

May I offer a somewhat belated contribution to the discussion on Mr. Kenneth Austin's paper. I regret that owing to the migratory habits which I have lately acquired the *Journals* only arrive at intervals.

In Broken Hill (New South Wales), all the mines pay their contractors by the actual weight of ore broken. Every truck of ore, as it leaves the ore pass, has a label attached to it, bearing on it the number of the party. Arriving at the brace, the trucks are run over a weigh bridge and the weight recorded by a clerk in the employ of the company, and checked by a tally clerk paid by the men. Every now and then a truck is tipped on to a sorting table, examined by the ore inspector and reweighed after any mullock has been thrown out. Miners who habitually send up mullock are dismissed. Dismissals from this cause are not very common. The method works splendidly, and no complaints are possible, as a representative of the men themselves checks every truck. All ore broken and nearly all tramming is done on contract. I know that this method would be difficult of application on the Rand, where self-dumping skips are in use, but it is the only method of paying contractors which is free from error. Every surveyor knows the frequent complaints, that are made as to the measurements on pay day. This liability to error is greatly increased in wide stopes. The Broken Hill stopes average 65 ft. in width, there are many stopes, however, where the width exceeds 200 ft.

Mr. A. Richardson mentions the failure of the Arbitration Act. That Act promised much and accomplished nothing. If anything, it accentuated labour troubles. Strikes are just as frequent in states possessing the Act as in the other states. In point of fact, the Act has caused more strikes and class bitterness than any factor of recent years. I do not know whether the consideration of the working of this Act comes within the province of this Society, but it seems not unlikely, that it may attract some attention in the near future, for I understand it is one of the projected measures of your new Government. If, however, the President considers that some information as to the way it has worked, or rather failed to work, in Australia, would be of interest to members, I should be more than pleased to submit some notes dealing with it. Out here labour politics form no small portion of the manager's worries. What with Arbitra-

tion Courts, Excise Courts, Wages Courts, Tariffs and other things, we are compelled to maintain a keen interest in current politics.

GERARD W. WILLIAMS.

THE USE OF FILTER-PRESSES FOR CLARIFYING DECANTED SLIME SOLUTION.

The tonnage of ore crushed at the Knights Deep having increased, it was found necessary to instal more solution clarifying arrangements. A filter-press containing 36 hollow frames and served by a 3-in. high lift centrifugal pump was erected. The frames are 30 in. square inside measurement, and contain 450 sq. ft. of filtering area. The hollow frames admit of a cake of slimes 1 in. thick being formed before the press is full.

In the first instance the pump suction was connected directly to the decanting main. It was found with this arrangement that the cloths had to be changed at least every twenty-four hours and sometimes oftener, as they soon choked and the pressure rose beyond the capacity of the pump (40 lb. per sq. in.): The effect of steam for two hours to dehydrate any colloidal silica present was tried, and this increased the life of the cloths by anything up to twelve hours. Heated air should serve even better. The press was never by any means full of solids when it became necessary to change the cloths, and hence the necessity for so thick a hollow frame in this class of work is by no means obvious. Half the thickness in pressed steel or sheet iron should be sufficient, and inlets and outlets of solution into the press should be ample and of equal area. The cloths very soon became hard, and the pores choked even after vigorous scrubbing in water. On analysis it was found that 90% of the hardening solid deposited on and in the cloths was carbonate of lime, and Mr. McArthur Johnston experimented with various reagents to discover the best means of removing this. He found that by treating with hot hydrochloric acid of 5%—10% strength, and rubbing to release the bubbles of carbon dioxide, which prevented further action, the cloths were not only softened but were apparently uninjured. This is now being done regularly on the working scale. It was suspected that a good deal of the carbonate of lime giving this trouble was that which is seen floating on the surface of any undisturbed slime solution, and that the pump being connected direct to the decanting main, not only drew in this but also some slime, especially when the last few inches of solution were being decanted. The suction of the pump was then connected to the sides of two of the ordinary sand filter vats at a

point opposite the inflow and about 18 in. above the sand level, and a box was put round the hole open at top and bottom to prevent any floating carbonate of lime being drawn in. This arrangement allowed the carbonate of lime to become wetted and to settle on the sand, and was so successful that cloths now run three and four days without changing, clarifying up to 800 tons per day. At the Simmer Deep the decanted slime solutions will enter the centre of a 25-ft. clarifying vat with peripheral overflow like a slime collector, from whence they will be pumped into the presses.

W. R. DOWLING.

Obituary.

The death is recorded with much regret of Mr. CHARLES GLUYAS (member), which took place on the 7th June, from pneumonia.

Mr. Gluyas, who was only 43 years of age, had been on the Rand for about 20 years, and for the greater part of that period he held the position of general manager of the Jubilee and Salsbury Mines. There was a very large attendance at the funeral at Braamfontein on Whit-Monday. Mr. Gluyas was elected a member in December, 1902.

Notices and Abstracts of Articles and Papers.

CHEMISTRY.

COLORIMETRIC DETERMINATION OF IRON IN COPPER ALLOYS.—"The method is based upon the red colour reaction given by ferric salts with a solution of salicylic acid in presence of sodium acetate and acetic acid, the blue or green colour due to the copper being destroyed by the addition of potassium cyanide; 0.2 gm. of the alloy is dissolved in the smallest possible quantity of strong nitric acid, and if tin or antimony be present, the solution is diluted slightly and filtered. Lead, if present, is removed as sulphate. The solution is treated with 20 c.c. of a concentrated solution of sodium acetate and 10 c.c. of a 2% solution of salicylic acid in glacial acetate acid, and then a 3% solution of potassium cyanide (a strong solution will not answer the purpose) is added gradually until the green colour has disappeared and the precipitate of copper cyanide has re-dissolved. The solution is then made up to a definite volume and the red colour due to iron matched by adding a standard solution of ferric chloride to a mixture of 20 c.c. sodium acetate solution and 10 c.c. of the acetic acid solution of salicylic acid diluted to about the same volume as the solution of the alloy. Results are given showing the accuracy of the method."—A. W. GREGORY, *Chem. Soc. Trans.*, 1908, 93, 93—5. —*Journal of the Society of Chemical Industry*, Feb. 2, 1908, p. 163. (A. W.)

THE EFFECT OF HIGH LITHARGE IN CRUCIBLE ASSAY FOR SILVER.—"The object of this paper is to point out that the use of a large excess of litharge in the assay of some ores will give results for silver that are uneven as well as low. So far as I know, however, an excess of litharge does not affect the results obtained in the crucible assay of ores for gold.

The main reasons for using, in the crucible assay, much more litharge than is required to give the necessary lead button are: (1) Its action as a flux; (2) its action as a desulphuriser; and (3) its action as an oxidiser, especially on metals like copper and nickel, whereby they are forced into the slag as oxides and thus prevented from passing into the lead button. Hence, by the use of much litharge in the crucible assay more ore can often be taken than in the scorification process, and a lead button obtained which can possibly be cupelled at once or after a single scorification. The method is specially advantageous with an ore carrying much copper or similar impurity and poor in silver, when the assayer does not wish to resort to a wet analysis for the determination of the silver. For several years I have noticed that, when much litharge was used with certain sulphide and arsenical ores, the results were considerably lower than when the scorification method was used. This fact was more forcibly brought out in connection with certain work carried on this year by H. A. Frame and F. C. Jaccard, students at the Massachusetts Institute of Technology, to ascertain the best method of assaying the rich arsenical nickel and cobalt ores from Ontario.

The following are some results obtained: Ore No. 2,687-2 had a reducing power of 4.2 and contained nickel, 12.92; cobalt, 10.92; and arsenic, 46%. The minerals noticed in the ore were niccolite, smaltite, erythrite, cobaltite and arsenopyrite.

Charge for the Crucible.						Results.		
Assay, ton.	Sodium bicarb.	Borax glass.	Litharge.	Argols (R.P.=11)	Lead button.	Silver found.		Silver in slag.
						gm.	Oz. p. t.	
1-20	10	5	30	1½	23	0.11615	2323	Not
1-20	10	10	35	1½	23	0.11648	2329.6	assayed
1-20	10	5	80	1½	28	0.11272	2254.4	52.4 oz.

Ore No. 2,687-6 consisted chiefly of smaltite, erythrite, niccolite and arsenopyrite; R.P. = 4.06; nickel, 3.94; cobalt, 11.25; and arsenic, 59.7%.

Assay, ton.	Sodium bicarb.	Borax glass.	Litharge.	Argols.	Lead button.	Silver in slag.
	gm.	gm.	gm.	gm.	gm.	Oz. p. ton.
1-20	10	10	35	1.5	22	258.2
1-20	10	10	80	1.5	21	241.2

The same ore assayed after amalgamation:—

1-20	30	10	30	1.5	23	229.8
1-20	10	10	35	1.5	23	230.8
1-20	10	10	80	1.5	23	220.2

Subsequent to the above tests I made further investigations on the ores tested as well as on other ores, and obtained the following results: Ore No. 2,687-2; R.P. = 4.2; nickel, 12.92; cobalt, 10.92; and arsenic, 46%.

Scorification Method—Charge.				Results.	
Assay, ton.	Borax glass.	Lead.	Silica.	Lead button.	Silver.
	gm.	gm.	gm.	gm.	Oz. p. ton.
1-20	3	65	1.5	11	2330.4
1-20	5	65	1.5	10	2338.0

Crucible Method—Charge.					Results.	
Assay, ton.	Sodium bicarb.	Borax glass.	Litharge.	Argols R.P.=11	Lead button.	Silver.
	gm.	gm.	gm.	gm.	gm.	Oz. p. ton.
1-20	10	6	35	1.5	22	2333.2
1-20	10	6	35	2	30	2330.8
1-20	10	6	80	1.5	23	2229.2
1-20	10	6	100	1.5	25	2244.2

Ore A. Chiefly smaltite and niccolite with free silver, containing nickel, 5.06, and cobalt, 9.12%.

Assay, ton.	Sodium bicarb.	Borax glass.	Litharge.	Argols.	Lead.	Silver in lead.	Silver in slag.	Silver in cupel.
	gm.	gm.	gm.	gm.	gm.	Oz. p. ton.	Oz. p. t.	Oz. p. t.
1-20	10	10	30	1.5	19	2051.4	9.6	34.0
1-20	10	10	40	1.5	21	2056.0	—	—
1-20	10	10	40	1.5	21	2050.0	—	—
1-20	10	10	80	1.5	30	1968.6	—	—
1-20	10	10	80	1.5	22	1944.6	135.2	35.0
1-20	10	10	80	1.5	21	1984.8	70.2	34.6
1-20	10	10	80	1.5	21	1914.8	—	—

Ore No. 2,703-1 consisted of smaltite, native bismuth and native silver in calcite; R.P. = 5; nickel, 0.3; cobalt, 8; and arsenic, 55%. The scorification assay gave 404.8 oz., and the combination wet and dry analysis gave 403.7 oz. of silver per ton.

Crucible Method—Charge.					Results.	
Assay, ton.	Sodium bicarb.	Borax glass.	Litharge.	Argols.	Silver in Lead.	Silver in Slag.
	gm.	gm.	gm.	gm.	Oz. p. ton.	Oz. p. ton.
1-20	10	6	35	1.5	402.6	Not
1-20	10	6	80	1.5	388.0	assayed
1-20	10	6	100	1.5	392.0	11.8

The same ore after amalgamation gave, by the scorification assay, 292 and 291.2 oz., while by the combination wet and dry analysis the result was 292.2 oz. of silver per ton.

Crucible Assays—Charge.					Results.	
Assay, ton.	Sodium bicarb.	Borax glass.	Litharge.	Argols.	Lead button.	Silver.
	gm.	gm.	gm.	gm.	gm.	Oz. p. ton.
1-20	10	6	35	1.5	24	293.0
1-20	20	6	35	1.5	23	292.8
1-20	20	6	35	1.5	25	291.8
1-20	10	6	60	1.5	24	288.0
1-20	10	6	80	1.5	26	283.6
1-20	10	6	100	1.5	26	279.8

I have a number of other examples, but these should be sufficient to illustrate the fact to which I wish to call attention. The ores used carried practically no gold. The same lot of litharge was used in all the fusions, and the conditions under which the fusions were conducted were as nearly identical as possible. Heavy crystals of litharge were found on all the cupels. Only $\frac{1}{16}$ assay ton of ore was used in the assays, because Messrs. Frame and Jaccard found that in case of ore No. 2,687-2, carrying 12.92% of nickel, if 5 gm. of ore were taken and 35 gm. of litharge were used, the resulting lead button would not cupel. If 5 gm. of ore were taken and the litharge increased to 80 gm., in order to slag the nickel, the button would cupel but the silver results were low. Some ores from the cobalt district carry so large a percentage of nickel that $\frac{1}{16}$ assay ton of ore is the limit that can be used in either scorification or crucible work, and low litharge is inapplicable in the latter method. The following ore serves as an illustration: Ore No. 2,703-2, niccolite (NiAs); R.P. = 5.3; nickel, 38.01; cobalt, 1.19; and arsenic, 53.31%.

Assay ton.	Sodium bicarb.	Borax glass.	Lith. arg.	Silica.	Argols.	Ratio of litharge to n'kl in ore	Lead
	gm.	gm.	gm.	gm.	gm.		gm.
1-20	15	10	120	5	1	214 to 1	24
1-10	15	10	120	5	none	107 to 1	25
2-10	15	10	120	5	nitre 1	54 to 1	25

The lead buttons from $\frac{1}{16}$ and $\frac{1}{8}$ assay ton of ore would not cupel, both cupels being covered with a thick film of green nickel oxide (NiO). The lead button from $\frac{1}{16}$ assay ton of ore would just cupel, leaving the cupel stained green.—R. W. LODGE.—*Mining World* (abstract of paper read before Am. Inst. of M. E.), Feb. 1, 1908, p. 213. (H. A. W.)

Remark.—It is a pity the author still uses the long ago condemned bicarbonate of soda in place of the modern method of preferring the carbonate. [ED. COM.]

ANHYDROUS BORATES.—“The preparation of borates by fusing boric anhydride with the oxides, nitrates, and carbonates of different metals in a specially constructed furnace for three hours, at a temperature from 1,350–1,450°, is described. Many oxides like those of iron, aluminium, chromium, silicon, zirconium, tin, molybdenum, tungsten and uranium were found to be insoluble, or but slightly soluble in boric acid. Some oxides were reduced to a lower stage of oxidation, others were oxidised still higher. In tin compounds the stannic oxide was partially reduced to tin. Sulphates, chlorides, bromides, and iodides were found to be unsuitable in the preparation of the borates; and from alkali carbonates the carbon dioxide was difficult to expel. The oxides soluble in boric acid form three groups: (1) Those which, in equivalent admixture (valency of metal atoms = valency of boron atoms) produce clear, homogeneous fusions, either crystallising on cooling or leaving clear glasses without segregation. (2) Those which produce clear, homogeneous fusions at the higher temperatures but show dissociation and the formation of an emulsion at a definite degree of concentration. This is a case of limited mutual solubility of two liquids which are miscible at higher temperatures in all proportions. (3) Those which do not give homogeneous fusions even at 1,400°, two distinct layers of liquids being produced, like oil and

water. The equivalent mixtures crystallise as orthoborates. To the first group belong the oxides of lithium, potassium, sodium, rubidium, cesium, thallium, and silver. Sodium and potassium metaborate, NaBO₂ and KBO₂, fuse at 820° and 890° and deliquesce in the air. They are remarkably volatile and dissolve alumina, chromic oxide and silica freely. To the second group belong cuprous oxide and the oxides of lead, bismuth, antimony, arsenic, titanium, molybdenum, and tungsten. They produce emulsions, but show no crystallisation. Some of the glasses are of different hardness: PbO, B₂O₃ is as hard as flint glass, while 3PbO, B₂O₃ softened in boiling oil. The third group embraces the oxides of calcium, strontium, barium, magnesium, zinc, cadmium, manganese, iron, cobalt, and nickel. Magnesia produces two compounds, orthoborate, 3MgO, B₂O₃, and pyroborate, 2MgO, B₂O₃. No other anhydrous magnesium borate exists. The corresponding borates of cobalt and nickel were likewise found. It was not possible to produce the ferrous borate, since oxidation invariably took place. The fusion produced two layers, of which the lower showed crystals having approximately the composition, 3B₂O₃, 2FeO, 2Fe₂O₃. In melting cupric oxide the length of fusion played an important rôle and two layers were produced. The lower layer showed crystals of CuO, B₂O₃, which decomposed on longer heating, evolving oxygen. On complete decomposition the residue again consisted of two layers, the lower of which contained crystals of 3Cu₂O, 2B₂O₃, which, on still further heating, decomposed into cuprous oxide and boric anhydride, forming an emulsion. Crystals of 3ZnO, 2B₂O₃ and 3ZnO, B₂O₃ were obtained. The manganese boric acid fusion resulted in two layers which devitrified on heating and formed crystals of the formula, MnO, B₂O₃. Other borates, produced by previous investigators, are 3MnO, B₂O₃ and 3MnO, 2B₂O₃. According to the author, the following compounds of the alkaline-earth with boric acid exist, of which the pyroborates have been first prepared by him.

Orthoborates	3CaO, B ₂ O ₃	3SrO, B ₂ O ₃	3BaO, B ₂ O ₃
Pyroborates	2CaO, B ₂ O ₃	2SrO, B ₂ O ₃	2BaO, B ₂ O ₃
Metaborates	CaO, B ₂ O ₃	SrO, B ₂ O ₃	BaO, B ₂ O ₃
Borates	CaO, 2B ₂ O ₃	SrO, 2B ₂ O ₃	BaO, 2B ₂ O ₃

The author recognises five types of anhydrous borates in place of the four of Le Chatelier: (1) 3Me^oO, B₂O₃, orthoborate; (2) 2Me^oO, B₂O₃, pyroborate; (3) 3Me^oO, 2B₂O₃, sesquiborate; (4) Me^oO, B₂O₃, metaborate; (5) Me^oO, 2B₂O₃, baborate. With reference to devitrification, the author states that it is a process closely akin to an explosive chemical reaction, set up at a definite temperature, since an amorphous substance is as unstable a system as a mixture of hydrogen and oxygen.—W. GUERTLER, *Sprechsaal*, 45, 612–6.—*Journal of the Society of Chemical Industry*, Feb. 25, 1908, pp. 158–9. (A. W.)

LEAD SILICATES.—“Mixtures of rock crystal (99.96–99.97% of silica) and lead oxide, in different proportions, were fused, and the products examined. Combination took place at 700°–800° C., in most cases below 750° C.; the products were solutions of lead in oxide in lead glasses or silicates. The solubility of the lead oxide increases with the temperature. On cooling the products, the dissolved lead oxide gradually separates, with evolution of heat. The characters of the products are shown in the following table:—

	Composition.	SiO ₂ .	Physical characters.	Intervals of :	
				Temperature of formation.	Softening and melting temperatures.
1	6PbO : SiO ₂	Percent. 4·32	Dark brown, hard and brittle; dark yellow when powdered. Contains little 'glass.'	709—794° C.	740—789° C.; melts to a thin liquid; solidifies suddenly
2	5PbO : SiO ₂	5·14	Lighter colour than No. 1; wax-like, and contains more 'glass' than No. 1. Resembles PbO when powdered.	727—798° C.	736—796° C.; melts, etc., like No. 1.
3	4PbO : SiO ₂ (subsulfate)	6·34	Hard, brittle, amber-coloured mass. When powdered, is of lighter colour than PbO.	709—726° C.	719—729° C.; melts, etc., like No. 1.
4	3PbO : SiO ₂	8·51	Hard, wax-like mass.	700—725° C.	714—725° C.
5	2·5PbO : SiO ₂	9·78	Light yellow brittle mass; greyish-white powder; contains much 'glass.'	708—732° C.	728—740° C.
6	2PbO : SiO ₂ (singulosulfate)	11·94	Dark amber-coloured glass; powder of lighter colour than No. 5.	718—720° C.	Begins to soften at 730° C.; thin at 765° C.
7	4PbO : 3SiO ₂ (sesquisulfate)	16·89	Light-yellow, strongly refractive and iridescent glass; white powder.	709—720° C.	Softens at 740° C., and remains viscous.
8	PbO : SiO ₂	21·32	Colourless crystal glass; snow-white powder.	709—724° C.	Softens at 740—750° C.

All the products, when finely powdered, are soluble in hot dilute nitric, hydrochloric and acetic acids, with separation of amorphous silica. The silicate, PbO₂·SiO₂, is also soluble in hot dilute alkalis with formation of alkali silicate and plumbate; from the solutions, nitric acid precipitates amorphous silica, whilst hydrochloric acid precipitates crystalline lead chloride and silica. At 350°—600° C., the lead oxide in the silicates is reduced by hydrogen first to lead suboxide, Pb₂O, and then to metal. (The reduction of free lead oxide by hydrogen begins at 290°—300° C. with formation of the gray suboxide; at 410° C. the reduced metallic lead collects in the form of globules.) The silicates can also be reduced by means of carbon monoxide or hydrocarbons.

These results indicate that in the roasting of galena, the proportion of silica in the charge is an important factor. When sulphide ores of lead are roasted in presence of silica at 700°—750° C., the lead oxide formed will combine with the silica. The silicate thus produced will dissolve further quantities of lead oxide, the solubility of the latter increasing with rising temperature. The silica will thus, at high temperatures, prevent the lead oxide from being converted into sulphate. This occurs, for example, in the slagging-roasting of galena in continuous reverberatory furnaces and in the Huntington-Heberlein and Savelsberg processes. In the cooler portions of the furnaces: for example, on the upper hearth of a furnace with two hearths, the temperature is not high enough for the formation of silicates, and the lead oxide is converted into sulphate by the sulphur trioxide in the furnace gases; the sulphur content of the ore-charge remains unaltered or is only reduced by 1—2%. This confirms the view that in the roasting proper, where the temperature rises to 700° C. and above, the silica exerts a very favourable effect. The separation of metallic lead in the furnace-charge frequently observed, is due, in part, to the reduction of lead silicates by reducing gases from the fire."—W. MOSTOWITSCH, *Metallurgie*, 1907, 4, 647—655.—*Journal of the Society of Chemical Industry*, Feb. 29, 1908, pp. 163—4. (A. W.)

EXPLOSIVE COMBUSTION.—"At the Royal Institution, on Friday, February 28, Prof. W. A. Bone gave a lecture on 'Explosive Combustion, with special reference to that of Hydrocarbons.' He said that the question of how a hydrocarbon burned, that was, precisely how it was attacked by the oxygen, had

been the subject of much discussion during the past 15 years. The two combustible elements, carbon and hydrogen, of which a hydrocarbon was composed, were, in a sufficient supply of oxygen, ultimately burnt to carbon dioxide and steam respectively, but on kinetic grounds it seemed inconceivable that the passage from the initial system of, say, ethane and oxygen to the final system of carbon dioxide and steam could be immediate and direct. It had therefore been universally recognised that the process involved a number of successive stages, though opinion had been sharply divided as to their nature. During the greater part of last century the belief prevailed that the hydrogen was much the more combustible of the two elements of a hydrocarbon, and consequently that when combustion occurred in a limited supply of oxygen the hydrogen was preferentially burnt. This view was supported by Graham and Faraday, and for 50 years was regarded as one of the most certain articles of chemical faith, until it was finally overthrown by Dixon and Smithells in 1892. A second theory originated in 1861 with Kersten, who, as the outcome of experiments on the explosion of a mixture of ethylene and electrolytic gas, boldly asserted 'that before any portion of the hydrogen is burnt all the carbon is burnt to carbonic oxide, and that the excess of oxygen then divides itself between the carbonic oxide and the hydrogen.' Kersten thus attempted to substitute the idea of the preferential burning of hydrogen, but his views received no serious attention till they were revived and endorsed by Dixon and Smithells in 1892. But the idea of a 'preferential' combustion, whether of carbon or of hydrogen, seemed repugnant to well-established principles concerning the nature and conditions of chemical interactions in gaseous systems, and a third view was that the solution of the problem lay in the assumption of an initial association of the hydrocarbon and oxygen, forming an unstable 'oxygenated' molecule which subsequently rapidly decomposed. Many years ago Prof. H. E. Armstrong suggested that the combustion of a hydrocarbon took place under the conjoint influence of water and oxygen, and involved the successive formation of intermediate 'hydroxylated' molecules, which at high temperatures rapidly decomposed into simpler products; but little notice was taken of his suggestion at the time. Prof. Bone, however, said that in conjunction with his pupils at Manchester University he had carried out researches covering the entire range of conditions under which

hydrocarbons could be burned, and an exhaustive study of the slow combustions of methane, ethane, ethylene and acetylene at temperatures between 250° and 400° C. was decisive against the preferential burning, whether of carbon or of hydrogen, the balance of evidence being decidedly in favour of the hydroxylation theory, with the proviso, however, that the oxygen was directly active. He then performed a number of the experiments, which he thought disposed of the theory of the preferential combustion of carbon, and remarked that they afforded no evidence of any real discontinuity between the chemical phenomena of ordinary inflammation and those of detonation. The higher temperatures and more violent conditions of detonation were responsible for the more complete breaking down of unsaturated hydrocarbons and a greater 'unburning' of steam by carbon, but there was probably no difference as regards the mode in which the hydrocarbon was attacked by the oxygen in the two cases."—*Times Engineering Supplement*, March 4, 1908. (J. A. W.)

METALLURGY.

SAND COLLECTING AND WASHING.—"Auriferous sand, when kept in close contact with continually renewed amounts of cyanide leach by stirring, is known to give off its gold far more readily than if it is allowed to remain at rest in the leaching vat, the liquid penetrating through it in a downward direction. Still, so far it has not been possible to design a stirring apparatus by the aid of which considerable amounts of ore could be kept in permanent motion and intimate contact with the cyanide particles with the expenditure of relatively low amounts of energy. Ores containing clay or other earthy impurities are especially refractory to permanent stirring, owing to their becoming partly glued together. In fact, such impurities are liable to prevent a normal leaching process of ground ore, the latter, as well as the sand filter, being made impervious, and the conduits and suction pumps becoming obstructed.

Difficulties of this kind were experienced by a Chilian mining company, whose relatively rich ores (20-30 gm. of gold per ton) were impaired by iron clay impurities aggregating as much as 30%. After extensive trials had failed to ensure a separation of the clay, Mr. Reinhold Freygang, of Hamburg, succeeded in designing an interesting apparatus for effectually removing those impurities and allowing the ore to be readily leached.

This apparatus comprises a slanting tube, inside of which a worm revolves, water and ore powder being supplied through a vertical tube and hopper. After sinking downwards in the water contained in the vertical tube the ore powder is seized by the worm, and while being stirred is thrown upwards, the clay is separated, and the water with these admixtures in suspension leaves the tube through the outlet. All heavier particles—that is to say, the washed-out sand—having been carried upwards by the worm, are dropped in a moist condition from the upper end of the slanting tube into the leaching tank, in which the normal vat leaching process can then take place. It may be said that the total amount of clay contained in the ore could be removed by a single washing, and as the water used in this connection is drawn back from the settling tank, in order to be used over again, it is by no means lost. The clay slimes precipitated in the settling tanks, and which still contain considerable amounts of gold, can then be treated with cyanide leach in a special battery of stirring worms arranged in series.

By arranging several units in series (the sand cleaned in the first apparatus being discharged into the hopper of the next) a real leaching battery is obtained provided the second hopper be fed with cyanide leach instead of with water. The leach issuing from the second apparatus then is either allowed to enter the hopper of a third apparatus or is carried away in order to be freed from its gold, this third apparatus being supplied with further amounts of leach. The same process can be continued until all the gold contained in the sand has been removed. The gold carried along by the clay discharged from the first apparatus then is separated in a similar manner.

In order to work the sand and clay simultaneously in two parallel batteries, the first apparatus, containing a mixture of sand and clay, may be fed immediately with cyanide leach instead of with water. This leach, along with washed-out clay impurities, then enters from the outlet into the hopper of the parallel clay-leaching battery, whereas further amounts of leach are supplied in the next hopper to the sand issuing from the first apparatus at the end of the slanting tube.

This process obviously allows of a great number of variations to suit the requirements of each kind of ore. The power consumption is extremely low (an apparatus of 20 tons daily output being operated by a 1½ h.p. motor), while the stirring effects are most rapid and perfect.

The apparatus further lends itself to a number of applications in the chemical industry, being used to advantage whenever a fundamental substance is to be freed from clay or other impurities, such as in washing chalk or china clay (kaoline), preparing earthy dyes, or separating earthy compounds (chromium oxide, etc.) from the mineral.

According to whether the heavier or lighter portions of the material are to be subjected to further separation or treatment, an arrangement in parallel or in series of the various apparatus constituting the battery should be given the preference."—*The Times Engineering Supplement*, Feb. 5, 1908. (W. A. C.)

TANTALUM.—"Owing to its rarity, tantalum and its qualities are comparatively little known; but, as in the case of the other metals treated in this paper, constant investigations in its metallurgy and properties are being carried on.

The one principal use to which the metal is now put is as a filament in incandescent lamps. These lamps were put on the market in Germany in 1905, and on the American market in 1906. There is a considerable saving in current in their use, as they consume but 2 watts per candle-power, as compared with 3·5 watts per candle-power for the ordinary carbon filament lamp.

An excellent article by W. von Bolton and O. Feuerlein, who developed the tantalum lamp for the Siemens & Halske Aktien-Gesellschaft, was published early in 1905, which gives the results of their investigations of the metal.

A portion of this article relating to the tantalum incandescent lamp was quoted by Dr. J. H. Pratt in the 'Mineral Resources of the United States for 1904.'

Some of the properties of this remarkable metal are given in the following condensed translation of a portion of the article cited:—

In the cold the metal is extraordinarily inert. The metal is not attacked by hot hydrochloric, nitric, or sulphuric acids, aqua regia, or alkaline solutions, but is attacked by hydrofluoric acid.

Heated in the air at 400° C. it becomes yellow, like steel, and like this, when heated to 600° C., or for a longer time at 500° C., it becomes blue. In fine threads heated in the air it burns with little intensity and small flame. It eagerly combines with hydrogen and nitrogen at the beginning of the red glow, forming metallic-looking but brittle compounds. It combines easily with carbon, forming several carbides, which, so far as known, appear metallic and are very hard, but brittle. From the high atomic weight of tantalum (181) it can be seen that a very small percentage of carbon (atomic weight 12) is sufficient to carbonise a relatively large amount of tantalum.

Melted and drawn tantalum has a specific gravity of 16.8. In powder, with oxygen and hydrogen still present, it has a specific gravity of 14. It is a little darker than platinum and of about the hardness of soft steel, with a greater tensile strength. It can be hammered into plates, though individual blows show little effect. It can be rolled and drawn into fine wire, having a tensile strength that is remarkably high, amounting to 93 kgm. per sq. mm., while that of good steel is 70 to 80 kgm. If a lump of tantalum heated to a red glow is placed under a steam hammer, it may at once be beaten into a plate, which, after being heated and hammered several times, attains a hardness equal to a diamond.

An attempt to perforate such a sheet 1 mm. thick with a diamond drill running continuously at 5,000 revolutions per minute for three days penetrated but $\frac{3}{4}$ mm., while the drill was much worn. A complete perforation could not be made. Despite this, the plate could still be rolled thinner—a remarkable union of toughness and hardness. If it were only a cheap metal, it would be ideal for armour plates. Siemens & Halske A.-G. hope to employ it for dies, drills, bearings, journals, etc.

At 110 volts, for a 32-candle-power lamp, a filament 700 mm. (about 27.6 in.) long, and for a 25-candle-power lamp a filament 650 mm. (about 25.7 in.) and 0.05 mm. in diameter is used. As the filament softens when highly heated, it cannot be used in a loop like a carbon filament, so that the arrangement was finally hit upon of looping it back and forth upon metal supporters held by a central glass rod.

For 220 volts a filament 1,350 mm. (about 48.2 in.) long is necessary and becomes impracticable. A filament 650 mm. long by 0.05 mm. thick weighs 0.22 gm., so that about 45,000 filaments will weigh a kilogram (about 20,600 filaments per lb.). A 0.05 mm. wire will support 400 gm.

This lamp gives a comparatively white light, and after it has been used for about five hours, it gives 15 to 20% more light, owing to the filament changing to the form of a series of semi-globular masses. There is afterwards a diminution of light, but the lamp's life is somewhat longer than that of the carbon lamp. When it burns out, its ends will weld if brought in contact under current, and the lamp will go on burning. It will stand a much greater overload than a carbon lamp, and with 50% overload shows much less blackening of the bulb for the same time. With rising temperature the resistance increases, while with carbon it decreases. It gives a steadier light than a carbon lamp, because it is less sensitive to current changes.

These lamps are now on the market in very small forms to be used on low voltages (2 to 5). The light of all the forms is excellent, approaching the tungsten lamp in whiteness.

In carrying out the manufacture of pens from tantalum metal, the metal having been smelted so as to obtain in the first instance a lump of metal of irregular form, which is in a soft condition, it is worked by rolling, or otherwise, in any suitable known manner into the form of thin sheets, from which the pens are produced by the same means as those employed for the manufacture of pens of other metals. By the said process of rolling the tantalum metal assumes, as before stated, a much greater degree of hardness than before, and it may therefore require to be repeatedly annealed between the several stages of rolling.

After the final stage of rolling, the thin sheets of tantalum metal may be found to be of the right hardness for forming the pens therefrom; if too hard they may be again annealed to a certain extent, or if the pens are required to have a greater degree of hardness than can be attained by merely working the metal, the tantalum may have a small quantity of the before-mentioned hardening substances, such as carbon, added to it. This may either be effected, in the first instance, when the metal is smelted, a very small quantity, such as 0.1%, of carbon being sufficient for the purpose, or the prepared sheets of tantalum metal may be packed in carbon powder and subjected to a considerable heat for some time.

If an alloy of tantalum with another metal is to be employed, the most suitable metals for this purpose are wolfram and iron, either of these metals being simply added to the tantalum metal when in the fused condition. Care must in this case be taken to protect the tantalum against chemical change, for which purpose the melting is preferably effected in vacuo. The composition of such alloys may vary very considerably, but very suitable alloys for the purpose consist of from 95 to 98% of tantalum and from 2 to 5% of wolfram or iron.

Tantalite, in at least a majority of the cases, occurs in pegmatites or coarse granites."—FRANK L. HESS, Mineral Resources of the United States, 1906.—*London Mining Journal*, Jan. 25, 1908, p. 117. (A. R.)

THE HOT BLAST IN PYRITE SMELTING.—"Mr. L. Parry is quite right in his contention that it is not at all necessary to have heated blast for pure pyritic smelting, while it may be quite advantageous for partial pyritic smelting or plain matte smelting where the costs of heating the blast are not prohibitive, and there are good thermo-chemical reasons for it.

In pyritic smelting proper we should burn iron sulphides (with small amounts of zinc sulphide, lead sulphide, manganese sulphide, iron arsenide, etc.) for fuel, and there must always be an excess of iron sulphide to go to the matte produced, as otherwise two grave difficulties will be encountered, *i. e.* :—

1. Unless the iron in the matte produced is over 30% of its copper contents, the slags produced with it will be of too high a tenour in copper to be thrown away, and will require re-smelting.

2. If the matte produced should have a copper contents exceeding about 75% of their weight, the explosive reaction between Cu_2O and Cu_2S , so well known in both reverberatory and converter practice, would take place and stop the operation.

Neither of these difficulties is likely to occur in ordinary practice, but I have known the former to take place for short periods in my own practice, and am told that the latter actually occurred in an experiment in Bisbee, Ariz., and they afterwards found matte of 76% to 78% copper high up in the charge when cleaning out the furnace.

If the matte produced contains iron in excess of, say, 50% of its copper contents, it is plainly evident that there is an excess of fuel on the charge, as converter practice shows that such a matte will give off enough heat to smelt the lining necessary to form its slag and increase its temperature and that of the slag produced some 300° C., at the same time giving off in the gases produced about double the amount of heat contained in the matte when the blow commenced.

In the ordinary pyritic practice mattes with 12% to 20% copper and 50% to 60% iron are made from ores containing 2% to 3% copper. These mattes, therefore, contain a very large amount of fuel unburned, and carry away from the furnace the heat due to the temperature of the excess iron and sulphur which they contain, as well as the heat that should have been produced by its combustion. This is plainly shown from the fact that we are able to take these mattes after cooling and smelt them again in a similar manner with proper additions of fluxes and blast to a matte of a converting grade practically without other fuel than their own iron and sulphur contents. Metallurgists generally have recognised the fact that no carbonaceous fuel is necessary, and Mr. J. Parke Channing says that the coke seemed only to be necessary to keep the charge in a good mechanical condition.

Given the ores with the proper composition and necessary fuel value, the difficulty with pyritic smelting lies wholly in the nature of the fuel, together with the difficulty of securing the metallurgical ability and fine manual skill to burn the fuel in our present appliances. Our furnaces are constructed with the sole view to smelting with a solid fuel which cannot be melted (*i.e.*, carbon) while the fuel we should use in pyritic smelting melts at from 1,000° to 1,050° C. With a molten fuel (FeS) falling through the focus or smelting cone of the furnace, it is more or less a matter of chance whether you burn it or not; and in our present general practice we burn very much less than we would like to.

Evidently if we are not burning all the fuel in our charge which is desirable, not only to burn, but also to get rid of, it is useless to add more, and that is precisely what is done if we add either coke or heated blast, as in the one case we are adding carbon which requires oxygen for its combustion—oxygen which we need for another purpose, and in the other we are adding heat, which we should get from the combustion of fuel already in our charge.

The heated blast should, theoretically, only have the effect of increasing the temperature in the focus, and of maintaining the focus near the tuyere level; but owing to the fusible nature of the fuel, this effect is only temporary. The ultimate effect seems to be in the fusing out of the sulphides from a thicker body of silicious matter; the consequent formation of a more silicious slag of a lower formation temperature, resulting in faster driving, lower grade mattes and lower temperature.

There is also more or less loss of air from leakage in the heating apparatus, and the additional pressure necessary to overcome the increased friction due to the greater volume of the heated blast increases both the losses from leakage and from slippage in the blower, resulting in less oxygen going into the focus and less fuel burned."—REDICK R. MOORE.—*London Mining Journal*, Jan. 25, 1908, p. 113. (A. R.)

PRESENT SOURCE AND USE OF VANADIUM.—Vanadium was formerly chiefly derived from certain

Spanish lead ores containing 4 or 5%, but now chiefly from a Peruvian ore containing about 40% vanadium sulphide, which calcines easily, giving nearly 60% vanadic oxide (V_2O_5) in the roasted product.

Vanadium is a silvery-white metal of melting point about 2,000° C., and is used to impart certain properties to steels; alloyed with two parts of iron, its melting point is 1,375° C. only, and in this form it is prepared and sold to steel-makers.

A small quantity (0.2% in engineering steels) greatly increases the strengthening effect of the elements, such as chromium, and also very markedly increases the resistance to fracture by alternating stresses—most important where the metal is subject to vibration.—J. KENT SMITH.—*Bi-Monthly Bulletin of the American Institute of Mining Engineers*, September, 1907, p. 727. (G. H. S.)

PURE COALS AS A BASIS FOR THE COMPARISON OF BITUMINOUS COALS.—In comparing calorific powers of coals, results obtained are calculated on "pure coal," *i.e.*, ash and moisture free coal. The author shows that two other variables, sulphur and water of composition of the ash, should also be taken into account and allowed for.

It is sufficiently close to consider all the sulphur as combined with iron in pyrite and discard it completely, deducting five-eighths of its weight together with the ash and moisture from 100% to obtain "sulphur-free pure coal"; deducting also from the result the heat developed due to the sulphur.

With regard to the second variable, part of the ash at least is fireclay, the chemically combined water of which is lost when the ash is ignited, but not when the coal is dried. This is much more difficult to allow for, as different clays contained combined water from 5 to 12%, the average probably being about 8%. But it is probably sufficient to assume that the ash of the coal is similar to the beds overlying and underlying it.

Further, the composition of the pure coal itself is not constant, and coal samples deteriorate on keeping, both of which points must be attended to in making comparisons.—W. F. WHEELER.—*Bi-Monthly Bulletin of the American Institute of Mining Engineers*, Jan. 1908, p. 49. (G. H. S.)

ORE CONCENTRATION.—"The two best friends of the ore producer are fire and water. Water concentration—that is the mechanical washing off of valueless material and concentration of the metallic contents of an ore into a smaller and much more valuable product—has claimed and is claiming the attention of many of the best men we have, but while it has many advantages, it has also its difficulties and limitations. Many ores are complex, their values lying partly with the silica and partly with the various sulphides carried, so that the problem of saving these values is a matter for serious consideration and careful study, and often, even when the theory works out all right, practice declines to conform—and the values 'go down the creek.' Leaving out of consideration the so-called 'surface ores,' that are susceptible to various well-known methods of treatment, suppose we consider the condition of the mine operator who has patiently undergone and overcome the vicissitudes of the earlier work involved in the making of a mine, conceding him a good, strong, well-mineralised vein to start with, and meeting him at the point where his 'free-milling' ore has changed to material that will neither fish nor cut bait—in other words, his amalgamation,

water concentration mill (conceding him that also) will not save the values. There are plenty of sulphides—too many to suit him—but all the gold there is in the ore lies with them, what little silica there is being practically or entirely barren. The high percentage of pyrites precludes the possibility of making a marketable product, two or three into one being the very best the tables will do, achieving only about a 60% saving at that—and the ore runs perhaps \$5 per ton. Given a prospect plus years of the hardest kind of work, not alone development work, but plenty of blood sweating exertion at the financing end, plus enough free milling material to partly pay expenses during the development period, and then—an almost solid body of low grade sulphides. What does "X" equal? The 'concentrator' men have achieved wonderful results, where the ores are at all suited to water concentration; but every engineer who has any considerable amount of practice knows that in practically all of the developed camps in this country, British Columbia, Mexico and elsewhere, there are thousands of tons of low grade sulphides left underground, because it will not pay to mine them, and the reason it will not is because, in everyday miner's parlance, 'they will not concentrate.' The fact is, that Nature has already concentrated them, in so far as sulphur, iron, more or less copper, perhaps some arsenic, a little antimony, and a sprinkling of lead and zinc is concerned, but the gold is spread out so thin that the mineral, as Nature left it, equals "X" from the miner's standpoint.

Naturally when water concentration is not feasible the mind of the metallurgist turns to fire, and this opens up a field that is certainly full of most alluring possibilities. Matting, the fire concentration of low grade copper ores, has long been successfully practised, but its application to the concentration of iron sulphides, carrying small quantities of gold with perhaps some silver, furnishes a wide opportunity for careful investigation. While it would be an error to say that there are no technical difficulties to interfere with the successful consummation of this process, they are slight when compared with the mechanical and commercial obstacles met with. After the ore supply is assured, the first question that arises is that of available fuel; for while theoretically a straight iron sulphide contains sufficient sulphur to smelt itself, this is not true in practice, although it does admit of a minimum carbon burden and pyritic smelting is to-day being successfully carried on with from 3% to 5% of coke, with occasionally more or less protracted runs with an even smaller quantity. One of the great advantages of pyritic smelting is the diversity of carbonaceous fuel that may be employed in carrying on the operation. Coke is, of course, preferable, but in the absence of this material, wood, coal or charcoal can be used with excellent results. The next thing to be considered is a sufficient supply of ores carrying at least a small percentage of copper, this being required as a collector of the precious metal contents of the ore to be handled. It is surprising how small a quantity of copper will do this work effectively, practice having demonstrated that 3% is ample, while eminently successful work can be done with as low as half this quantity. There is some diversity of opinion among metallurgists as to whether a hot or a cold blast is preferable in pyritic smelting, but the tendency in practice is in favour of the former, and it is a reasonable hypothesis that oxidation will proceed more rapidly where it is not necessary to utilise an appreciable portion of the heat units at the fusion zone of the furnace in raising the temperature of the air

blown in through the tuyeres to the point of effectiveness. As is the case with every business enterprise, the prime requisite for successfully conducting a pyritic smelting plant is good judgment and plain 'horse sense.' The advocates of this process do not claim it to be a panacea, but it certainly does not occupy a position in the world of metallurgy that entitles it to recognition, because it renders available the immense quantities of lean sulphide ores that are susceptible of no other known method of treatment. The mechanical difficulties have been, in a great measure, overcome as the possibilities of the process become more fully appreciated. There is no question but what many plants will be erected in various parts of the country where suitable material is obtainable. Transportation facilities must not be overlooked, because it is outside the province of a pyritic furnace to produce a finished product, transportable in small bulk. A plant of this kind, in a general way, occupies a position corresponding to that of one equipped with concentrating tables, where the operation is carried on by water, and its output must be subjected to the further process of refining before its metallic contents are put into shape for the consumer. It has well defined limitations and ores carrying appreciable quantities of lead or zinc are not adapted to this method of treatment; neither is it the object of a strictly pyritic furnace to produce a high grade copper matte in large quantities, but rather to win from the vast bodies of iron sulphides now lying in the stopes of the mines throughout the country their gold and silver values, and thereby materially increase the profit possibilities of many mines that are now partly or altogether idle. To the younger members of the profession, there is no more attractive field for study and research than that of pyritic smelting, because the opportunities therein are practically limitless, and the demands for the services of those skilled in this branch of metallurgy will, within the next few years, be even greater than they are now."—H. P. DICKINSON.—*Mining Science*, Jan. 16, 1908, p. 75. (J. Y.)

EFFECT OF CHILLING ALUMINIUM. — Investigations made by F. G. A. Wilm, of Drevitz, Germany, resulted in the discovery that the strength and ductility of aluminium may be increased if it is chilled in a certain manner. Like steel, aluminium has a critical temperature, which, during the cooling process, is made manifest by the emanation of heat. This is called the point of recalescence. Alloys of aluminium and copper were experimented on. The method of treatment used, however, can be applied to pure aluminium or any other of its alloys. The critical temperature at which the aluminium and copper alloy must be chilled in order to effect this increase in strength and ductility was found to lie between the temperature at which the alloy becomes solid and a temperature not more than 30° C. below the recalescence point. When this temperature is attained the alloy is immediately chilled in cold water. In illustration of this process an alloy of 93% aluminium and 4% copper will be considered. This alloy solidifies at 640° C., and its point of recalescence is 525° C. Taking 30° C. off, we obtain a temperature of 495° C. The alloy has, therefore, to be heated to a temperature between 495° and 640° before it is chilled. Actual application of this process on an alloy of 96% aluminium and a 4% copper cast in a chill mould resulted in an increase in tensile strength of 48% and an increase in elongation of 2%. Nearly the same

increase was found with sand castings, whilst wire, sheet and rod, all produced similar results. Temperatures of recalcence were determined during the investigations for varying percentages of copper in the aluminium. As the copper content is increased from 1 to 33% the recalcence temperature rises from 485° C. to 540° C., the rate of increase of recalcence temperature being less with the high percentages of copper. A patent has been granted in connection with the process, which will doubtless be valued in increasing the tensile strength of aluminium castings."—*Indian Engineering*, Jan. 25, 1908, p. 59. (A. R.)

TWO DETERRENTS TO THE DISSOLUTION OF FREE GOLD IN THE CYANIDE PROCESS.—"I do not know if it has been previously noticed that oil and lime can act as deterrents to the dissolution of free gold by cyanide solution; but owing to the interference with the uniformity of the results of some work in which I was engaged on the Witwatersrand, I was impressed by their possible importance as such, in cases of low extraction that were otherwise inexplicable.

In one pronounced case, when the sand contained 29 gr. of gold per ton no longer amenable to cyanide, it was found possible by laboratory treatment to reduce this residual gold by further cyaniding to 13 gr. per ton; both deterrents being present. The sample containing 29 gr. to the ton was washed with water several times to ensure the absence of dissolved gold, and one portion (a) was repeatedly washed with ether, and another portion (b) with diluted hydrochloric acid. By evaporation of the washing from (a) a substance was recovered resembling vaseline in appearance, and 'touch-lime' (*sic*) was found in the washing from (b).

Further treatment with cyanide solution now reduced (a) to 15–17 gr. per ton, but (b) only to 27 gr. per ton. On treating, after thorough water washing, (a) with dilute hydrochloric acid and (b) with ether, and again dosing them with cyanide solution (0.25% KCy), both were reduced to 12–13 gr. per ton. The oil film had resisted removal by the working cyanide solution (0.15% to 0.05% KCy) during the treatment period of about six days.

Prolonged aeration by circulation in the sumps was effective in preventing the precipitation of carbonate of lime to any excessive amount in the leaching tanks, and a threat of dismissal for the mill hands on its repetition prevented the further leakage of bearing-oil into the cyanide works."—DUNCAN SIMPSON.—*Institute of Mining and Metallurgy, Bulletin 41*, Feb. 13, 1908. (A. R.)

PLATINISING IRON.—"To platinise iron, says the *Scientific American*, first heat and give it a coat of 22 parts of borate of lead and 4 to 5 parts of blue vitriol mixed with turpentine to paste, washing it off after a while. Platinising formula:—10 parts of platinum, changed into platonic chloride, mixed with 5 parts of ether and exposed to the air until the ether is evaporated. The residue is mixed with 20 parts of borate lead, 11 parts of red lead and some oil of lavender to a paste, which is mixed with 50 parts of amylalcohol. Dip the object in the mixture, dry and heat it."—*Indian Engineering*, Jan. 18, 1908, p. 41. (A. R.)

ESTIMATION OF PHOSPHORUS IN STEEL.—"The results of an investigation by Drs. Frank and Willy Hinrichsen, on the methods of determining the amount of phosphorus present in steel are set forth in *Stahl und Eisen* for February 26. It is shown

that the presence of arsenic is liable to influence the estimation of the amount of phosphorus contained in steel by means of ammonium molybdate. The results come out too high. Pure arsenic acid in solution is not precipitated under similar conditions, the arsenic is merely carried down with the phosphorus. The errors caused by the simultaneous precipitation of the arsenic do not exceed under ordinary circumstances (when the contents of the steel in arsenic reach about 0.05%) a total of 0.015%. The simultaneous precipitation of the arsenic is facilitated by the presence of ammonium chloride. It is restricted by the use of free hydrochloric acid, and to some extent also by the employment of an excess of the precipitant, but it cannot be wholly avoided unless the arsenic is first eliminated."—*Times Engineering Supplement*, March 11, 1908. (J. A. W.)

MINING.

APPLIANCES FOR RESCUE WORK.—"The author delivered a lecture on the latest appliances for rescue work in mines. In the first place, he explained that in dealing with any form of breathing apparatus for rescue work, certain requirements must be satisfied. The apparatus must give one a supply of oxygen such as would last at least two hours—a time which would allow of efficient work being carried out—and that supply must be sufficient, not for a man in a resting state but doing the hardest work. In rest a man required something like 0.3 litre of oxygen per minute, but in the hardest work, such as hill climbing, he might use almost 2 litres per minute. The apparatus must therefore allow of a supply of 2 litres of oxygen per minute for two hours. Then the apparatus must have an efficient absorber for the carbonic acid gas given off, and the absorber must keep the percentage of that gas below the amount which was injurious. It was exceedingly dangerous for the percentage of oxygen to fall off much. Normally, it was 21% in the atmosphere, and in the apparatus it ought never to fall below 12%. At 10% there was risk, and at 7% there was very great risk. The dangers of want of oxygen were very insidious, and lack of it might cause loss of consciousness without any warning at all. It was therefore, of the greatest danger to have an apparatus so contrived that the oxygen might fall below 12%, and it was of the greatest importance that the man should have warning when the supply of gas was falling off. Then as to the amount of carbonic acid gas which constituted a danger, he remarked that in a badly ventilated room the percentage did not rise above 0.5%, which did not have any injurious effect at all. If, however, carbon dioxide was present to the extent of 3%, it produced some panting and increased depth of respiration. If it rose to 7% it produced unpleasant increased depth of respiration. When it was present to the extent of 10%, there was extraordinary panting, and the whole effort was given up to breathing. With 15% of carbonic acid one might become stupefied and rendered unconscious. Nevertheless, one might live many hours in 15 or 20% without being poisoned. So far as the apparatus was concerned, they should never allow the atmosphere of the breathing bag to rise above 3%, because that amount began to produce troublesome excessive breathing, though it would not do a man any harm. As a matter of fact, it was better to keep it down to about 1%, and then there would be no increased breathing worth talking about. The amount of oxygen, however, was a more important thing than excess of carbonic acid, so long as it

did not exceed 3%. Then the breathing dress must be provided with a breathing bag which would allow sufficient air for each breath. It must be ample to allow one to fill one's lungs at each breath. Then there must not be a large dead space, such as a considerable space in a mask would provide, because that would tend to increase the volume of carbonic acid inhaled. Further, the apparatus ought to be as light as possible, and it ought to be so arranged as to incommode a man as little as possible. It should be well disposed about the body. It was most important to well hang the weight, and that was a matter that had been worked out by the German physiologists, in connection with the army, in finding out how to distribute the weight a soldier had to carry about his body. The breathing dress, unfortunately, could not be a light thing, and it was naturally not easy to arrange this apparatus in a light form. The lightest dress on the market was that known as the 'Pneumatogen.' Dr. Hill described the apparatus, and remarked that the supply was quite good under certain conditions. If a man was resting or walking in a quiet way, it would last him one hour, and he could walk a mile and a quarter with it. As long as he was quietly walking it was all right, but supposing he tried to walk quickly, the apparatus could not keep time with it. It was only meant for emergency work, and for use for a short space of time. Prof. Hill then described the 'Dräger' and the 'Shamrock' apparatus, afterwards proceeding to explain the principle of the 'Aerolith' liquid-air apparatus, and also that of the 'Weg.' Finally, he explained the construction and working of the 'Reuss,' upon which the lecturer had himself effected improvements. The equipment was made, he said, of canvas and leather in one piece, so that the wearer could pick it up and drop it over his head. All he then had to do was to put his mouthpiece in, apply the nose-piece and turn on the oxygen. There were two oxygen cylinders, carried at the back, and a reducing valve, giving a steady supply of 2 litres per minute for two hours. There was an emergency valve and a pressure-gauge carried in front. The caustic potash, used for absorbing the carbonic acid gas, was carried loose at the bottom of the breathing bag, instead of in cartridges. As a consequence, every movement shook the bag and shook the sticks of potash together, with the result that the carbonated surface was rubbed off and the carbon dioxide was the more readily absorbed. It weighed just over 30 lb., the oxygen supply was sufficient, and the carbonic acid was well absorbed even with the severest work.—Prof. LEONARD HILL.—*Colliery Guardian*, Jan. 17, 1908, p. 133. (A. R.)

NEW FUSE FOR INCREASING THE SAFETY OF SHOT-FIRING IN FIERY MINES.—"The fundamental idea embodied in the safety fuse devised by the author is to prevent miss-fires by igniting the blasting charge along its whole length, and not merely at one point, by means of a leaden detonating tube charged with trinitrotoluene. This substance is not very sensitive to external conditions, and is very stable, so that the fuses are safe to handle. The fuse is ignited by a detonator composed of 1 gm. of fulminate, and then detonates at a velocity of about 19,500 ft. per second for the 6 mm. ($\frac{3}{4}$ in.) fuse. The products of detonation include fragments of the leaden tube, and 3.7% of carbon dioxide, 70.5% of carbon monoxide, 1.7% of hydrogen, 19.9% of nitrogen, and 4.2% of carbon. The detonation temperature is 2,428° Cent.

In order to ascertain the risk attending the detonation of the fuse in an atmosphere of firedamp and

air, in view of the fact that the detonation temperature is higher than the limit (1,500° Cent.) permitted by the French mining regulations, a number of tests were performed by Messrs. Watteyne and Stassar at Frameries, with a 6 mm. fuse and with one measuring 4 mm., the explosive core in the latter being only 2 mm. in diameter. In the former case it was found that 28 in. (70 cm.) of fuse can be ignited with safety in an explosive atmosphere, ignition of the gas occurring only with a length of 6½ ft.; and as the shorter length is more than sufficient to fire 1 lb. of explosive, it is claimed that the fuse can be used in fiery mines without risk. With the narrow fuse as much as 10 yd. could be ignited without setting fire to the gas, the degree of safety being therefore still greater.

As regards the practical considerations relating to the absence of secondary reactions between the products of an explosion of the fuse and blasting charge, and the complete combustion of the former in the surplus oxygen disengaged by the charge, it results from the fact that the amount of trinitrotoluene is only 2% of the weight of the charge, that in order to compensate the increase in the amount of the hot gases the weight of the limit charge need only be reduced by 2%—a negligible quantity. On the other hand, the combustion of this 2% of trinitrotoluene will not raise the temperature of detonation by more than 150° Cent.; and a similar increase by the oxidation of the weight (10%) of lead present in the tube: a total of 300° Cent. Experiments conducted in shot-holes bored in clay rock showed that when fired along with a charge of ammonium nitrate explosive, the carbon disengaged by the trinitrotoluene is not consumed by the surplus oxygen from the nitrate, but remains as a sooty deposit on the sides of the cavity produced by the explosion through such combustion does occur with certain explosives containing potassium chlorate, the conclusion being that the fuse acts solely as a detonator of ammonium nitrate explosives (grisonnite) and that the fuse does not introduce any new element of danger in fiery mines.

Theoretically, the detonating tube presents the following points of superiority over the ordinary method. It enables certain high explosives (such as mixtures of ammonium nitrate and naphthalene or mononitronaphthalene) to be used that have hitherto been unsuitable on account of the difficulty of ensuring satisfactory detonation. It also enables slow powders to act as high explosives, and thereby removes the only obstacle in the way of their use in safety explosives. At the same time there seems to be every probability that the new fuse will enable ammonium nitrate to be used alone as a blasting charge, practical trials having shown that effects equal to those of grisonnite can be obtained by this means, especially with a fuse 7½ mm. thick, seeing that this fuse does not burn in the charge of nitrate.

The author also proposes to apply the new fuse to nitroglycerine explosives. In this case the fuse will be laid on one side of the shot hole so as to project a short distance from the mouth, the cartridge being then introduced singly in the ordinary way and stemmed. The detonator will be attached to the end of the fuse outside the hole; and with a narrow fuse (say, $\frac{1}{4}$ in. thick) there would be no risk in fiery mines, in view of the results already mentioned as having been obtained in the tests at Frameries, the system of attaching the fuse to the detonator increasing the safety of the method. It is admitted, however, that the arrangement will require to be properly tested before being admitted

into mining practice. Another advantage claimed is that, the detonator being outside the shot-hole, it can be replaced, with less risk in the event of a miss-fire."—M. LHEURE, *Annales des Mines*.—*Colliery Guardian*, Jan. 24, 1908, p. 165. (A. R.)

BOREHOLE TEMPERATURES.—"A meeting of the Edinburgh Geological Society was held recently, when Mr. James Grant Wilson, of H.M. Geological Survey, exhibited a diagram prepared from the journal of the Balfour bore in Fifeshire. The bore began near the top of the millstone grit and passed through the upper limestone group, the middle coal-bearing group, and stopped about the horizon of the Hozie limestones in the lower limestone group. The remarkable feature of this bore is the great development of the coal in the carboniferous limestone series. Mr. E. M. Anderson, H.M. Geological Survey, described the temperature observations taken by Mr. John Gemmell, mining engineer, in the Balfour bore. One maximum thermometer by Cassella was used, and four by Hume on the principle of a clinical thermometer. The greatest depth which could be reached was 3,955 ft., and at this depth a temperature of 92.2° F. was recorded. This corresponds to a temperature gradient of 1° F. in 87.5 ft., which is well under the average. The gradient was least in the upper part—a feature which was accounted for by the high conductivity of strata (including millstone grit), passed through in this part of the bore."—*Colliery Guardian*, Jan. 24, 1908, p. 182. (A. R.)

POINTS IN BREATHING APPARATUS.—"All breathing apparatus for use in mines must be airtight, as far as the passage of air from the outside to the inside is concerned. Such apparatus should be fitted out with emphatic mechanical warning instruments and will warn the wearer of the failure of oxygen before the percentage has fallen to a dangerous limit. The result is best obtained by arranging and working the apparatus so that it becomes filled with a mixture containing 60% of oxygen. Before the oxygen percentage has been reduced to the limit of safety the apparatus will then become so empty and respiration so impeded or impossible that the attention of the wearer cannot fail to be attracted mechanically. Any apparatus which permits the possibility of the user being unknowingly led into breathing a mixture containing less than 12% of oxygen must be looked upon as extremely dangerous. All breathing apparatus should also have attached a moderately distended bag to act as reservoir and as a buffer or cushion for the ebb and flow of inspiration or expiration may be contained in it quite easily. The dead space in a respiration apparatus should not exceed 200 or 250 cubic centimetres." (T. L. C.)

HELMETS FOR MINERS.—"Many ways of decreasing the injurious effects of dust on miners have been tried. In these methods either the dust is allayed by spraying or the dust is prevented from entering the lungs of the miners. To the water spray miners often object because of the difficulty at many dry mines of getting water for the supply tank. To the respirators the miners object mainly because it hampers conversation with a nearby partner. At the St. John del Rey Mine, Brazil, helmets supplied with air from the compressed air pipe are worn by the machine men. The small rubber pipe, which brings the air to the helmet, can be detached instantly by

means of a connection, the valve in which closes automatically when detached. Expansion cools the air, and renders work in a hot stope much pleasanter." (T. L. C.)

MISCELLANEOUS.

EARTHQUAKES AND PETROLEUM FIELDS.—"In a paper recently presented to the French Academy of Sciences Mr. Tassart points out an interesting connection between petroleum layers and seismic phenomena.

A thorough examination of the location of petroleum fields has brought out the following facts:—

1. All petroleum fields situated in recent strata are confined within regions of maximum seismic activity or in their immediate vicinity.

2. Petroleum fields are found only exceptionally in ancient strata, with seismic zones.

3. Those petroleum fields which are situated outside of such zones belong to ancient strata and were formerly the seat of a lively seismic activity."—*Indian and Eastern Engineer*, Jan., 1908. (A. R.)

ZINC DUST IN CEMENT.—"It has been known for some time that a cement made out of certain oils and zinc dust possesses the useful property of becoming exceedingly firm and adhering closely to iron, steel and other metals when heated to a temperature of 150° C., or even less, if treated for a sufficient length of time. The theory of the nature of zinc dust which Mr. Alfred Sang has given in his article on sherardising in our last issue, explains this hardening by the release of the zinc from its peculiar condition, to form a solid without the formality of passing through the liquid stage. In the body of the cement it is protected from oxidation and the zinc becomes mechanically continuous. It is an excellent composition for caulking cracks and crevices in metallic objects, for packing joints and for smoothing off the surface of castings."—*Electro-Chemical and Metallurgical Industry*, June, 1907, p. 248. (K. L. G.)

SYNTHESIS OF GEMS.—"In a recent German patent (D.R.-P., 182,200) a method is described for producing artificially certain mineral species, such as olivine, zircon, beryll, and spinel, in a definitely crystalline form. This consists in dissolving their constituent oxides in appropriate proportions in molten sodium or potassium metaborate. The temperature of the fused mixture is then raised to 1,300° C., when the alkali metaborate volatilises, leaving the artificial mineral in the form of crystals. In addition to obtaining products corresponding with the naturally occurring minerals, other compounds having no mineralogical counterparts may be produced by this method. A nickel chrome spinelle, NiO, Cr₂O₃, prepared from its constituent oxides, was obtained in the form of small green crystals. It is well known that the mineral species corundum occurs in the form of very variously coloured stones ranging from colourless sapphire to brown and opaque corundum. Between these extremes one meets with sapphires tinted in yellow, green, blue, red, and intermediate hues, and it is generally supposed that these various colours are due to the presence of compounds of iron, manganese, chromium titanium, or other foreign elements. In the *Comptes rendus de l'Académie des Sciences* F. Bordas describes experiments in which the colour of these gems is caused to change by exposing the stones to the action of a very radioactive specimen of radium bromide. In these circumstances

a blue sapphire assumes successively green, light yellow, and dark yellow tints, whilst a red sapphire develops in succession shades of violet, blue, green, and yellow. These experiments justify the belief that the distinctive colours of these precious stones are not due to the presence of any particular oxides. The variation always occurs in the above sense from red to yellow, and it seems likely that the topaz represents the last term in this transformation. Moreover it seems probable that these gems are found in regions where the surrounding soil has a certain degree of radioactivity. This idea receives support from the fact that the yellow sapphires are the commonest, although yellow and blue sapphires frequently occur together. The gems which have been thus artificially coloured are not radioactive; they do not become luminescent in the dark under the influence of radium bromide, but they retain their colour on heating."—*Times Engineering Supplement*, Jan. 1, 1908. (J. A. W.)

A MODERN METHOD OF LEAD BURNING.—"The use of pure oxygen in place of air not only enables much more perfect combustion and higher temperatures to be obtained than are possible with the hydrogen and air system, but it possesses a still further economic advantage in that either coal or natural gas from the town supply may be employed instead of hydrogen.

The oxy-coal gas blowpipe is constructed on the injector principle, and is now extensively used by lead burners. By its use oxygen delivered under slight pressure from a trade cylinder is caused to draw the gas direct from the ordinary town supply and then eject the mixed gases in the right proportion through the nozzle of the blowpipe. The system is being introduced by the Linde Air Products Co., of Buffalo, and its superiority over the old hydrogen and air system, as regards quality of work, economy and convenience in use is admitted by all who have adopted it. It is suitable for ordinary flat work, horizontal and upright joints, overhead patching and the jointing of ordinary lead piping. Any workman conversant with the hydrogen and air system of lead burning will experience no difficulty in operating the oxy-coal gas blowpipe.

It is estimated that in regard to the question of economy there is a saving of approximately 50% by using the oxy-coal gas system in preference to the old hydrogen-air method of lead burning. There are besides many other advantages, as enumerated here below:

1. The hydrogen generator is dispensed with.
2. The air bellows or pump is dispensed with, and consequently the services of a boy are not required.
3. Instead of having to move a heavy hydrogen generator and bellows from one job to another, it is generally only necessary to move a light cylinder containing the oxygen required.
4. No apparatus to get out of order, involving expenditure, delays and repairs.
5. As neither zinc nor sulphuric acid is used, there is no deleterious matter to be carried through the blowpipe to act injuriously on the lead seam.
6. No preheater or 'Fou-Fou' is required on heavy work. The oxy-coal gas flame is so hot that even heavy lead in wet and cold positions can be burned *in situ* without preheating.
7. No gas is generated when the blowpipe is not in use, and consequently there is no waste of gas and no charge to withdraw overnight.

It may be stated that for cases where a supply of town's gas is not available coal gas can also be

obtained in cylinders, or the oxygen may be used advantageously with the hydrogen 'machine.'"—*Electro-Chemical and Metallurgical Industry*, Feb., 1908, p. 82. (K. L. G.)

Reviews and New Books.

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

LEAD REFINING BY ELECTROLYSIS. By ANSON GARDNER BETTS. 394 pp., \$4. (New York: J. Wiley & Sons.)

"This book contains information resulting from years of study, experiment, and practical work of the electrolytic refining of lead bullion, which is now an established metallurgical process and one from which further developments may be expected in the future. The methods of slime treatment are also discussed in considerable detail."—*Mining and Scientific Press*, April 18, 1908, p. 538. (W. A. C.)

MINE GASES AND EXPLOSIONS. By J. T. BEARD, C.E., E.M. 402 pp. price \$3. (New York City: John Wiley & Sons.)

"The scope of the book is shown by the following chapter headings: The Chemistry and Physics of Gases; Heat and its Effects; The Atmosphere; The Common Mine Gases; Mine Explosions; Safety Lamps; Testing for Gas. The subjects treated are particularly pertinent at the present time.

The book is interestingly written and contains much valuable information. The subject of dust explosions is clearly treated, a good résumé of much of the literature upon this subject to the present time being given. The treatment of safety lamps is probably the most complete treatment of the subject thus far published. There are some points in the arrangement of the book in which many will differ with the author—for instance, since the title of the book is Mine Gases, under Specific Gravity, one naturally expects to find something about the specific gravity of gases, but no mention whatever is made of the subject at this place, while the subject of the specific gravity of gases is treated under the head of the Behaviour of Mine Gases. The tables are frequent and interesting, but their value and also many of the incidental references to other works would be increased if the original source of the information were stated, so that those desiring to do so could consult the original articles. Under the heading Mixture of Gases and Air, the author gives the name Flashdamp to what he considers a more or less definite combination of marsh gas and carbon dioxide, and holds that this mixture is more dangerous than firedamp. This seems rather unreasonable and is opposed to the author's own statement on p. 104, where under the heading of Effects of Other Gases on Firedamp, he says: 'Carbon dioxide reduces the explosiveness of firedamp in proportion to the amount present in the mixture. When the firedamp is at its most explosive point, one-seventh of its volume of carbon dioxide will

render the mixture non-explosive.' The percentage composition of flashdamp is given as 38% carbon dioxide and 62% methane. If the statement quoted is true, which it undoubtedly is, it is difficult to see how a mixture of practically one part CO₂ and two parts methane can be more dangerous than pure methane. Inquiries made of a large number of mining men do not substantiate the occurrence of any such definite mixture.

The author also gives a number of tables to show that there is a direct connection between volcanic and other earth movements which will account for periods of an unusual number of explosions. We doubt very much if this contention can hold, and certainly all of the other writings upon the subject oppose it, and it seems contrary to geological acts."—*Mines and Minerals*, March, 1908, p. 373. (A. McA. J.)

SIMPLE MINE ACCOUNTING. By DAVID WALLACE.

64 pp., \$1. (New York: Published by the Hill Publishing Co.)

"This book is intended for those who have no chance to learn book-keeping. It is well adapted for the use of foremen and superintendents, being sensible and simple. It covers the ground satisfactorily, from vouchers, cash-books, and ledgers to stock and smelter records."—*Mining and Scientific Press*, April 18, 1908, p. 538. (W. A. C.)

METHODS AND DEVICES FOR BACTERIAL TREATMENT OF SEWAGE. By W. M. VENABLES. 236 pp., \$3. (New York: J. Wiley & Sons.)

"This subject is fully treated from the viewpoint of the civil engineer, and contains a full summary of the known engineering principles involved in the subject under treatment and a statement of the problems unsolved."—*Mining and Scientific Press*, April 18, 1908, p. 538. (W. A. C.)

CHEMICAL REAGENTS, THEIR PURITY AND TESTS.

By E. MERCK, authorised translation by Henry Schenck, A.B. Cloth, 280 pp. price \$1.50. (New York, 1907: D. Van Nostrand Co.)

"This little book is a translation of the latest edition of Krauch's *Die Prüfung der chemischen Reagentien auf Reinheit*, by E. Merck. The translator added tests for such reagents as are universally used in the United States, but not in use in Europe, and, consequently, were not to be found in the original work.

Considering the agitation for chemically pure chemicals in the last few years, and the fact that the experienced analyst looks somewhat sceptically on the so-called chemically pure reagents, this book ought to find a place in the library of every one interested in analytical chemistry.

The special qualitative tests are arranged very well, and even the beginner in analytical chemistry should have no difficulty in determining the purity of his reagents."—*Mines and Minerals*, March, 1908. (A. R.)

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.) 177/08. Sidney James Nash. Improvements in carriers for uncovered receptacles. 11.5.08.

(P.) 178/08. James Hosking. Improvements in ore dressing machines. 14.5.08.

(P.) 179/08. Jacob Andreas Frerichs (1), Anthony Maurice Robeson (2). Improved method of and apparatus for measuring and recording volumes and/or weights of gases or fluids flowing through pipes by means of pitot tubes. 15.5.08.

(P.) 181/08. Ralph Davenport Merson. Improvements in insulating supports for high tension conductors. 15.5.08.

(P.) 182/08. George Clark Richards. Fume condensing apparatus. 15.5.08.

(C.) 183/08. Daniel Shaw Waugh. Rock drill feeding mechanism. 15.5.08.

(P.) 184/08. Frederick Walter Bowden. Improvements relating to explosives. 15.5.08.

(P.) 185/08. Harold August Wilson. A new or improved combined automatic depth and weight indicator for use on mines. 16.5.08.

(P.) 186/08. Diederick Johannes Cornelius Enzlin. Improvements in signalling systems, more particularly adapted for use in mines, and apparatus therefor. 16.5.08.

(P.) 188/08. Francis Westall. Improvements in rope jockeys. 16.5.08.

(P.) 189/08. Rollo Bowman Ballantine. An improved process for the manufacture of sodium cyanide. 18.5.08.

(P.) 190/08. Harry August Stockman. Improvements in portable mills. 18.5.08.

(P.) 191/08. Angus Lecuona. Improvements in apparatus for sifting and cleaning grain, meal and the like. 19.5.08.

(P.) 192/08. Alexander John Arbuckle (1), Alfred Osborne (2). Improvements in filtering apparatus. 20.5.08.

(P.) 193/08. Alexander John Arbuckle (1), Alfred Osborne (2). Improvements in filtering apparatus. 20.5.08.

(P.) 194/08. William Arthur Caldecott. Improvements in the treatment of crushed ore products and apparatus therefor. 21.5.08.

(P.) 195/08. James Taylor C. Carrick (1), Basil Stuart Pattison (2). Improvements in agitating and separating mixtures of solid matter and liquids. 21.5.08.

(P.) 196/08. Alfred Joseph Card. Tailings tipping stage. 21.5.08.

(C.) 197/08. Gustave Jacques. Improvements in dust collectors for rock drills. 22.5.08.

(C.) 198/08. Stephen Mathias Smith. Improvements in the methods of treating ores. 22.5.08.

(P.) 199/08. Charles Edwin Draper Usher (1), Adair-Usher Process, Limited (2). Improvements in

fluid distributing pipes for ore treatment vats. 22.5.08.

(P.) 200/08. Abraham Anthony Auret. Improvements in the treatment of conglomerate ores. 23.5.08.

(C.) 201/08. Perceval White Tracey. Improvements in the construction of tube mills. 23.5.08.

(C.) 203/08. Otto Trunnesen. Improved outfit for setting out and surveying shaft beacons, pegs and survey fix-points of any kinds. 27.5.08.

(P.) 204/08. Otto Trunnesen. Improved stand for theodolites and other instruments. 27.5.08.

(P.) 205/08. Harry August Stockman. Improvements in apparatus for cooling liquids. 27.5.08.

(P.) 207/08. Julius Wilhelm von Pittler. Improvements in rotary engines, pumps and similar mechanism. 29.5.08.

(C.) 208/08. Walter Skelton Hudson (1), Edward Hudson (2). Improvements in tip wagons. 29.5.08.

(C.) 209/08. Sydney Armstrong. Improvements in or relating to brewing, distilling and the like. 29.5.08.

(C.) 210/08. Henrich Wilhelm Oberlies. Masts of iron, concrete for electric conduits of and weak current or the like. 30.5.08.

(P.) 211/08. George Thomas Plumb. Improvements in signalling system for mines or the like. 1.6.08.

(P.) 212/08. James Taylor Carrick (1), Basil Stuart Pattison. Improvements in pyritic smelting. 1.6.08.

(P.) 213/08. Edouard Bouchard Praceig. Warning protector against the spontaneous explosions of nitrated explosives. 5.6.08.

(P.) 215/08. Joseph Walter Cowie. Improvements in cams, pulleys and the like. 6.6.08.

(P.) 216/08. H. Clarkson Fletcher. Improvements in and means for treating crushed ore products with cyanide solutions or other liquids. 6.6.08.

(P.) 217/08. Alexander John Arbuckle (1), Alfred Osborne (2). Improvements in filtering apparatus. 6.6.08.

(C.) 218/08. David Gilmour. Improvements in slimes filtering apparatus. 6.6.08.

(P.) 219/08. Edwin Crowther. Improvements in electrical signalling systems. 6.6.08.

(P.) 220/08. John Whyte (Premier mine). A central jockey with a vice grip for hauling purposes. 9.6.08.

(P.) 221/08. Alexander Macnamara. Improvements in boring or drilling. 9.6.08.

(P.) 222/08. William D'Arcy Lloyd (1), Ernest Thomas Rand (2). Improvements in apparatus for extracting precious and other metals from solution. 9.6.08.

(P.) 223/08. William George. An improved pump. 9.6.08.

(P.) 224/08. John Charles Mill. Improvements in the tappets of battery stamps. 10.6.08.

(P.) 225/08. William Mack Hutton. Improvements in screening or washing trommels. 11.6.08.

(P.) 226/08. Harry August Stockman. Improvements in vehicle carriers for aerial railways or other mono rail tracks. 11.6.08.

(C.) 228/08. Adolph Gabriel Sydney Horace Barber. Improvements in tappets. 12.6.08.

(P.) 230/08. Alexander John Arbuckle (1), Alfred Osborn (2). Improvements in slime separators or means for separating comminuted ores from liquids. 15.6.08.

(P.) 231/08. William Arthur Caldecott. Improvements in or appertaining to means for separating liquids from crushed ore products. 15.6.08.

(C.) 232/08. Maurice George Newbould. An improved automatic cut-out for electrical conductors. 16.6.08.

(P.) 233/08. Horatio Dunn. Improvements in means for disposing of sand or similar material on mine dumps or other depositing sites. 16.6.08.

(P.) 234/08. Alexander John Arbuckle (1), Alfred Osborne (2). Improvements in filtering apparatus for separating pulverised ore from liquid. 17.6.08.

(C.) 235/08. William L. Imlay. Improvements in lixiviators. 19.6.08.

(C.) 236/08. Russel B. Sigafos. A rotary tunnelling machine. 19.6.08.

(C.) 237/08. William Prellwitz. Improvements in rock drilling machines. 19.6.08.

(C.) 238/08. François Dallemagne (1), Henri Dallemagne (2). Improvements in ore concentrating and separating apparatus. 19.6.08.

(P.) 239/08. William Arthur Caldecott. Improvements in linings for tube mills and the like. 22.6.08.

(P.) 240/08. Richard Care Harris. Improvements in ore feeders for stamp batteries and the like. 22.6.08.

(P.) 241/08. William George Landells. An improved self-heating adjustable cattle branding appliance, convertible for use either as a soldering bolt, blow lamp and burning off lamp. 22.6.08.

Changes of Addresses.

Members and Associates are requested to notify the Secretary immediately of any change in address, otherwise it is impossible to guarantee the delivery of Journals or Notices. The Secretary should be at once notified of non-receipt of Journals and Notices.

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