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Chemical, Metallurgical and Mining Society

OF SOUTH AFRICA.

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VOL. VIII., JULY, 1907. No. 1.

Proceedings

AT

Ordinary General Meeting, July 20, 1907.

The Ordinary General Meeting of the Society was held in the Chamber of Mines, on Saturday, July 20th, Prof. J. Yates (President), in the chair. There were also present :—

43 Members: Dr. J. Moir, Messrs. T. L. Carter, J. Littlejohn, R. G. Bevington, W. R. Dowling, G. O. Smart, A. Whitby, H. A. White, Prof. J. A. Wilkinson, W. Beaver, H. D. Bell, B. V. Blundun, A. A. Coaton, M. H. Coombe, G. A. Darling, N. M. Galbraith, F. N. Hambly, W. H. Jollyman, J. A. Jones, J. Kennedy, G. A. Lawson, H. Lea, C. W. Lee, C. D. Leslie, W. P. O. Macqueen, G. Melvill, H. H. Morrell, P. T. Morrisby, W. D. Morton, T. T. Nichol, F. B. Ogle, C. F. Parry, J. F. Pyles, O. D. Ross, C. B. Saner, S. Shlom, W. H. Stout, H. Taylor, J. A. Taylor, H. Warren, John Watson and J. O. Welch.

12 Associates and Students: Messrs. S. J. Cameron, J. Chilton, C. L. Dewar, W. J. N. Dunnachie, J. H. Harris, C. B. Hilliard, E. Homersham, R. Lindsay, C. Toombs, A. Waugh, H. Weldon and L. J. Wilmoth.

12 Visitors and Fred. Rowland, Secretary.

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

New Members.

Messrs. Melvill and Saner were elected scrutineers, and after their scrutiny of the ballot papers, the President announced that all the candidates for membership had been duly elected, as follows :—

EVANS, THOMAS, Knights Deep, Ltd., P. O. Box 143, Germiston. Assayer. (*Transfer from Associate Roll.*)

GREER, Jr., JAMES COURTNEY, Knights Deep, Ltd., P. O. Box 143, Germiston. Chemist.

JACKSON, RICHARD, Treasury G. M., Ltd., Cleveland. Shift Boss.

JOLLY, HAROLD R., Robinson Deep G. M. Co., Ltd., P. O. Box 1488, Johannesburg. Chief Assayer. (*Transfer from Associate Roll.*)

SCARF, HENRY A., Robinson Deep G. M. Co., Ltd., P. O. Box 1488, Johannesburg. Cyanide Foreman.

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

ANGUS, WILLIAM HAY, Knights Deep, Ltd., P. O Box 143, Germiston. Foreman Amalgamator.

BAYLEY, CHARLTON F., Knights Deep, Ltd., P. O. Box 143, Germiston. Mill Foreman.

JONES, G. J., Messrs. H. Eckstein & Co., P. O. Box 149, Johannesburg. Technical Chemist.

POWTER, HAROLD BOWEN, Knights Deep, Ltd., P. O. Box 143, Germiston. Engineer.

WILSON, PETER, Knights Deep, Ltd., P. O. Box 143, Germiston. Mill Foreman.

INAUGURAL ADDRESS.

By PROFESSOR JOHN YATES (President).

I have to thank you for the honour you have conferred on me, an honour which I fully appreciate. The leading of this, one of the premier societies of South Africa, is no light responsibility, and probably never was the responsibility greater than at the present juncture when both the gold industry and the State are in such an unsettled condition consequent on the repatriation of the Chinese, the strike of our miners, the coming into power of the new Government with its many possibilities, and, above all, the rude shock which has been experienced by all those who, having the permanent welfare of the country at heart, realise for the first time that the average grade of the Rand is merely 30s. per ton milled; I question whether even now the full significance of this last point and its vital incidence on the whole economic framework of the country has yet been fully grasped. Never before have our economic conditions been so disturbed, depression been so acute, or ruin hovered over so many, and it but increases the bitterness of the position when we find that South Africa is alone in the pit of depression and that the world generally is revelling in a surfeit of abundance. But our industrial depression should merely act as an incentive to all in South Africa to put their shoulder to the wheel and make a determined effort to help the country along, and I feel sure that what we, as a Society, can do in this direction we will most willingly perform.

Dr. Moir has drawn your attention to the fact that I am the first mining president the Society has had, and it is somewhat of a coincidence that I was largely instrumental in adding mining to the Society's title and work. This broadening of our scope was, as you will doubtless remember, not effected without opposition from a section of our members, but even they must now be convinced of the wisdom of the change—a mining society was much needed on these fields, and I submit that, judged by their contributions, our mining members have done right well, and that our reputation as the Mining Society of South Africa is now firmly established.

Mr. Johnson has kindly left me to review the past year's work, and as an old member—Mr. Rowland tells me I joined in 1896, when the membership was only 91—I have a duty, a pleasant duty, to perform, and that is to take advantage of my long acquaintance with the members and on your behalf, give thanks to just a few of those to whom thanks are due. Since the war you have had as your presidents, Williams, Pearce, Caldecott and Cullen, and this "Old Guard," ever watchful of your interests, Mr. Johnson has just joined, a worthy associate for our other veterans. Of your indebtedness and the indebtedness of the mining and metallurgical world to these men I do not purpose speaking except to say just a few words on Mr. Johnson's labours during the past year. He is, I think, even an older member of the Society than myself; he had a long apprenticeship and did much solid work before taking the chair, the onerous duties of his appointment in no way interfered with his devotion to the interests of the Society, and for this and his unfailing courtesy he has well earned our thanks. Of our Mr. Rowland so many nice things have been said from time to time that I will content myself with remarking that he deserves them. Next we come to a veritable corner stone of the Society, our esteemed Hon. Treasurer, Mr. Littlejohn, who after many years exposure to the stress of our financial matters presents to them as smiling and unruffled a front as ever. Of Dr. Moir and Mr. Bradford, who were associated with me as Vice-Presidents, it is a pleasure to place on record the good work they have done; Mr. Bradford especially has, as we all know, had a year of strenuous labour, working, as he well knows how to work, in the interests of the industry and the country. In concluding this very brief review, I think I may well say of the *personnel* of the present council that its constitution is a matter for congratulation both for the Society and myself.

I trust that you will continue to strive to lengthen our membership roll, and I wish to extend a cordial invitation to all of you to come forward with papers and take part in our discussions and thus benefit both yourselves and your co-workers. As a Society we are noted for our discussions: their breeziness has contributed in no small measure to the making of the Society and many of its members, yet in this connection I need hardly remind you that authors, even when we may differ from their views, are entitled to a full measure of courtesy at our hands in return for their expenditure of time and thought on the Society's behalf.

I believe I am expected to-night to review the past, comment on the present, and forecast the future.

The Past Year.

The past year will be recorded in South African history as one of acute depression, a year of losses for financiers, shareholders, and tradesmen alike, of empty houses for landlords and of relief works for the needy. So far as our Society is concerned it is not necessary that I should reiterate what you have already perused in our Annual Report.

The papers contributed were of a very varied and instructive nature, and the authors are to be congratulated on the standard they attained, the mining papers being especially deserving of commendation. There is, I am pleased to note, a tendency among our members to deal with details of plant and practice; I hope that this tendency to bring forward little departures from ordinary routine will grow and that members will be good enough to convey to their fellow workers, through our transactions, ideas which may prove of service directly or indirectly.

The year has in many ways been a remarkable one for mining and metallurgy, and on the Rand many developments worthy of note have occurred. Thus, a 300 stamp mill with steel battery framing has been ordered for the Simmer Deep, Ltd., the stamps will be 1,750 lb., probably the heaviest gravity stamps in the world. The crusher station of this installation will also be steel framed. The Gold Prince Mill, Colorado, is an example of a large mill (100 stamps) built almost entirely of steel in the manner proposed for the Simmer Deep, Ltd., and having steel battery posts.

Several small improvements have been effected in our tube-mill practice and very little has been heard during the year of the Wheeler pan as a supplementary crusher on these fields. Steel framing for shafts in being introduced in the Kleinfontein group and our latest seven-compartment shafts are being equipped with a permanent repair cage in the pump and ladder way. The mono-rail is making headway in connection with our underground transport and is about to be installed on the Rand mines subsidiaries. The unsettled state of the unskilled labour question gave rise to a boomlet in connection with small machine drills, but once again expectations have not been realised and we still await a really simple and efficient mechanical substitute for hand drilling in small stopes.

Good work has been done by the Safety Catch Commission, and from the multitude of designs submitted to them three have been proved to possess outstanding merit, viz., the Garvin, the Schweder, and the Undeutsch; but whilst the merit of these designs compared with the old standards is obvious, it is noteworthy that none of the three are free from that greatest of all objections to such safety appliances, namely, the liability to come into play when not wanted, but, at any rate, it is satisfactory to note that the damage likely to arise from such uncalled for action is greatly reduced in these new types.

The year has advanced our knowledge of explosives considerably and we have come to realise that nitro-glycerine compounds have little respect for formulæ, that perfect detonation is the exception and not the rule, and that our blasting operations are almost invariably attended by the evolution of those objectionable gases, NO and CO, and, this being the case, our miners would do well to assume that these gases are present after every blast. The subject of the ventilation of our mines has been very much in evidence during the year, and though Dr. Moir's paper anent this raised a storm of protest the interesting controversy has done a certain amount of good inasmuch that it has attracted attention to the absence of ventilation in certain working places underground, a state of affairs which, however, also occurs on other mining fields. To this extent, therefore, the discussion was advantageous, but I am afraid that otherwise the paper and discussion have unfortunately given rise to much unjust prejudice against the quality of the ventilation on our mines generally.

Our working horizon is steadily descending, our deepest mine, the Simmer West, Ltd., being about 4,500 ft. deep, but we are, in this matter, behind the copper mines of the Lake Superior district which are at present sending ore to surface from over 5,000 ft. vertical and apparently see no technical difficulty to delving to 10,000 ft. vertical.

Turning now for a moment to other mining countries among noteworthy events of the year is the starting up of a slime plant on the Homestake Mine to treat $\frac{3}{4}$ dwt. slime, a feature of the plant being a filter press with an automatic sluicing device by means of which the press can be quickly emptied of its contents without being opened. The crude and laborious method of discharging filter presses hitherto obtaining has been one of their greatest drawbacks, and it is to be hoped that the Homestake Co. has satisfactorily overcome this disadvantage. Considerable ingenuity is at present being concentrated on the treatment of slime by other methods than decantation, and among the ideas being tested on other mining fields are the Moore filter basket and the Ridgway machine. The latter consists of a number of horizontal circular plates revolving around a central vertical tubular column to which they have a pipe connection; each plate has an under filtering surface and dips through a portion of its revolution into the slimes pulp; a cake is formed by the application of a vacuum and the plate continuing its revolution next finds itself in a water bath where it is washed and the cake subsequently dislodged; this is, I say, ingenious, but on the Rand the decantation process leaves little to be desired.

Magnetic separation is making great strides in Sweden where iron ores well suited for this treatment abound, and according to Prof. Peterssen, the Professor of Mining at Stockholm, there are now 21 plants in operation and concentrates containing 63 to 68 per cent. iron can without difficulty be produced from a crude ore with from 25 to 30 per cent. of iron if crushed fine enough, the loss of iron in the tailings being comparatively small.

Flotation processes have been largely tested during the year and they promise to be of considerable assistance in the treatment of certain ores of base metals.

Cornwall, that birthplace of British mining, which has so long been content to live in the past is at last waking up and is throwing out its historic buddles and frames to make way for the Wilfley and such like approved modern appliances. The magnetic separator is also doing good work on the Cornish tin ores separating the tungsten and materially augmenting profits, the production of tungsten ore from Clitter's United and East Pool mines in 1907 being valued at £8,174.

A matter of interest to the mining world has been the development of the cobalt deposits of Ontario, Canada, these ores carrying silver, nickel, and arsenic, in addition to cobalt, and being richer than the New Caledonian deposits. The year was a boom year for mining and it witnessed remarkable increases in mineral production and consumption. The Transvaal, Australia and United States of America together produced over 70 per cent. of the world's output of gold which is now about £80,000,000 per annum. The world's silver production exhibited little change, but over 700,000 tons of copper, 900,000,000 tons of coal, 100,000,000 tons of iron ore, 13,000,000 tons of salt, 1,000,000 tons of lead, etc., were mined, these figures giving some idea of the magnitude of mining operations. The last return of the world's miners shows that there are 3,644,416 distributed in the different countries, as follows :—

Great Britain and Ireland ...	974,634
Germany	814,352
United States of America ...	607,069
Russia...	344,255
France...	322,536
Austro-Hungary	225,371
Japan	163,530
Other Countries	192,669

Legislation has been proposed in the United States for the prevention of fraud in connection with the promotion of mining enterprises, the idea being to make misrepresentation a felony and fixing heavy penalties. But the public is itself largely to blame for the often unscrupulous methods of company promoters ; so long as people, in their mad rush to make money, blindly accept the reports of men who are not qualified to report or speak on mining matters how can you expect otherwise than that a certain class of people will make a business of trading on this weakness ; ways of evading the penalties of the law can generally be discovered, and any attempt at saving the public from itself in this matter by legislation looks well nigh hopeless in view of the fact that some people do not think the possession of a report is a necessary preliminary to investment in a property. It is of little use attempting to reason with many of the investors in mining stock, they may be sane men in their own business but the glamour of a possible bonanza mine is too much for their mental equilibrium.

As in 1905 the Transvaal last year was easily the world's greatest gold producer, the output being approximately £24,000,000 sterling ; the United States and Australia were respectively second and third on the list, and it now seems improbable that we will be deposed from our premier position for many years to come. Our gold industry is magnificent in its proportions : that it should at the present time be almost the only support of the country is the Transvaal's misfortune, and because of this dearth of other revenue producing industries it is gratifying to hear that it is proposed to manufacture cyanide locally ; our mines now spend over £300,000 per year on this commodity.

The Practice of To-day and the Possibilities of To-morrow.

To speak of the past is easy but attempts to outline the future are often seen in the after light of developments to be merely caricatures. But so far as metallurgy is concerned I think I may safely say that its development has in most cases exceeded expectations, that what was in past years hoped of it has been very often surpassed by actual accomplishments, and it may be that this pleasing trait will be maintained in the future. I have often thought that we would do well to thoroughly reconsider our impressions and practices every few years. Our practice at any time is based upon the particular conditions existent at that period, and as the conditions change so should our methods if we are to reap the full benefit of economic and other developments. Metallurgy especially has been advancing so rapidly of recent years and working conditions in the Transvaal exhibit such a betterment compared with pre-war days that we cannot be too watchful of events or too critical in our inspection of our own work ; propositions which would have been absurd in the old days may now, owing to the changes which have occurred, be feasible and payable schemes.

I shall not be at all surprised to see a few years hence, economic conditions permitting, 800 stamps or more under one roof on these fields. Such a mill need not necessarily be attached to one mine ; for instance, three large adjoining deep level properties, each of 400 stamp capacity, and each independent so far as shareholders interests are concerned, might advisedly have a joint 1,200 stamp mill with suitable workshops, power station and staff; this is what the unrivalled expanse of our gold beds calls for, and this operating on a large scale, a scale commensurate with that of the deposit, is what will have to be done if we are to work these reefs of ours to the depths they should be worked. We want larger properties, great joint mills and a cheapening of our surface installations and our working costs. Turning now to detail, the use of the rotary sand distributor at work on the Langlaagte Deep, Ltd., is being attended with an improvement in extraction and we may expect to see it thoroughly tested. It is improbable, I think, that any further cyanide plants of the superposed type will be erected : the plants of the future are more likely to have only a few catching tanks but a liberal number of treatment tanks, all more or less at one level, transference of the sand being effected by conveyor belts. When considering mechanical appliances, like the Blaisdell excavator, we have to bear in mind the cheapness, compared with most other mining fields, of our unskilled labour, and though the machine mentioned works well, I doubt that it can be installed in every case with advantage. Our tube mills are doing good work and have proved a friend to the shareholders by increasing our profits. Our stamps are, as I have already mentioned, taking on more weight year after year and I am inclined to predict that we will see 1 ton gravitation stamps and even larger. Compared with the giant steam stamps of the Lake Superior Copper mines with their capacity of 300 to 500 tons per stamp per 24 hours our stamps are but toys, and whilst I fully appreciate the difference in the quality of the product in the two cases I cannot help asking our metallurgists and engineers whether, under the conditions at present obtaining on the Rand, steam stamps are not at least worthy of consideration; I merely put this as a question you will observe. True progress is often hampered by conservatism on the one hand and ill advised attempts to advance on the other; it is for us to try and avoid both of these and I think it unfortunate that the continuous slime process has proved unsatisfactory on the New Goch because the failure may deter our engineers and financiers from venturing on any new lines unless absolute safety is assured, and this is often very difficult to guarantee in advance. The idea of all-sliming is in abeyance for the present, but with cheaper power and supplies we may expect a recrudescence of arguments in its favour; the new Usher-Adair process which has, I understand, passed trial runs satisfactorily will, it is to be hoped, cut down the present capital charge for slime tanks somewhat.

Concentration by Frue vanners on the Rand is about to become a thing of the past, the Langlaagte Estate having decided to discard them and fall into line with our general practice. The Wilfley table is still at work on the East Rand Proprietary mines and it remains to be seen whether its undoubted superiority to the vanner will enable it to hold its own. The treatment of residue dumps *in situ* has not been sufficiently successful to induce more than a very few mines to try it.

Relative to our mill construction the next few years will probably see timber battery posts superseded by steel, as the increasing weight of our stamps is likely to turn the scale against fear of trouble arising from crystallisation of the metal.

Concerning the advance of the metallurgy of metals other than gold I would call your attention to the recent presidential address of Prof. Gowland before the Institute of Mining and Metallurgy, London, wherein he deals with the present and future of the metallurgy of copper, and also to a recent paper on technical education by Prof. R. H. Richards, read at Halifax before the Mining Society of Nova Scotia, in which, in the course of showing how closely bound together are technical education and industrial advancement he spoke as follows:—"At about this time (1870) the American scientific schools began turning out their graduates and the Americans who had obtained similar training abroad returned. These men brought in a new leaven, and the resulting increase in the work of a furnace is represented by the following:—

In the year 1870 the charcoal furnaces then in use had a capacity of 10 tons each per 24 hours, a height of 39 ft., and a width of hearth of 2 ft. 6 in.

In 1904 the capacity of these furnaces had been increased to 160 tons, their height raised to 70 ft., and the width of hearth increased to 8 ft. 8 in.

In 1870 the anthracite iron furnaces in use had a capacity of 25 tons and a height of 40 ft., which, in 1904, had been increased to 465 tons per day and 100 ft. in height.

Iron furnaces burning coke had a capacity of 207 tons and were 75 ft. high as late as the year 1897, but in 1904 the latest furnaces had an output of 600 tons per day and stood 100 ft. high.

The same wonderful progress is true of the Bessemer process. When it was first introduced into the United States about 1868, two converters could work five charges of 5 tons each, 25 tons in all, each day. Now, through the improvements brought in by the introduction of scientific methods, two converters can make 900 to 1,000 tons of steel a day.

The story of copper furnaces has been the same. The reverberatory furnace of 1878 had a hearth of 9 ft. x 15 ft. and worked 12 tons in 24 hours. The Argo, Colorado, reverberatory now has a hearth 19 ft. x 112 ft. and works 350 tons.

The lead furnaces of 1870 were 24 in. sq. in section, and smelted 12 tons in 24 hours. Now the cross sections are 48 in. x 164 in., and smelt 160 tons a day.

Such extraordinary development as this came, not without resistance from conservatism, as the direct effect of the application of science and the scientifically trained mind to the subject in question."

Coming back to the Rand and its mining practice, steel collar sets for our shafts are likely to become popular because of their great permanency compared with timber and the innovation at Kleinfontein in the way of steel sets throughout will be watched with interest. Our shafts are increasing in sectional area as we go south to the deeper zones and the irresistible demand for less capital outlay and for maximum profits will, of course, result in their number, relative to a unit area, being reduced to a minimum. The deeper we go the more costly will our development become because, among other things, of the increasing heat and the longer time occupied in getting to and from ends, etc., and for these and other reasons I foresee the laying out of our deeper levels with longer backs in conjunction with mechanical transport of the ore in the stopes. On hand versus machine stoping our experience on these fields has demonstrated, in my opinion, that we should use hand drilling in stopes under 5 ft. wide, and $2\frac{3}{4}$ in. and larger drills in stopes over this size, and my own experience with "baby" drills was such as quite convinced me personally that there was little scope for them on the Rand.

On this field we have been more than once accused of indifference to labour saving devices, but, as a matter of fact, there is little in the shape of labour savers that we have not tried, some have successfully stood the test of practical application and have been adopted, others have failed ignominiously when put to the trial and have therefore been cast aside, and I believe that out of deference to public opinion, and with a whole-hearted desire to economise labour to the full, our engineers and managers are responsible for our having labour saving devices at work at the present day which it would benefit us to relegate to the scrap heap. And after all, as has already been pointed out, these mechanical contrivances touch our labour army very slightly, and we must remember that both white and coloured are affected and that labour savers do not necessarily mean a higher ratio of white to coloured labour, nor yet increased profits.

And now I come to another subject which has rightly assumed great prominence of late, and which I introduce to you without apology, for it is a matter in which this Society and the kindred Societies of Johannesburg should take a deep interest :—I refer to the subject of education. This Society has, in its time, done much educational work; twelve years ago it was educating our cyanide and mill men, later on it took upon itself the education of our mining men. Its duties as an educational factor have largely passed to the Transvaal University College, with which I have the honour of being connected, but even now the Society is still an educational power in its own sphere of work, and it can, I think, be looked upon as a finishing school where all who care to may come and hear discussed the problems of our great industry. The Society is rightly noted for its instructive discussions, and I trust that our workers will come forward in the future, as in the past, and give of their experience and their knowledge for the good of the community.

Germany, the United States of America, and the United Kingdom—the leading commercial countries of the world—have long realised how vital to a country's prosperity is sound and thorough technical education, and money is being lavishly spent by them in this connection; experience has taught them that it is an investment which will bring an ample return, and that a parsimonious policy in connection with a nation's educational establishments will surely and quickly result in a fall in that country's status. The Royal School of Mines, London, appreciating the necessity of teaching their men the practice, as well as the theory of their profession, has decided to spend a large sum of money on an ore dressing and metallurgical laboratory which is to be equipped on the most advanced lines, and a scheme has been evolved by which a number of their students are sent either to Australia, or these fields for practical work. Speaking as a man who has had the good fortune to pass through well nigh every phase of my profession, from the lower rungs to the top of the ladder, I cannot emphasise too much the importance of the rising generation being taught the practical application of theory and principles before they are turned on to the world to do battle for themselves, and more especially does this hold good in the case of the mining profession the circumstances surrounding which are undoubtedly exceptional. So far as the mining course of the Transvaal University College is concerned, there is, in some respects, little to complain of, in fact, we have, in certain directions, advantages which are unrivalled, but we have as yet no provision for the practical teaching of ore dressing, nor yet of the metallurgy of the base metals, but as equipment for this work is an essential feature of every mining school, and as nature has not been niggardly to South Africa in the way of base metals, it is to be hoped that this important mining country will see the wisdom of providing such equipment as will enable South Africa's metalliferous wealth to be worked by the men of South Africa. It is a sign of the times that there are two schemes afoot on the Rand for the practical training of miners, and these schemes are in no small measure due to a member of this Society, Mr. Bradford. By the one scheme adults are taken and taught machine drilling only. The other scheme is designed to give the young men of the country a thorough insight to underground practice with a view to making them expert breakers of ground. It is proposed that both classes shall be encouraged to attend the lectures at the Transvaal University College, which I think you will agree with me is wise, for, as you know, the close proximity of a scorching hot furnace is not the best spot to explain the re-actions going forward therein, nor are our under-ground workings always the most suitable place wherein to expound our mining practice. The idea of devoting a mine exclusively to the training of white miners is naturally of special interest to me, but so many considerations are involved that I would rather be excused discus-sing it this evening. That we are badly in need of trained workers no one denies, that our miners as a body are inefficient is now generally admitted, but let us above all things be careful not to do injustice to the many first-class men among them who are fit to work alongside the best in their profession. The inefficiency is very largely with those who have more or less drifted into mining, men, strangers to the work, but welcomed by our mine foremen in the absence of trained men. Unfortunately, these men have in many cases been satisfied to learn the bare routine work and draw the very satisfactory pay attached thereto. In other cases the absence of facilities for study has undoubtedly contributed to the low standard of efficiency, but the evening lectures now open to all are doing away with this disability, and the fact of such numbers of all grades already availing themselves of the opportunities afforded is decidedly encouraging, and testifies that we have many ambitious men in the ranks who are determined to know their profession thoroughly and rise in it. In connection with this subject of education, a great and far-seeing business man has bequeathed the sum of £200,000 for the founding of a Uni-versity in the Transvaal.—I refer to the late Mr. Feit.

So much for the education of the white man, now for the industrial training of the native. I am a great admirer of the native races of South Africa, and they are undoubtedly one of the country's greatest possessions; the Kafir is not good at thinking, but properly handled he is obedient and willing to a degree, and I do not consider that we have so far availed ourselves of anything like his full capabilities. With a little selection and training, I am, for instance, con-vinced that our Kafirs would be capable of doing everything in connexion with machine drilling except selecting the benches, locating and pointing the holes, and charging and firing, and some of the experienced boys would make a very fair attempt at even these if permitted. But, as I have already said before this Society, we are paying the Kafir an outrageously high wage compared with the fewness of his wants, and this point and his engagement for longer periods should be among the first to receive attention in discussing economic reforms.

Leaving education, let us turn to the health of our miners, a subject of equal importance. Thanks largely to our mine managers and the members of this Society the past 12 months has seen a betterment of underground conditions, though it is true that our managers are inclined to regard a few of our members as extremists who would like to have our underground workings used as a sanatorium and health resort by all those in need of an equable, pure and dustless atmosphere. That the efforts of certain of our members and of the Government Mines Depart-ment to secure for the Transvaal mines some degree of perfection of health conditions should have been misconstrued by some people to mean that existing conditions are bad generally is certainly unfortunate, and therefore as a participant in the recent discussion on this subject, I would again aver my personal conviction that the general health conditions attendant on mining work on the Rand are to-day as good, and in many cases better than those of any other metalliferous mining field in the world. Miners' phthisis still needs our attention, there is a lot of ground to cover before it can be run to earth, but stopped it can be for it is a preventable disease, so let us by all means see that it is prevented so far as is reasonably possible, and let us see that, where necessary, our miners are protected against themselves; but I think that we may safely rely upon Drs. Macaulay and Irvine attending to this. May I say in leaving this subject of health that had the Mines Department suggested a ·2 per cent. CO_2 vitiation limit, as was originally contemplated by Dr. Moir, I am inclned to think there would have been little opposition on the part of the mines; time would familiarise us with such a quality standard and experience would in the end have settled whether the strict standard of ·15 per cent. CO_2 was really advisable.

As a Chemical Society the subject of agriculture has on several occasions received our attention, and I believe that more than one of my predeces-sors has thought fit to say a few words thereon. At the present juncture, when we are hearing so much of assistance to farmers, it is perhaps as well that the agricultural potentialities of this country, the support of South Africa in the distant future, should be again brought to your notice. I speak as a child in these matters and with all deference to authorities, but a child may ask questions and I have a few I would like answered. Those who know sunny South Africa will, I think, agree with our Premier that it is indeed God's own country, but one cannot travel over it and see the hundreds, aye, thousands, of square miles untouched by the plough, unstocked by cattle or sheep, and barren of timber without receiving the impression that man has, so far, been more or less indifferent to the gift and availed himself of it but little. I fully appreciate the many troubles of our farmers here; they are such as call for indomitable pluck and perseverance, but I cannot believe, after viewing the country and after considering our exports and imports, that all has been done that might have been done. Am I wrong in saying that our farmers, as a body, are indifferent to progess, that they are content to live and are averse to the work and strife which is ever associated with advancement; I am much afraid that their past isolation and few wants have in many cases spoiled them, and that we have this, as well as numerous pests, to combat in our attempts to make the country a thriving agricultural land. Let the farmer bestir himself and do his share in helping the country along.

Turning to the imports of South Africa for the first three months of 1907 I find that we spend nearly £2,000,000 on imported articles of food and drink, this sum representing about 28 per cent. of our total imports; surely at this period of South African history this is a great reflection on our farming community. Why do we not grow more mealies? The country is well suited for such. Why do we not have more sheep and cattle farming in conjunction or otherwise with such mealie growing, why is the country not covered to a greater extent with timber for our our consumption and for export years hence when our freights are cheaper? Just imagine a country like the Transvaal with only about 500,000 cattle and 850,000 sheep on it, and worse still, I find that the total amount of land under cultivation in this colony is returned as only 1·26 per cent. of the entire area, and of this only one-half is cultivated by whites.

Mr. D. E. Hutchins, writing in 1903, said that the forests of Germany occupied one quarter of its total surface, and had a capitalised value of £900,000,000 sterling, and of Cape Colony he remarked that in 1902 the imports of timber amounted to approximately £500,000, and that for some years previous to the war the average was £250,000, and he futher mentions the fact that the Cape Government Railway which had been spending about £100,000 yearly for imported sleepers had decided to lay down special sleeper plantations, the estimated cost of which was £60,000 to £70,000, and these were expected to yield, 20 to 25 years hence, a perpetual revenue of £100,000 per annum. It is worth noting that in the year 1905-6 the mines of the Transvaal consumed timber to the value of over £600,000.

Such figures, I think you will admit, well justify the question why do we not see more timber in the Transvaal? It is because of such considerations that I think it is a matter for congratulation that the Government is giving great attention to farming, and it is to be hoped that under its fostering care the land will give a due response.

And now, gentlemen, you may be inclined to put to me that all absorbing question of the moment, how can the present acute depression, a depression which is wrecking the fortunes of so many, be removed and the future welfare of the country best assured? Remedies have been put forward from time to time, and they are again obtaining publicity before the Industrial Commissions at present sitting, and as it is largely reiteration, permit me to put them briefly. Reduce rents and bring down the cost of living; pull down freight charges, for cheap railway charges contribute largely to the development and prosperity of a country; lay out our new mines on an adequate scale and not on the kindergarten lines of the past; have large joint mills of even 1,000 stamps with centralised workshops, power station, and staffs to match; put down the minimum number of shafts; look upon labour saving devices with suspicion, for their promises are often better than their performances; afford our miners the opportunity of learning both the principles and practice of their profession; engage the Kafir on two years' contracts, and pay him a less wage for the work he does; give the miner and the Kafir each his proper sphere of work, the former using his intellectual gifts as a superintendent controlling the physical power of the coloured worker:—I submit that to have white men expending their energy on physical work which the much cheaper coloured labour is quite capable of performing is, on the face of it, absurd from a business point of view. Pay our miners a reasonable wage and let the scheme of pay be such as to encourage the men to develop and exhibit skill. See that underground supervision is made more effective, that small stopes are run by hand labour and large ones by ordinary sized machines; see that the healthiness of our working places receives due attention and insist on the miner using water jets, and plenty of water generally, to keep down dust. Workmen permanently resident in the country are desirable and, as suitable material is available, all that is necessary is its education and training. The married man has always been our best worker, so let us take care that our wage rate will suffice for his living here in comfort with his family and so induce him, if not a son of the country, to at least make it the land of his adoption. On the subject of our unskilled labour supply, the cause of such wordy strife here and such perturbation in Great Britain, I can only say that in view of the scarcity of natives practically ever since these goldfields were opened, the apparent impossibility of securing a sufficiency under the conditions hitherto obtaining, the finding of the many Commissions that have investigated this subject, the inability of the industry to forge-ahead without an adequate compliment, in view of these and other reasons I consider the Chinese an unfortunate necessity, but a necessity all the same, their importation has been an expensive experiment for the mines, and it is sincerely to be hoped that no unreasoning bias against this alien labour will be allowed to cripple the mines and the revenue of the country. Cool reasoning surely counsels that we will do well to retain the Chinese until the expected substitute has materialised, and if it so happens that this great importation experiment results in converting unbelievers to the actuality of our labour scarcity and gives rises to measures which will assure our mines an adequate supply of natives on suitable terms then I think it will be admitted that the silk-clad, luxury-loving, bicycle-riding, heathen Chinese has served a good purpose, and our mining houses will probably look upon the money as not having been spent in vain.

I have here a classification of the mines of the Witwatersrand for September last, based upon their yield per ton milled. Out of the 65 mines then milling, 24 yielded not more than 30s., whilst the remaining 41 gave over 30s. Out of the total 65 mines 21 yielded between 25s. and 30s. and 20 gave between 30s. and 35s. Now these figures call for most earnest consideration. We are, as sensible business men, at the present day working the rich selected areas which offer us a profit, such areas as do not promise a due return for our capital and enterprise we naturally endeavour to avoid, though our efforts in this direction are not always successful. It may be assumed in a general way that most of the ground which offers an adequate profit under present economic conditions is being worked, and as this comprises only a small number of mines it follows that we have an immense tonnage of low grade banket on or near the outcrops as well as our great and almost intact deeper horizons of the reef, and all this reef, owing to the high cost of working, the average low grade, or the large capital which has to be risked, as yet remains largely unproved and unworked. Here I would say that I do not think that we have anything like conclusive proof of the falling away of value in depth so far as this field is concerned; in judging this matter allowance must be made for the fact that selection of stopes has been taking place, and still continues, in our existing properties. Are these low grade areas and deep zones to remain unexploited, is the country content, for instance, that only the present mines should work and working gradually fall out exhausted leaving the country to face serious financial straits only a few years hence? Surely not, and yet if this is not to be the case something of the nature of an economic revolution will have to be engineered to effect a lowering of costs, the augmenting of profits and the restoring of the confidence of the investing public. I have shown you how nearly 40 per cent. of our present mines, our selected rich areas, are not yielding more than 30s. per ton milled, and it is of interest to note that it has been recently estimated that 30s. per ton milled is probably the average value of all the unworked reef on the Rand. It is in essentially low grade rock that this country is rich, and it is the many golden miles of this that the country has to look forward to for sustenance in the years of the future. Our engineers have recently expressed the opinion that the best interests of the gold industry and the country call for a reduction of costs to about 16s. per ton milled. Now let us make every allowance for ulterior motives on their part, for even our mining engineers and financiers are not without them, let us examine their statement as critically as possible, and there will, I think, nevertheless remain a large majority of us who will agree with them that herein lies our present and future salvation, the return of prosperity, the solution of our white labour troubles, and the solid foundation upon which it will be possible to build the future of the country. Only by expansion is it possible, only by economic reform is expansion attainable, then, I say, let us have such reforms. And be it remembered that the working of very low grade ore will confer much greater benefit upon the country than upon the shareholders, the reward of the latter will be small indeed, but so long as profit is forthcoming will our gold beds be worked. Do not let our attention be distracted from the broader issues by such a comparatively small consideration, for instance, as labour ratios, this after all affects but a few of the many people in the land; do not let us, for the sake of the minority, sacrifice the majority by refusing to avail ourselves to the full of the country's rich asset of native labour, but let us earnestly and honestly assist in erecting an economic framework in the country which will stand as a fitting support for all future time. Our farming should be developed with all rapidity, our base metal and other industries should be encouraged, our present population must be provided with the wherewithal to live and settle in the country, and to do all this calls for the reforms mentioned. The country is called upon to select one of two paths—down the one there is a distant vista of a numerous and prosperous people with farming their chief vocation, substantially supported by the mining of gold, coal and base metals; down the other is seen a country undeveloped and forsaken of all but a few farmers, farmers without a market and content merely to live, a country of deserted towns and bankrupt in money and prestige, a country from which its very sons have fled to where progress holds sway. These are no idle visions but they are, I believe, faithful outline pictures of the logical outcome of the adoption of the two policies open to the country; is it possible that we will ever see the latter one? Let us hope not.

Mr. T. Lane Carter: I rise to propose a hearty vote of thanks for the able address we have heard from our new President. In listening to this address I have been reminded of a countryman of mine who started to write a history of the State of New York, and commenced that history from the time of Adam and came down the ages, and in like manner it seems to me our President to-night has commenced at the beginning and surveyed the whole field. He has touched upon many subjects in the field of mining, and there are so many points of controversy introduced into his address that I almost regret the custom in this Society of not debating the President's Inaugural Address, for I am sure many of us present would be only too pleased to get back at our worthy President. I will simply say that I appreciate his review, both of the past, present, and probable future. In regard to the uncertainty of the future and the trying term of office which will be his, I am sure we will all give him our hearty support in the difficult year he has before him. He has placed before us a picture of the future, a possible picture of a country going down to ruin, and alternatively a picture of this country as it might be if it is only given a chance. Let us hope that from all these clouds we will yet emerge, that the country will be given a chance, and that we will prove the great value of our industry for many years to come.

There is one detail he mentioned of which I should like to speak, namely, the treatment of slime in the mines in the Black Hills, U.S.A. He mentioned that slime is being successfully treated, there assaying only $\frac{3}{4}$ dwt. per. ton. I have the misfortune to have slime which is not much better—just about 1 dwt. or a shade over, yet we succeed in making a considerable profit out of this low grade stuff.

Prof Yates speaks as one having authority when he deals with the question of education, and I am sure that every one of us will do his little share in helping him in his work, by recommending our miners to attend the evening classes, and in doing all we can to encourage apprentices on our mines, and wherever it is impracticable for the men to come to the classes to advise the men to enter the correspondence schools, though this instruction, of course, is inferior to the excellent lectures they get at the Transvaal University College. Prof. Yates mentioned agriculture, and said he spoke as a child on this subject. I speak not as a child, but as one who has tried it, and all that I have to say is that I wish everyone who goes in for agriculture in this country every success, but for my part I prefer to stick to mining. I have much pleasure in now proposing a hearty vote of thanks to our President for his able address.

Mr. H. A. White: In rising to second this vote of thanks I wish to draw attention to the admirable attitude adopted by our President in his address. He has not been like Achilles sulking in his tent, but like Ajax defying the lightning. Financiers, engineers and people connected with mining generally have been told recently that the effect of the hasty banishment of the Chinese would be to put them in a fit of the sulks. I think that our worthy President has given us the correct line of conduct to take, namely, that in spite of the ills forced upon us either naturally or from external sources, we will do our best to make this industry a success, and to make this Society a great part of that success.

The President: I am very much obliged to Mr. Carter and Mr. White and to all the members present for the kind way in which they have received my address, and for the promises of assistance during my tenure of office.

NOTES ON WAIHI ORE TREATMENT.

By Ralph Stokes (Member).

There are probably few gold fields in the world, from Kalgoorlie down to Bendigo, with which it may be more advantageous for the Rand metallurgist to exchange notes and experiences than the Waihi, New Zealand, whose ore has provided its exploiters with divers metallurgical problems similar to our own and whose practice has long been at a very high standard of efficiency. The Waihi Company, outside whose boundaries the field possesses little of industrial importance, employs three mills, the Victoria, Waihi and Union, of 200, 90 and 40 stamps, respectively. As at present constituted, the Waihi is the most efficient.

The object of these brief notes is not to comprehensively describe the scheme of ore reduction and treatment, but merely to draw attention to three special features likely to interest the members of this Society, namely, the honeycomb tube mill liners, the independent placing of the amalgamating house, and the vacuum slimes plant.

Primarily the characteristics of the ore and its particular requirements must be considered. The pyritic ore drawn from the lower levels of the Waihi to-day constitutes a quartz of an average hardness rarely met with in South Africa; it partakes of a chalcedonic nature which makes the necessary fine grinding a difficult operation. Before the introduction of tube mills, 1,000 lb. stamps and 40 mesh woven wire screens gave a stamp duty of 2·9 tons, and to-day, at the Waihi mill (with 20 mesh screens and 960 lb. stamps), the duty is only $3\frac{1}{4}$ tons. The increase of the mesh was naturally accompanied by the installation of regrinders. Tube mills, grinding pans and ball mills have been tried, and the first-named, on the strength of data that appeared absolutely conclusive to the management, were put into regular operation in May, 1905. At Kalgoorlie the balance of favour is with grinding pans of the improved Wheeler pattern for the fine grinding of roasted ore after Krupp ball or Griffin mills reduction and with tube mills for concentrates in connection with the Diehl bromo-cyaniding process. Thus the functions of tube mills at these two centres are dissimilar and the marked diversity of opinion is natural. At Kalgoorlie, the product is ground and reground by the flint mills until all in such a fine state of division as to be readily amenable to treatment by agitation with bromo-cyanide. At Waihi, the underflow from the spitzkasten below the stamps is passed once through the tube mills (a return is likely to be soon effected) for the production of a mixed sand and slime to be subsequently subjected to amalgamation and concentration. The relative hardness of Kalgoorlie (excluding three mines) and Waihi ores may be likened to that of semi-oxidised and pyritic ore on the Rand.

*Honeycomb Liners.**—At the Waihi mill, there are four tube mills in operation, and at the Victoria mill, five miles from the mine, nine will shortly be in use, apart from those utilised upon vanner concentrates. These mills are of the Davidsen type, 22 ft. long, and are for the most part of local manufacture. Charged with $5\frac{1}{2}$ tons of flints and revolved at $27\frac{1}{2}$ r.p.m., power consumption is given at 50 h.p. But the most striking feature about these mills is the honeycomb liner (Barry's patent) which strikes one immediately as the best solution of the difficulties long associated with this portion of the machines. These liners have, I believe, been introduced upon the Rand and have possibly been discussed before this Society. In forwarding these notes upon local experiences, it is therefore necessary to risk the shock of an unofficial reply anent the decease of a certain long lamented Queen of England.

For some considerable time the Waihi employed the silex blocks, but the management, bearing in mind their well-known defects and the existence of other equally durable stone, which, however, could not be fashioned into rectangular blocks, devised an admirable scheme whereby more irregular rock fragments could be economically utilised. This involved the construction of cast iron frames, $18\frac{1}{2}$ in. by $15\frac{1}{2}$ in. wide and $3\frac{1}{2}$ in. deep, divided each way so as to comprise four compartments. The sides and dividers of the frame are about $\frac{1}{2}$ in. thick on the inside, and $\frac{1}{4}$ in. at the back; so that the stones to be bedded therein are securely held. For the filling of these "honeycomb" frames a local white cherty quartz has been used with excellent results. As yet the life of these liners is uncertain, but based on six months' experience it may be calculated at nine months. As an alternative scheme, the imported flint pebbles are now being tried, but whether the greater durability more than compensates for the extra initial cost is a question yet to be determined.

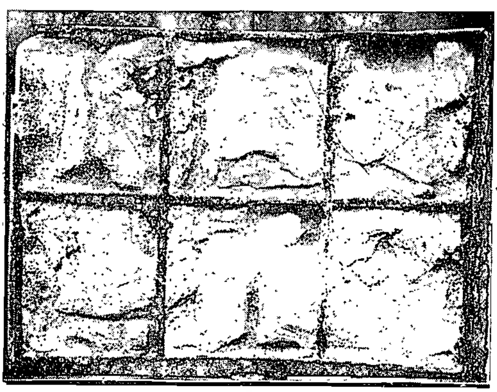
The setting of the lumps or flints into the liners is a matter of as much importance as the subsequent operation of building the liners into the mill. It is essential to lasting efficiency that the stones be most carefully packed at the back of the liner, which is merely an iron plate temporarily bolted to the frame until the mortar has hardened. The condition on top, where the stones may be allowed to stand well above the frame, is of less moment than the arrangement of the rocks, in their bed of cement, so that they have the greatest possible stability. The mortar is made of Portland cement mixed with an equal proportion of ground flint fragments obtained from the tube mill. After filling, it is necessary to stack the liners until thoroughly hardened. The cement is kept wet with sacks, given an occasional hosing, and allowed to stand for a month or more. The liners, which are cast at the mine foundry, are, of course, shaped to the interior of the mill. In connection with the fitting in and repairing of the liners, whose great additional merit is that a loosening of a stone must be confined to a single compartment of 7 by 9 in., Mr. Barry, the inventor, and works superintendent of the Waihi Company, has favoured me with the following information:—

"In case any difficulty should arise in fitting the barrel segments against the rough faces of the end liners, it is more convenient to have a cast iron ring in segments cemented into the corner of

* See abstract "Grinding in Tube Mills" this *Journal*, p. 24. See also this *Journal*, vol. vii., p. 127 (Oct., 1906), p. 272 (Feb. 1907) and p. 348 (April, 1907).

the mill before starting to put in other liners. If the standard circumferential liners are a fairly neat fit, the last one in each complete ring will be slid into place, but the last one in the last ring must be made a little narrower, so that it can go straight into position, when it is keyed in with any pieces of scrap iron, wooden wedges or flat stones driven into the mortar."

HONEYCOMB LINER, EMPTY AND FULL FRAMES.



HONEYCOMB LINER AFTER SEVERAL MONTHS USE

Building Liners into Tube Mill.—The interior being clean, lay a straight row of liners, starting from one of the doors, bedding them well down in neat cement. This is a point to be carefully attended to, as some tube mill barrels are very much out of truth and a segment might bear on its edges only and have no support under the stone in the divisions. Five such rows can be laid without moving the mill. The fifth row is then to be supported by a length of wood about 3 in. by 2 in. laid along its centre. This wood is then tightly held with six stretcher bars from the opposite row of liners. The stretcher bars are simply lengths of 1 in. gas pipe with a $\frac{7}{8}$ in. bolt in one end, screwed up to a head, and an ordinary nut. The last row being thus firmly held in position so that it cannot drop down, the mill is turned round so that the last row is on top, the sixth row is then put in, the mill again shifted $\frac{1}{8}$ turn, and so on to the last or eighth row. An opening left at the closing, up can be jammed tight with bits of scrap iron, old flat pieces of stone from worn out linings, or wooden wedges driven into the mortar.

Repairs.—In case the stone filling should fall out of a division it can be repaired in five minutes by putting in a spare division frame, previously filled with stone, and keying it into position with soft wood wedges."

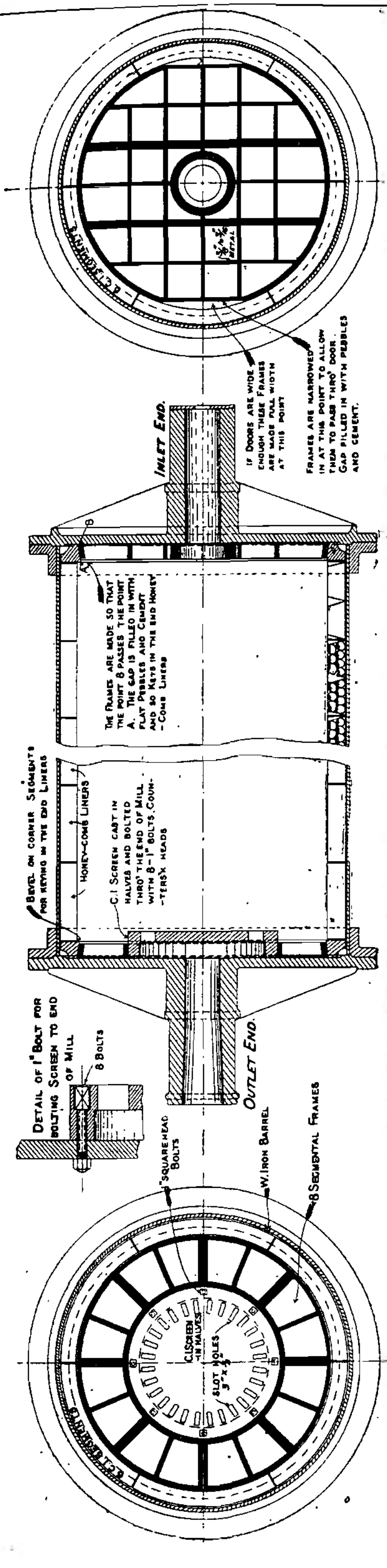
The diagram, which will be seen on the next page, further enables those interested to observe the methods employed at Waihi for the application of the liners.

Tube Mill Efficiency. — Returning to the question of tube milling generally, it must be admitted that the work done by a single transmission of sand is particularly good on such a hard material. The following is a fair parallel of sizings before and after tube milling, given to me by the chief metallurgist, Mr. Banks, a member of this Society.

	Before Tube Milling. Per cent.	After Tube Milling. Per cent.
+ 30	5·32	0·03
− 30 + 40	9·77	0·12
− 40 + 60	15·94	1·13
− 60 + 100	13·96	7·43
− 100 + 150	12·29	18·42
− 150	42·72	72·87

The cost of running is given at 1s. 2d. per ton of sand, of which flints and liners account for 7d. Each mill passes nearly 80 tons per day.

From the tube mills the general pulp flows to a large V box, from which, by means of syphon pipes, it is delivered to the amalgamating plates in a house quite apart from the stampers. There is one syphon pipe to each plate, so that the product is perfectly distributed. The advantages of this system, not to my knowledge practised anywhere else in Australasia, are several. In the first place, the full table efficiency is constantly obtained, with equal distribution, even when stamps are held up. While any plates are being cleaned, the flow from the distributing V box is returned by launder and elevator to the general inflow. The cleanly tidiness of the house—the like of which can rarely be seen outside catalogue engravings—and the prevailing quietude are also factors of importance, being conducive to careful



PLAN SHOWING PATENT HONEYCOMB LINERS FOR ENDS OF TUBE MILLS.

work and to a thorough understanding of queries and orders, perhaps too trivial for expression in a shout, between boss and men. Then, again, the dangers of theft are enormously reduced. Below the Waikino or Victoria 200 head mill, the amalgamating house is only entered by six men, two men per shift, excepting head amalgamator and staff officials, in the ordinary course of work.

Vacuum Filtering of Slimes.—At the Waihi mill (at the Victoria, tube mill and vacuum filter practice is not yet regularly established) the treatment of the pulp below the plates is as follows:—

Passing through a series of inverted pyramidal boxes, it is classified into coarse and fine sand and slime. The first two products pass over 30 union vanners, of the Frue type, yielding concentrates and tails; the former constituting up to 3 per cent. of the pulp, and being worth £35 to £40 per ton, the latter joining the above-mentioned slimes on their way to the main spitzkasten commanding the cyanide works. The sands are given a six-day treatment in 40 or 80 ton vats whilst the slimes pass through settling tanks, by which the water is reduced to 2 to 1, to the vacuum filter plant.

Firstly, the slime is treated in vacuum thickeners (of the same type as the filters below described) and reduced to 30 per cent. moisture, then disintegrated with a jet of cyanide solution and passed into the treatment tanks, in which it is mechanically and pneumatically agitated for 2½ days. The long cyanide treatment is necessitated by the high silver values in the ore. Waihi bullion, almost as white as tin, is only worth 12s. to 13s. per ounce, the gold being by weight about an eighth of the alloy.

After treatment the slime is run into a large rectangular tank, into which the filtering apparatus or "basket" is lowered hydraulically —though an electric elevator has been installed by the Grand Junction Company with promise of smoother operation. The vacuum filter is similar in its salient features to the Moore type, as used in the States, but differs in minor points with such results as to remove those defects observed, I understand, by a prominent member of the Society's council during an American trip some time ago. The "basket" consists of nine or eleven frames of closely corrugated iron, over which the cloth is tightly stretched. The inside vacuum pipes are applied round the frame and for an inch or two down the trough of each corrugation. Each frame is 16 ft. by 4½ ft., and the width of the "basket," across the frames, 10 ft. In the Moore machine, wooden ribbed frames are used. The vacuum, applied at 22 in., holds the slime to the cloth in a remarkably adhesive state, so that when raised the basket draws about $4\frac{1}{2}$—5 tons of slime with 25 per cent. moisture in cakes on each side of the frame cloth of $1\frac{1}{4}$—$1\frac{1}{2}$ in. thick. The filtering is effected in about 45 minutes, after which the laden basket is lowered into another tank of weak solution for washing for another 45 minutes, after which the waste slime residues are allowed to drop from the frame, by cutting off the vacuum, into a hopper, whence it is sluiced away to the river. The simplicity and probable durability of these machines appear to make them greatly superior to the rotary type of vacuum filters which the writer saw at work in Kalgoorlie six months ago, where the demand for such a machine is even more weighty than at Waihi, for wages in Western Australia are 50 per cent. higher.

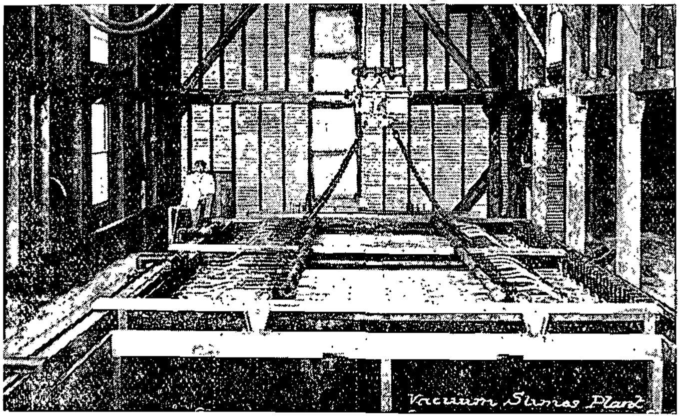
By comparing costs and efficiencies of the presses and vacuum filters, the Waihi has already had sufficient experience of the new installation to learn that there are even no grounds for controversy on the matter. The presses will soon be completely ousted. At the Waihi mill, where the filters have been used for several months, 220 tons of slime are put through per day by means of two baskets. The installation cost about £4,000. Labour requirements are three men, one per shift, and the part services of a fitter.

Running costs are :—

	Per day.
Three men at 8s.	24s.
Cloths at $\frac{1}{2}$d. per ton treated	9s. 2d.
Part services of fitter ...	3s.
Two vacuum pumps (17 h.p.)	30s.
Power for pneumatic agitation	10s.
	£3 16s. 2d.

Or, say, $4\frac{1}{2}$d. per ton treated. At the Waihi, this means a saving of 1s. 3d. per ton of slime as compared with the Johnson presses.

So conclusively successful has the coincident introduction of tube mills and vacuum filters proved upon the property—and it is necessary to bear in mind that the product of the tube mill as at present dealt with includes a quantity of fine sand which passes the spitz and finds its way to the slimes plant—so favourable have been the results of lengthy experimenting and practical work, that the controlling heads are already beginning to speak in an undertone of the practicable extension to a far greater scope of fine grinding and filtering; in fact, to use the magic term, "all sliming." The question is beyond the limits of this patchy contribution; but it is one which cannot well be judged by Rand standards.



TWO BASKETS, WITH NINE FRAMES EACH, SUBMERGED.
THE NEAREST VAT (EMPTY) IS USED FOR WASHING SLIME WITH WEAK CYANIDE SOLUTION.

In conclusion, it may be noted that the rich concentrates won at each mill, by vanners at the Waihi mill from fine and coarse sand, and by Wilfley tables at the Victoria from only the heavier sand, are all collected and treated at a plant in connection with the latter works. After being carefully weighed and sampled the concentrates are passed into tube mills, whose product is elevated and classified by a spitzkasten, returning the coarse to the tubes, whilst the fine is thickened and treated by cyanide solution made up to ·03 strength for about seven days in air agitation tanks 14 ft. deep and $5\frac{1}{2}$ ft. in diameter. An extraction of 95 per cent. gold and silver is obtained.

As for the total extraction, official records, which are kept with the most careful scrutiny, show an improving average of 90 per cent. gold and 75 per cent. silver. The residues, which run away to the river, have already proved the snare and ruin of one adventurous syndicate.

The President: We have been listening to a paper which has come to us from the South Pacific, from one of the earth's beauty spots, Fiji; it might almost be said that it was written under the shade of the palms. Mr. Stokes, the author, is travelling round the world, visiting the various mining centres, and, I think, it is very kind of him to remember the Society when he is so far away from us. The Waihi Mine, New Zealand, is one of the best of the world's gold mines, and one of the largest. Its monthly output is about £64,000 sterling from a tonnage of about 27,000, so that it is also a high grade proposition. I move that a special vote of thanks be sent to Mr. Stokes for his paper.

This was agreed to.

LAST DRAININGS.

(*Read at February Meeting, 1907.*)

By H. A. White (Member).

REPLY TO DISCUSSION.

Mr. H. A. White: I have to thank those gentlemen who have contributed to the discussion on this paper and to congratulate this Society on two able recruits to the ranks of active participators in our proceedings. It is pleasing to find that the general principles set forth have been fully endorsed and found to be useful in practice. I believe that occasional papers of this kind, which endeavour to deal with the principles underlying the best modern cyanide treatment, will always be acceptable and make up in usefulness what they must lack in novelty. I fully agree with Mr. Dowling, Mr. Pyles and Mr. Lea that draining dry after each saturation will give the best results where sufficient time is available. This method uses each ton of solution to the best advantage but, of course, if the plant provided is not large enough experiments must be made to determine the best treatment possible. On this point I have found the difference between the two methods to be less than would be anticipated on a casual consideration of the case. I find in strictly comparative experiments on a working scale that 176 tons of solution applied during leaching dry eight times is almost exactly equal in effect, as far as concerns last drainings, to 184 tons applied during five leachings dry. On a circumscribed plant it is possible that the one method might be used in winter when sumps are usually a shade higher than in summer and the relief of slightly less tonnage would be felt.

I would point out to Mr. Dowling that though slimes solutions are precipitated most satisfactorily it must not be overlooked that the zinc in these boxes is mostly newly prepared and is at a great advantage when compared with that in weak and medium boxes. I think in the warm weather a shade less than 0·1 per cent. KCy might be profitable, but my experience shows no advantage in reducing this strength in winter. It is not the solution but the precipitation of the gold which is in this case the deciding factor.

I do not quarrel with Mr. Lea's figure of 2d. per ton or ·04 dwt. as a cost of increasing solution pumped and precipitated. My object in taking 6d. as a working hypothesis was to show profits to be derived even on small or poorly equipped plants by a careful examination of results obtained by varying methods.

I notice in the daily papers that one small group of mines in an outlying district found trouble over trying to economise cyanide and reports more gold left behind in the boxes after clean up than usual. This might have been avoided by classing the solutions in accordance with gold values and ignoring cyanide strength. The method Mr. Dowling illustrated in his contribution is similar to that I recommend, save the simplification of opening at once to strong boxes, which I find reduces white precipitate and improves results generally as the following figures for three months show:—

Strong (rich)	·57 per cent. KCy,	value 4·57 dwt.
Medium	·41 per cent. KCy,	value 0·82 dwt.
Weak (poor)	·33 per cent. KCy,	value 0·42 dwt.

Mr. Fraser Alexander feeds fat his ancient grudge against the mining department in the matter of bunches of acid ore, and all will agree with him that this point deserves, and will eventually obtain, especial treatment. Not only the sands plant but the slimes plant also show the bad effect of dumping, without warning or any precaution, a few tons now and again of acid or otherwise contaminated material into the stream of ore from which the reduction works has to charm away the valuable metals.

I hope Mr. McNaughtan will not deem it impertinent to suggest that our monthly meetings, even in these depressed times, are worth coming in for. If his promises are fulfilled I will guarantee that eight or nine leachings dry will soon cease to mystify.

I have to express regret that no one has supported my suggestion to register cyanide strength and alkalinity in terms of the effective ions. Possibly we are somewhat shy of dealing with these newer developments of chemical theory in spite of their able exposition by Prof. Oettingen before this Society eight years ago.*

It is to be remarked, in passing, that to speak of loss of cyanide in the boxes is only a *façon de parler*, as total cyanogen is practically the same at the head and the foot, and that it is in the tanks and treatment vats where the real loss takes place. As our records are in terms of available cyanide, this custom has, of course, some little justification beyond that of mere convenience.

Mr. Pyles's contribution to the method of dealing with lumps of slime is very welcome, and, though he does not report complete success, he has given us some useful particulars of his results. He agrees with Mr. Lea that a tube mill product shows no necessity for including any "standing dry" in the treatment. All the figures brought forward go to show that the bulk of the gold is dissolved very quickly, but as Mr. Dowling points out, a small amount goes into solution almost, if not quite, to the end of the treatment. This explains the possibility of Mr. Lea's result showing ·11 dwt. increase in value of drainings after transfer to second treatment. Mr. Lea can be congratulated on the adequacy of his plant which reflects credit on this Society, since one of our past presidents designed it. His very low results do him great credit; and it is in no envious spirit that I point out a possible drawback. I refer to the results shown after transfer to second treatment vats. 290 tons of solution are obtained of an average value ·09 dwt. Not all of this gold is derived from the sand, a "trace" in the sumps may be more than ·01 dwt. Again a part of this gold must go to increase value of slimes residues if some of the solution is used for second transfer there.

Assume, however, that 25 dwt. of gold are actually recovered from the sand and put against that the cost of extra handling, maintenance, interest, and amortisation on the second treatment tanks and cost of elevating to the additional height, and you will find that 360 tons of sand and 290 tons of solution will scarcely repay the cost of bringing them together. If, however, his figures show a margin of profit on this apparently discouraging proposition, however small, I entirely agree that the policy adopted is sound commercial economy. I am pleased to notice Mr. Lea's reference to the direct application of strong solution by Mr. Dowling as early as 1904, as it is by no means surprising to us, who know him, to find him well abreast of the times, and indeed it is my duty and pleasure to thank him and others of our members for useful information, the ungrudging imparting of which is part of the great reputation of our Society.

* See Proceedings, vol. ii., pp. 543 and 556.

MINE SUBSIDENCE.

(Read at March Meeting, 1907.)

By Alex. Richardson, A.I.M.M. (Member).

DISCUSSION.

Mr. H. Weldon: Mr. Richardson has dealt with a subject of peculiar interest, and it is satisfactory to know that his investigations have demonstrated the value of the recognised formula in regard to subsidences due to the collapse of mine excavations.

In regard to the support of roof in underground workings, there can be no doubt that as Mr. Richardson points out—"careful and efficient stowing" is the most reliable method. In our mines, in the case of steeply-inclined underhand stopes, there can be no question that stulls loaded with waste rock form a very safe, cheap and adequate support, whilst in overhand stopes, nothing could be better than to allow portion of the broken reef to remain in and partially fill the stope. Sorting in the mine has been suggested and tried from time to time, but the practice has not so far been taken up. I would suggest, however, that the difficulty experienced in some mines of obtaining sufficient waste rock to pack the stulls with, could be overcome by shooting down portion of the footwall by means of a series of short holes.

I note that Mr. Richardson estimates the ultimate strength of mine pillars in regard to their power to resist crushing, as 10,000 lb. per sq. in., and that these conclusions are based upon results of tests carried out on 4 in. cubes of local quartzite. Such a constant, however, only holds true when the height and sides of the pillar are of equal dimensions, but this is not usually the case in mine pillars, the length and breadth of which generally bear a proportion to their height of 2 or 3 to 1. Now we know that the power of a pillar (according to the formula laid down by Euler and Eytelwein) to resist crushing increases according to the square of its area, so that an ordinary mine pillar, the sides of which measure 10 ft., in a stope of 5 ft. in width, would have a strength of not less than 16 times that of a pillar of the same height with sides measuring 5 ft. In view of the rapid increase in weight-bearing capacity of a pillar for any given increase in its superficial area, the somewhat alarming conclusions arrived at in the percentage table given in Mr. Richardson's paper must be regarded as unwarranted and not borne out by practical experience.

In regard to the next table setting forth the bending and shearing factors, the conclusions arrived at are certainly not in accordance with mining experience in these mines, which is to the effect that shearing or punching of the roof is an extremely rare occurrence. This discrepancy between the theoretical and actual results may be due to the fact that the hanging wall is never of a homogeneous nature, lines of weakness being always present, and therefore vitiating any theoretical calculations.

The size of shaft pillars, the distance between stope pillars, and the diameters of the same are factors of the greatest importance, and it would be of great interest to learn the details on which these calculations are based.

I think that on these fields where we have such large underground areas on which we have buildings to protect, that this paper of Mr. Richardson's is particularly interesting. I am sure there are many more points which I have passed over, but these in particular struck me when I read the paper.

The President: I am sure we have to thank Mr. Weldon for coming forward and giving us his views. He has certainly raised more than one interesting point, and we wish he would attend our meetings more frequently. I would like to take this opportunity to say how indebted we are to him for the excellent report issued by the Mines Department. In this matter of mine subsidence, for instance, I can assure you that you will find the diagrams, etc., in this report most instructive, and I think it is only just to the Mines Department that this should be known.

Mr. E. Homersham: I cannot agree with Mr. Weldon that it would be a safe proceeding on the Witwatersrand generally to break into the footwall to get mullock for loading up stulls, as it would make the stope dangerous on account of the liability of slabs of footwall coming away from the slipping faces that usually exist in foot and hanging walls all through our mines, certainly at Randfontein it would be an impossible procedure.

In answer to the Chairman, Mr. Homersham said the reefs at Randfontein had a steep dip.

Mr. M. H. Coombe: We do not, on the Rand, adopt the practice which is followed in most countries to ensure safe mining. For instance we do but little "resuing." In stopes of more than 50 deg. dip this mode of stoping would be more economical in that we would get cleaner reef for the mill, and falls of ground from foot and hanging would be reduced to a minimum. Mr. Richardson's paper is an admirable one but whilst listening to the discussion here to-night I have been wondering, if it is possible for a number of gentlemen to gather together, and from formulæ of the crushing strength of various rocks, and the angles of cleavages, etc., lay down the law for the leaving of pillars, both in regard to position and size, for the support of the walls of a mine. With all respect to their learning and theory I say they cannot do it; this sort of thing comes under the ægis of the practical man, be he workman, shift boss, or mine foreman. And here I submit a grievance that undoubtedly exists amongst our older and most experienced miners. In a good many cases when a vacancy occurs on the underground staff instead of one of the best workmen being promoted, a young beardless lad from a School of Mines is put into the position and given authority over men with 20, 30 and 40 years experience of mining in all parts of the world. Educate young men you must in the higher branches of the profession, but when they have finished their education and graduated don't give them charge of miners and thus create inefficiency and danger underground, but first give them three or four years of practical mining work and thus turn out men who may become, if it lies in them, as near a perfect mine manager as can be created. There are plenty of men to draw from on our mines, with large experience, and if there were more of this type in charge of underground work here less would be heard of falls of ground and consequent loss of assets, or of life and limb.

Mr. S. H. Boright (contributed): I send a section of the strata taken at a point 400 ft. from the subsidence at the Great Eastern Collieries. This section evidently does not hold good at the point of subsidence as will be seen later.

SECTION OF STRATA PASSED THROUGH IN SINKING "OLD MAIN SHAFT," GREAT EASTERN COLLIERIES.

Formation.	Thickness in feet.	Depth from surface to bottom of formation in feet.
Surface soil and clay	23	23
Soft sandstone	64	87
Shale	8	95
Sandstone	56	151
Inferior coal and shale	65	216
Top coal	11	227
Good coal	19	245
Inferior coal	7	252
Chert	—	—

Our bords were worked from 15 to 20 ft. wide, leaving pillars 30 ft. sq. During the 10 years that these workings have been standing the pillars had reduced themselves by flaking to about 25 ft. sq., thus enlarging the bords by a like width, but the pillars were all in good condition, solid throughout, without any cracks or slips. The workings at this part of the colliery were from 15 ft. to 25 ft. high and at the exact point of subsidence they were about 20 ft., I think—possibly 25 ft. About 60 ft. from the subsidence, and on all sides of it, there were either pillars 60 ft. x 60 ft. or else solid ground. On the East side of the subsidence is a large dyke about 60 to 80 ft. from the edge of the subsidence. The coal had been mined up to the dyke but was solid beyond the latter. 60 ft. South is our boundary pillar and the same distance West are two rows of pillars 60 ft. x 60 ft. and the same on the North.

There had been, for some months before this subsidence occurred, a great many minor falls of roof both at this pit and at our other pit four miles away, and I think it will be found that falls were more prevalent throughout the Rand before the month of May than they have been since. There was no warning at this particular point before the fall but we had heard falls on the adjoining property beyond the boundary pillar, at a point some distance West of where the subsidence took place. The latter is roughly circular and 250 ft. in diameter; the depth is about 40 ft., and the sides nearly vertical. The underground dimensions are about 50 ft. larger than on the surface. The ground exposed by the fall is all surface soil and clay. Underground the fallen material consists of coal, shale, decomposed sandstone, and surface material. It seems that at this particular point there was very little sandstone and that the influence of the dyke had decomposed what there was. The pillars seem to have stood under the fall, and the roof of the bords given way under the direct pressure of the loose strata. I am firmly convinced that there would have been no fall if the sandstone above had been of the same quality as that shown in the section a short distance away.

NOTES ON SOME RECENT IMPROVEMENTS IN TUBE MILL PRACTICE.

(*Read at April Meeting, 1907.*)

By Kenneth L. Graham, M.I.M.M. (Member).

DISCUSSION.

Mr. Jas. Lea: Although banket has been used in tube mills for so long, as a substitute for pebbles, the comparative test of pebbles versus mine ore, made by Mr. Graham, and published in his paper, is the first definite information we have had on the subject. Since it appears to be now generally accepted amongst tube mill men, that banket is quite as efficient as pebbles as a grinding agent, I should like to draw the attention of members to the size of the banket fed in tube mills. There appears to be a disposition on the part of some, to emulate the stamp battery as a crushing machine, which I venture to say, is developing in the wrong direction. The smaller the pieces of ore fed into the mill, the sooner they become inefficient as pebbles, and the greater the total amount required to be fed. As banket is consumed at such an enormous rate compared to pebbles, and, as by the time the corners are worn off banket, to make it a decent shaped pebble, it is probably reduced from $4\frac{1}{2}$ in. to 3 in., it seems to me that we should start off with as large a piece of ore as possible, consistent with the object in view; that is, to have an efficient pebble by the time it has been knocked into shape.

I have not the convenience of an automatic feed, such as described by Mr. Graham, which must so greatly assist where the consumption is so high, but I find, being restricted to hand feeding, the latter has one very great advantage over an automatic feed with the present diameter of feed ends of mills, namely, that a larger pebble can be fed with less danger of choking. I have no difficulty in maintaining the pebble load by hand.

No. 1 Fraser & Chalmers mill, 22 ft. x 5 ft., has a $4\frac{1}{2}$ in. feed aperture, and by feeding in ore of slightly less size and keeping the load of pebbles up to throttling point—that is, well over half full—I find by actual weighing 3 tons of ore per day as much as the mill will consume. This is when using a $1\frac{3}{8}$ in. nozzle on the dewaterer, and the pulp containing an average of 37 per cent. moisture.

With a feed carrying 37 per cent. moisture I find that, if the pebble load exceeds half full by much more than about 6 in. back flow takes place.

On the old feed end of a No. 2 Allis-Chalmers mill, 22 ft. x 5 ft., wearing through, a new one was obtained of a slightly different design. The old hopper was retained, but the back of the feed end, instead of being solid was left open, and a bend cast on. By this means independent pulp and pebble feed apertures were obtained, and the pebble feed aperture was enlarged to 6 in. thereby taking a pebble as large as the feed end liner would allow. I find this entails less labour to maintain the load, and the consumption in this mill is considerably less than 3 tons per day.

The use of mine ore for grinding seems to me to demand a slight modification in the design of the feed end, and I would suggest that the diameter be increased, so as to take a 7 in. or

8 in. piece of ore. By this means we should obtain a correspondingly increased life to the pebble, and I believe the results would be equally satisfactory, and the much laboured mine ore consumption would be immensely reduced.

While on the subject of pebbles, I think the discharge screen requires a little more attention paid to it, than has been the case so far. Present practice seems to be to wear the pebble as near to pulp as possible. There must obviously be a limit to the size of an efficient pebble if we are to keep the tube mills for regrinding battery product. It is customary, I believe, to use a discharge screen having apertures of about $\frac{1}{4}$ in., but, if a pebble is retained in the mill until it is the size of a pea, it is certainly not going to crush anything by impact, and I should imagine it will have lost its virtue as a grinder, and, therefore, should not be in the mill, where it is occupying the space that should be taken up by an efficient pebble. I believe the Australian practice is to periodically sort out the small pebbles; this, however, can be regulated by the discharge screen apertures being larger.

The size of nozzle for the dewaterer is governed by a multitude of conditions, or lack of them, not the least being the number of mills installed per 100 stamps, and the degree of fineness to which it is desirable to grind. With a sufficient number of mills it may probably be advisable to use a smaller nozzle than on a plant where there are not enough. But as we are equipped insufficiently on these fields the greater the quantity of pulp, properly classified, passed through a mill, the greater the quantity that will be reground, and the smaller the percentage + ·01 grade entering the cyanide works. I find $1\frac{1}{2}$ in. the most efficient size nozzle to use from a regrinding point of view, giving 390 tons of dry sand per day entering at an average moisture of 37 per cent. I would point out that the nozzle used in our dewaterer is fixed in the bottom of the spitzkasten itself, and is 2 in. long, this being the total distance over which there is any pipe friction. These nozzles do not wear at the top for some days, but gradually wear from the bottom upwards, eventually leaving just a ring at the top of the original diameter, but the difference in the friction of a parallel nozzle 2 in. long and one that has worn slightly from the bottom up makes a very considerable difference in the tonnage passed. I mention this by way of emphasising the pipe friction spoken of by Mr. Alexander.

The number of shaking tables should bear some relation to the quantity of pulp passing through the tube. Four tables seem to be the regulation number per tube irrespective of tonnage, but, I think, where large quantities are passed through the mill six tables would be safer and would allow for overloading when scraping, dressing, repairing, etc.

The quick setting cement mentioned by Mr. Graham should go a long way towards reducing the time tube mills are hung up for relining; but, it is for the individual tube mill or cyanide manager to ascertain, whether it is more economical to use this very expensive cement or hang up the mill for an extra day. For instance, this quick setting cement costs, I believe, £65 per mill, as against £10 for ordinary cement, a difference of £55. Now, take a battery producing 800 tons of sand a day, this £55 would allow for an increase in the residue value of ·344 dwt. per ton, more, of course, with a smaller tonnage, and I think this is a larger increase than most cyanide managers find to be the case with one tube mill hung up, thereby not justifying the expense. I am not in any way arguing against reducing the time for relining, as I think there is room for a considerable improvement, but it should be done with a view to the greatest profit, not the shortest time irrespective of cost.

Of the last two mills relined on the Robinson Deep, No. 1 was stopped and handed over to the engineer at 6 a.m., it was then discharged, relined with local chert and ordinary cement, reloaded and under steam at 7 a.m. the next morning, and after 24 hours under steam was started up at 7 a.m. the second day, the total stoppage being 49 hours. No. 2 mill was stopped at 6 a.m., relined with silex and ordinary cement, reloaded and under steam at 8 a.m. the next morning, and after 24 hours under steam was started at 8 a.m. the second day, the total stoppage being 50 hours. On inspection, both mills are wearing well and do not show signs of weakness. I am of the opinion that the time for relining can still be considerably reduced, yet, if the quick setting cement used by Mr. Graham had been used in these mills, both would have been running inside 29 hours, if, as I believe, Mr. Graham allows three hours to set.

With reference to the increase of temperature of pulp passing through the mills, the highest I have been able to record is 5 deg. C.

The President: I think it would be as well to keep this discussion open until the next meeting. It is very interesting, and I can well understand that there are many more members who would like to come forward to discuss it.

This was agreed to.

A FEW NOTES ON THE REFINING OF BASE BULLION.

(Read at May Meeting, 1907.)

By C. W. Lee and W. O. Brunton (Members).

DISCUSSION.

Dr. T. K. Rose: The paper is interesting as another illustration of the care taken in South Africa not to let slip anything which may be of value in the mining industry. The method of procedure adopted by Messrs. Lee and Brunton, seems ingenious and satisfactory. I should be glad to know whether the clay tubes were found to wear away rapidly. With Morgan's thick-walled tubes, 1 in. in diameter, with $\frac{1}{8}$ in. bore, we have found the wear to be insignificant in toughening brittle standard gold at the Royal Mint, but the work lasts only a few minutes in this case, as the impurity to be removed, usually lead, is always less than 1 part per 1,000. The cost is hardly more than that of ordinary melting. In these cases we pour the slag with the metal and scrape off the still liquid or viscous slag as soon as the metal has solidified. I have not tried skimming off the slag in the pot, but chipping off the solid boro-silicates is certainly a very tedious operation.

The meeting then closed.

Errata.

Table of Melting Points.

(See this *Journal*, March, 1907, p. 297.)

Since the above table has been published several errata have been pointed out, namely :—

The temperatures for O and F are below zero, and, therefore, should have the sign minus in front.

The melting point of Mg is 633 deg., not 800 (Heycock and Neville, 1895).

The latest investigation of Holborn and Valentiner (*Annalen der Physik*, vol. 22, 1907, pp. 1—48) gives the melting point of Pt 1,790 deg. C. and Pd 1,575 deg. C.

The melting point of Ni is 1,484 deg. C. and Sn, 241 deg. C. (earlier observers placing this at 232 deg. C.).

The melting point of Ca is 800 deg. C., not 322.

In column viii. the metals should read Ru, Rh, Pd, and not as printed.—(*Electrochemical and Metallurgical Industry*, March and May, 1907.) (J. A. W.)

Notices and Abstracts of Articles and Papers.

CHEMISTRY.

Determination of Manganese in Tungsten Steels.—"Tungsten interferes with the determination of manganese by the author's persulphate method ; so does molybdenum to a less serious extent. If the amount of peroxide precipitated from the boiling solution of persulphate is determined volumetrically by hydrogen peroxide, the error caused by tungsten is much more serious than when ferrous sulphate is used for the determination ; but even in the latter case it is enough entirely to vitiate the results. In the case of tungsten steels, the error is quite avoided by dissolving the sample in the absence of air, when the tungsten remains undissolved and can be filtered off, the small amount oxidised and dissolved during the filtration and washing, being insufficient to affect the determination of manganese. A sufficiency of dilute sulphuric acid is placed in a capacious conical flask, saturated solution of sodium bicarbonate added till the flask is filled with carbon dioxide, and the weighed sample (2—10 gm., according to the amount of manganese) introduced. The flask is then closed by a cork which carries a twice-bent tube, drawn out to a point at the inner end just below the cork, and dipping at the other end under saturated sodium bicarbonate solution. The liquid is warmed till solution is complete, and finally boiled for a few minutes. After cooling, the undissolved tungsten is filtered off and washed two or three times, and the filtrate is treated with 10—12 per cent. ammonium persulphate in small quantities till the iron is peroxidised, then 30—40 c c. are added in excess, the liquid diluted to 400—500 c.c., boiled for 20 minutes, and the precipitated manganese peroxide filtered off and washed, dissolved in a known volume of acidified ferrous sulphate solution of known titre, and the unaltered ferrous salt determined."—G. v. Knorre. — *Journal of the Society of Chemical Industry*, April 15, 1907, p. 345. (A. W.)

Acetylene as a Precipitant in Analysis.—"Copper is easily and completely precipitated from cuprous solutions, either ammoniacal or acidified with acetic or tartaric acid, by acetylene, as a granular, easily filterable precipitate of cuprous acetylide, $C_2H_2Cu_2O$. The authors use an amount of substance containing 0·1 to 0·3 gm. of copper, dissolved in 100 c.c. of water. To this is added 10 c.c. of ammonia of sp. gr. 0·96, and 5 c c. of a 10 per cent. solution of hydroxylamine hydrochloride to reduce to the cuprous condition, and the precipitation is effected either by a current of purified acetylene, or by adding a solution of acetylene in acetone, about 5 c.c. of which is sufficient. The precipitate is filtered off and washed with warm and then cold water to which a little acetylene water has been added ; the filter and moist precipitate are then placed in a porcelain crucible of about 75 c.c. capacity, treated with 10—15 c.c. of nitric acid of sp. gr. 1·15, and heated on the water-bath. When decomposition is complete, a few drops of acid, of sp. gr. 1·52, are added, and the whole evaporated to dryness, then gradually heated to ignition, preferably with addition of a little powdered oxalic acid, to reduce any nitrocellulose which might otherwise decompose explosively, and the cupric oxide weighed. Of the other common metals, silver and mercury are the only ones precipitated by acetylene, so that they must be first removed if present, the silver by precipitation as chloride, the mercury by reduction in hydrochloric acid solution to calomel, by means of phosphorous acid. The phosphorous acid does not interfere with the precipitation of the copper. The separation of copper from the alkaline-earth metals, magnesium or cadmium, must be carried out in acetic or tartaric acid solution, to prevent the formation of carbonates, or the precipitate, if formed in ammoniacal solution, must be washed with weak acetic or tartaric acid. If aluminium, chromium, manganese, iron, or cobalt be present, tartaric acid must be added in sufficient amount to prevent precipitation when the solution is made ammoniacal. The same precaution applies to bismuth, antimony, and tin. The separation from lead is best effected in acetic acid solution. All of these separations are sharp and complete. Palladium is precipitated completely by acetylene from solutions acidified with hydrochloric acid. The precipitate is easily filtered and washed, and is quietly decomposed by heat, giving an oxygen compound of palladium, which is easily reduced to metal in a stream of hydrogen. In the filtrate, after rendering it ammoniacal and reducing by hydroxylamine, copper can be precipitated by acetylene. The acetylene method allows of separating palladium directly from platinum and its congeners, except osmium. This metal is precipitated by acetylene as metallic osmium; the mixed precipitate, when washed, dried, and ignited in hydrogen, is weighed as mixed metals, and the osmium is then volatilised by heating in a stream of oxygen, and the remaining palladium again weighed. Gold is also precipitated as metal by acetylene; and if it is to be separated from palladium, the mixed metals obtained, as in the case of osmium, must first be weighed, and then the palladium dissolved out by nitric acid."—O. Makowka, Z. anal. Chem., 1907, *46*, 125—128; 128—141; 141—145; 145—150.—*Journal of the Society of Chemical Industry*, April 15, 1907, pp. 344-5. (A. W.)

Standardising Acids with Magnesium.—"The author has used metallic magnesium to standardise acids for volumetric work. Having made approximate solutions of acid and alkali, and ascertained their value in terms of one another, he dissolves in a measured volume of the acid an accurately weighed quantity of magnesium ribbon (equivalent to not more than nine-tenths of the acid taken, so as to ensure complete solution within a reasonable time), and then titrates the excess of acid with the alkali solution."—A. Vesterberg, Z. anal. Chem., 1907, *47*, 81—83.—*Journal of the Society of Chemical Industry*, April 15, 1907, p. 344. (A. W.)

Formation of Calcium Cyanamide.—"The fixation of nitrogen by calcium carbide, according to the process of Frank and Caro, with the formation of calcium cyanamide, has been studied, particular attention being paid to the influence upon the reaction of temperature and admixture of calcium chloride or fluoride. Below 1,000° C., the absorption of nitrogen by finely powdered calcium carbide is limited and takes place very slowly, but between 1,050° C. and 1,100° C. the reaction readily occurs and proceeds rapidly, until the theoretical quantity of nitrogen required to form calcium cyanamide CaN_2C, has been fixed. Admixture of calcium chloride, as first observed by Polzenius (Ger. Pat. 163,320), lowers the temperature of reaction to a very marked extent, a rapid absorption occurring from 700° C. upwards. The influence of the proportion of calcium chloride has been studied, it being found that the rate of absorption increases with the content of calcium chloride up to 30 per cent., although the effect becomes less marked as the percentage increases. Admixture of calcium fluoride with the carbide is also advantageous, but the temperature of reaction is not brought quite so low as in the case of the chloride. Here an addition of 2 to 5 per cent. seems to be most favourable, since with an increase of percentage of the fluoride the quantity of nitrogen absorbed in a given time diminishes. In explanation of the effect of admixtures of salts the authors suggest that the removal of the film of cyanamide from the carbide may assist the reaction; the softening and fusion of the mass may also increase its power of dissolving nitrogen. At 800° C. in two hours, mixtures of calcium carbide with 15 per cent. of calcium chloride reached a content of 17·6 per cent. of nitrogen, with the gas under a water pressure of 132 mm., and 19·9 per cent. with a pressure of 1,840 mm.,' thus showing a slight favourable influence of pressure."—F. Foerster and H. Jacoby, Z. Elektrochem, 1907, *13*, 101—107.—*Journal of the Society of Chemical Industry*, April 30, 1907, p. 423. (A. W.)

New Method of Determining Ammonia in Water.—"The method proposed is based on the precipitation of the ammonia by mercuric chloride in the presence of sodium carbonate, and permits of the determination of quantities of ammonia varying from 0·0001 to 0·012 gm. per litre. The details of the method are:—One litre of the water to be examined is rendered alkaline by the addition of sodium hydroxide and distilled slowly until about 100 c.c. of distillate have been collected, the latter being received in a vessel containing 10 c.c. of 1 per cent. hydrochloric acid. If much ammonia is present, the distillate is diluted, but not in cases where the ammonia is less than 0·001 gm. per litre. Ten c.c. of 5 per cent. mercuric chloride solution and 10 c.c. of 15 per cent. sodium carbonate solution are added to the distillate, the mixture is placed aside for 24 hours and the precipitate then collected on a weighed filter, washed with 5 c.c. of water, dried at a temperature of 100° C., and weighed. The weight of the precipitate is multiplied by 0·03 to give the amount of ammonia in 1 litre of the water. The composition of the precipitate is only constant when less than 0·5 gm. of mercuric chloride per litre is employed for the precipitation."—A. Buisson, Compt. Rend., 1907, *144*, 493—495.—*Journal of the Society of Chemical Industry*, April 15, 1907, p. 346. (A. W.)

Manufacture of Explosives.—"In the course of the discussion on the vote for war stores in the House of Commons recently, Mr. Haldane, speaking of the tests applied to cordite, said that no cordite about which there was any suspicion would be made available for use until it had passed the test. The official reticence about the Woolwich explosion had nothing whatever to do with mercuric chloride. The Government had there samples of certain explosives which it was thought might put us ahead of all other nations; but these samples had now, unfortunately, disappeared into space. In black powder the particles of carbon, and the atoms of oxygen which were in combination with something else, lay side by side. These two substances side by side were very stable, and when the flash ignited the powder the oxygen was freed and had to travel a certain space, very small, and unite with the carbon, and they had a slow explosion and a great deal of smoke. Nitro-glycerine and gun-cotton, which were the ingredients of cordite, had wholly different properties. In gun-cotton and nitro-glycerine the atoms of oxygen and carbon lay together in one very complex molecule. The atoms of oxygen, when released, rushed very quickly to the carbon and produced a tremendous explosion. The result was that all these explosives were by nature dangerous. It was quite true that black powder, on the other hand, was a safe explosive, but black powder was feeble and emitted smoke, and any nation which used it would be 'out of it' with other nations. They had, therefore, to deal with chemical problems in order to do what they could to tame the dangerous explosives. The discovery of the means by which to tame these explosives was a very remarkable one. The nitro-glycerine and the gun-cotton had been found to be capable of being rolled together under heat, and mixed together with a solvent, and so incorporated that they made a kind of paste which would roll into a gelatinised form and assume a character which made them safe to handle and, which was much more important, safe to burn and capable of burning slowly. The process of kneading them together and making them into a horny substance made them perfectly safe, unless they changed their character, and it gave them a quality which remained for some time unchanged. All powders of whatever description in which the carbon and oxygen were in the same molecule were prone to deteriorate, particularly under heat. To some extent also the nitrogen compounds might be given off, and might assume by contact with the atmosphere the shape of nitrous acid or nitric acid. In that way reactions might be caused in the powder, making bad spots and developing heat which might cause local explosions that were communicated to the whole mass. The result was that they had to test in the very closest fashion to see whether the cordite was properly made, and not only so, but they had to test after certain intervals to see whether it had not deteriorated. He said, therefore, that the very best cordite made by the best process could not be trusted if exposed for a prolonged period to an unduly high temperature. That was why they were so careful about the magazines of ships, because in a hot climate like India there was danger, and also in an unduly cold climate, where the nitro-glycerine was frozen out. All cordite, therefore, was subjected to the heat test, to set free and disintegrate the nitrogen compounds of which he had spoken. Very elaborate and delicate tests were made by means of fine tissue paper steeped in starch, which was so exposed at a given temperature to the action of the fumes from the cordite that it would show certain lines, according as the fumes were given off abnormally quickly or normally, just as they should under the high temperature at which the test was conducted. Now, mercuric chloride had the property of preventing the giving off of the nitrous compounds, it interfered in a fashion which made it impossible for the test to act properly. The Abel heat test, which was the one they generally used, was the standard test for British cordite. The Abel heat test, which depended on the starch paper being affected by the emanations given off from the cordite under heat, was masked by the mercuric chloride, which prevented the emanations from being given off. Coming to the point which had been much discussed, could it be said that the mercuric chloride was useful in cordite, or served any other purpose than masking the heat test? He emphatically said no. He quite agreed that in the case of gun-cotton, on the contrary, mercuric chloride was used for a useful purpose. Gun-cotton, unlike gelatinised cordite, was not a hard, horny substance, but had an open texture. Like everything else easily accessible to the atmosphere, it was apt to be ravaged by bacilli, which formed a fungus that destroyed the gun-cotton. Mercuric chloride, which was a very fine antiseptic, destroyed the bacilli and prevented the fungoid growth. The nature of cordite, however, excluded these fungoid growths, and there was not any excuse for using mercuric chloride as an antiseptic in cordite. In the case of cordite there was one purpose only for which, in the opinion of his advisers, mercuric chloride could be used, and that was for masking the heat test."—*Mining Journal*, June 15, 1907, p. 810. (A. McA. J.)

The Reduction of Carbon Dioxide to Formaldehyde.—"In connection with the assimilation of carbon dioxide by plants, it has long been a debated point as to how this oxide of carbon is reduced to form the carbohydrates present in the plant. Recently the view that formaldehyde is the first product of the reduction of carbon dioxide has come into favour, although there is but little direct evidence to justify it. Moreover, the reduction of carbonic acid to formaldehyde is a change which has hitherto eluded all laboratory methods. This reaction has now been successfully effected by Dr. H. J. H. Fenton, F.R.S., who has obtained appreciable quantities of formaldehyde by treating an aqueous solution of carbon dioxide with metallic magnesium; the proportion of the aldehyde is considerably increased if weak bases, such as ammonia, aniline, or aluminium hydroxide, are present. Formic acid may also be reduced to formaldehyde by the action of magnesium. The fact that these reductions have been carried out by purely chemical means affords experimental justification for the view that a similar reduction of carbon dioxide occurs in the green parts of plants under the influence of sunlight. (Proceedings of the Chemical Society, March 21, 1907.)"—*Times Engineering Supplement*, April 24, 1907. (J. A. W.)

The Study of Crystals.—"It has long been known that if a saturated solution of a salt be protected from disturbance it may become very much supersaturated before it crystallises. A well known curve representing the solubility of a substance in a solvent is obtained by taking temperature for ordinates and concentration for abscissæ, any point on the curve showing the amount of the substance which the solvent can hold in solution at a particular temperature. Professor Miers finds that when a supersaturated solution—that is, one holding more than this amount—is stirred in an open vessel, a thin shower of crystals appears at the saturation temperature, but that nothing further happens until a temperature about 10° lower is reached, when a second and very much denser shower occurs. If, however, the experiment is made in a sealed tube, only the second shower falls, and no amount of shaking will induce crystallisation at the ordinary saturation temperature. The explanation is a remarkable one—namely, that the first shower only falls because the liquid becomes inoculated with crystal germs floating about in the air, while the second shower is due to spontaneous crystallisation.

Prof. Miers finds further that the second or 'labile' shower corresponds to a second curve more or less parallel to the ordinary solubility curve and below it, which he calls the supersolubility curve, and the interval between corresponds to a condition called 'metastable,' the terms being due to Prof. Ostwald, who predicted but never verified these phenomena. The somewhat disconcerting fact of the presence of such crystal germs in our truly wonderful atmosphere suggested to Prof. Miers the idea of experimenting with two substances, salol and betol, so rare that it could hardly be expected that their germs could be floating about. The experiments succeeded admirably at first, and both the curves of each were worked out by him and by his assistant. But towards the close, the very work itself had impregnated the air, and metastable crystallisation by inoculation began to occur. It also suggested to him some researches in association with Mr. Barker, which resulted in discovering that, although it was not necessary that the germ should be a minute crystal of the substance itself, yet it must be one which is either isomorphous with it, or is able to form parallel growths with it. The conditions requisite for parallel growth of one crystal on another have been established; the essential being that the structural dimensions of the crystals of the two substances shall be very nearly alike. The constants defining these internal stuctural dimensions are known as 'topic axes,' and were independently and simultaneously employed for the first time by Dr. Muthmann in Germany, and Dr. Tutton in this country, and they depend simply on the molecular volume and the axial ratios of the crystals. One of the most beautiful experiments shown was that of small crystals of sodium nitrate crystallising on calcite, two substances which have almost exactly the same topic axes, and which therefore fit into each other precisely." — Prof. H. A. Miers.—*Times Engineering Supplement*, May 8, 1907. (J. A. W.)

Determination of Free Acid in Superphosphates.—"The following method of determining free phosphoric acid in superphosphates is both rapid and accurate. Five grams of the material, dried for three hours in the water-oven, are digested for three hours at the ordinary temperature with 100 c.c. of ether in a stoppered flask, the mixture being shaken at intervals. Fifty c.c. of the filtered extract are evaporated to dryness, the residue is taken up with water, and the solution, filtered if necessary, is then titrated with $N/4$ sodium hydroxide solution, using methyl orange as indicator. The yellow colour appears as soon as all the phosphoric acid has been converted into mono-sodium phosphate."—J. van Dormael, Bull. Soc. Chim. Belg., 1907, *21*, 103—115.—*Journal of the Society of Chemical Industry*, April 30, 1907, p. 424. (A. W.)

Steam in Gas Producer Practice.—"This paper, presented by Dr. W. A. Bone and R. V. Wheeler, described experiments carried out with a gas producer plant at the iron and steel works of Messrs. Monks, Hall & Co., Warrington, with a view to determining the influence of variation in the proportions of air and steam in the blast upon the composition of the gas, its suitability for furnace operations, and the general and thermal efficiencies of the producers. Arrangements were made for the accurate determination of every possible factor in the results, and the authors believe that the results may be considered as establishing reliable data on the subject. The principal results of five trials are summarised in tabular form and go to show that the quality of the gas obtained steadily deteriorated as the steam saturation temperature was raised beyond 65° C., and that, whereas at 60° and 65°, the average percentage of total combustibles in the gas exceeded the high figure of 47 per cent., it steadily dropped to about 42 per cent. as the steam saturation temperature was raised to 80°. It is true that the falling off in quality was partly counterbalanced by an increase in the quantity produced per ton of coal gasified, but the general efficiency of the process fell off as more steam was used. With a steam saturation temperature of 60°, the resulting gas contained 27·3 per cent. of carbon monoxide, 16·6 per cent. of hydrogen, 3·35 per cent. of methane, and only 5·25 per cent. of carbon dioxide. At a saturation temperature of 80° the percentage of carbon monoxide had fallen to 16·05, the hydrogen had increased to 22·65 per cent., and the carbon dioxide to 13·25 per cent. In this connexion the paper points to the higher furnace efficiency of a producer gas rich in carbon monoxide in comparison with a gas of equal calorific value in which carbon monoxide is partly replaced by hydrogen. From the point of view of thermal efficiency the results tabulated show that the use of steam beyond that required to saturate the air blast at 60°, was not attended by any increased economy of working, and the thermal efficiency fell from 7·15 per cent. to 60·4 per cent. as the steam saturation temperature was raised from 60° to 80°. If a gas producer be regarded primarily as an apparatus for ammonia recovery, it should be worked with the highest steam saturation temperature consistent with the production of combustible gas, but if ammonia recovery be considered in conjunction with the suitability of the gas for furnace purposes, and the thermal efficiency of the process, the best steam saturation temperature is possibly between 65° and 70°. At 65°, over 30 per cent. of the nitrogen in the coal can be recovered as ammonia, which is nearly double the amount usually recovered in by-product coking processes, and, at the same time a gas is produced very suitable for furnace purposes.

Mr. Robert Armitage, M.P., said that the conditions under which the author's work was carried out were not normal working conditions, and that the production of a certain amount of saturated gas under the conditions described with an air blast saturated at 60° C. was not a guarantee of any degree of success in everyday work. To run regularly under such conditions would result in the shutting down of the plant, and the usual practice where steady and continuous working was desired was to use more steam than corresponded with saturation at 60°. The most surprising feature of the experiments was the attempt made to gauge the usefulness of the gas in the furnace without cooling it. He had been running a similar plant at his works for six or seven years, and while the Mond gas, rich in hydrogen, was found to be a very excellent heating agent, the necessity for cooling was fundamental.

Mr. B. H. Thwaite said the investigation had sealed the fate of hydrogen as an economic agent in power-gas production. The perfect power gas contained 30 to 32 per cent. of carbon monoxide, and not more than 7 per cent. of hydrogen. It would be interesting to know what potential power capacity of plant would justify the putting down of a by-product plant on the super-saturated or Mond system. Mr. A. H. Lymn disagreed that a power gas should not contain more than 7 per cent. of hydrogen. Engines were running on Mond gas which contained up to 28 per cent. of hydrogen without trouble from pre-ignition. Further than this, Messrs. Ehrhardt and Sehmer were putting down two 3,000 h.p. engines to run on coke oven gas containing 54 per cent. of hydrogen. The results shown in the paper had been arrived at by working the plant under abnormal conditions. It was not surprising that poor results were obtained with the larger quantities of steam. Mr. Walter Dixon said he had been engaged in investigating the same problem, and the practical result of the paper was that if you wanted a good gas very little ammonia should be expected, and if plenty of ammonia was required it was useless to trouble about the gas. Experiments which had been made on a commercial scale rather pointed in the same direction as the conclusions stated by the authors."—Iron and Steel Institute.—*Times Engineering Supplement,* May 22, 1907. (J. A. W.)

METALLURGY.

Grinding in Tube Mills.—"The ore contains a large proportion of hard, chalcedonic quartz, and the gold exists in an exceedingly fine state, conditions which necessitate very fine crushing in order to obtain a high extraction of the precious metal. The results of grinding in tube mills in other countries were so satisfactory that three tube mills were erected at the Waihi mill, the installation being completed in May, 1905, since which time an average duty of about 2·7 mills has been maintained. The mills are of the Davidsen, 22 ft. type, and are run at a speed of 27·5 revolutions per minute. Each mill is loaded with 5·5 tons of flints, and requires 50 h.p. to operate it. The quantity of flints consumed is 18 cwt. (2,016 lb.) per mill per week. Various liners have been used, including silex and Delarue quartzite blocks, and also cast iron liners, 1·25 in. thick. The iron liners last about as long as the quartzite blocks, namely, 2·5 months, but the grinding result is not so good. A new lining, invented and patented by H. P. Barry, called the 'honeycomb lining,' is now being tried with very promising results. This liner consists of a light cast iron frame, 22 by 14 by 3 in. deep, shaped to the curve of the mill. Thin walls divide this lining into four or six compartments. A temporary sheet iron back is fastened to the frame, and each compartment is then firmly packed with rough lumps of hard quartz or quartzite, varying in size up to 4 in. square bedded in with a mixture of Portland cement, coarse sand and fine sand. The liners so formed are allowed to set, preferably under exhaust steam, for several weeks—the longer the better—before being placed in the mill. This method of lining calls for a much shorter stoppage than with the quartzite blocks. The frames fit neatly with each other and with the shell of the mill, and only a small quantity of cementing material is required. If made with hard material these liners stand very well, and cost, including labour, about $175, as compared with $400 for lining with quartzite blocks. The grinding efficiency of a mill with this new liner appears to be quite equal to that of the quartzite blocks. Costs of running the tube mills are given by the writer.—Bi-Monthly Bull. Am. Inst. of M.E., January, 1907.—E. G. Banks.—*The Mining World,* March, 1907, p. 306. (H. A. W.)

The Homestake Slime Plant.—"The expenditure of half a million dollars by the Homestake Mining Co., of Lead, S. Dak., in the construction of a plant designed to treat material carrying gold values of an average of about 80 cents per ton, would seem to mark the opening of a new era in metallurgical economics

The plant in question, now nearing completion, is located at Deadwood, S. Dak., and will treat by cyanidation, by pressure lixiviation in filter presses, the slimes resulting from the daily crushing by stamps of some 4,000 tons of ore. The pulp from the stamps, after plate amalgamation, is separated by water classification into some 2,300 tons of leachable material or sands, which is reserved for the cyanide leaching plants, the remaining 1,700 tons, in the form of unleachable slimes, have heretofore been run to waste.

For some two years past Mr. C. W. Merrill, of the Homestake Mining Co., has been at work on the slimes problem, his solution of it taking form in a new design of filter press hereinafter described, which he has perfected and patented. The salient feature of his design, aside from great capacity, is the use of an automatic sluicing device by means of which the press can be quickly emptied of its contents without being opened. By this improvement Mr. Merrill proposes to reduce the labor cost of pressure filtering to practically nothing, whereas by the old method of opening and emptying the press by hand, this feature constitutes the principal item of expense.

The Homestake company is at present dropping 1,000 stamps, of which number 640 are at Lead, near the southern end of the company property, 100 are at Central, some 2 miles distant and near its northern boundary, while the remaining 260, at Terraville, occupy an intermediate position.

The location of the different mills with regard to the topography of the country, results in a natural division of them into two groups, termed northern and southern, respectively; each group being tributary to one of two adjacent water courses, each of which conveys a small creek. These gulches converge, and on steep grades eventually join at Deadwood, some 4 miles below Lead.

The mills at Lead, three in number, form the main or southern group and operate in conjunction with Cyanide Sands Plant No. 1, located in the gulch just below the town. The mill at Central, and the one at Terraville, together form the northern group and operate in conjunction with Cyanide Sands Plant No. 2, located at Gayville in the gulch some distance below the mills. In the selection of a site for the new plant to treat the residues from the two groups, the junction point of the two gulches offered ideal conditions.

Classification.—The classification of the pulp from the different mills, is as follows:—

The pulp from the mills at Lead has a consistency of about 12 parts water to one part solids, a sizing test on the solids giving the following results: Coarse (remaining on 100 mesh), 22 per cent.; middles (between 100 and 200 mesh), 18 per cent.; fines (passing 200 mesh), 60 per cent.

This pulp, after passing the plates, flows by gravity to what is known as the upper cone house where it is evenly distributed to 16 gravity settling cones; these are of iron, 10 ft. in diameter at top and with sides sloping at 50 deg. The overflow from these cones (overflow No. 1) consists of about 30 parts water to 1 part solids, all solids readily passing 200 mesh; the overflow, or spigot product, passes immediately, by gravity, to a second set of 12 cones, similar to the first, except that they are smaller, being 7 ft. in diameter. The overflow from this second set (overflow No. 2) has about the same character as overflow No. 1; the spigot product enters a 12 in. cast iron pipe line and on minimum grade of 2·5 per cent. is transported for a quarter mile down the gulch to Cyanide Sands Plant, No. 1. Here it is distributed to a third set of nine cones, identical with those of second set, overflow from which (overflow No. 3) further assists in elimination of water and slime material; the underflow, which is now quite thick, passes immediately to 36 cone classifiers, the product of each settling cone being distributed to four classifiers. These last are $3\frac{1}{2}$ ft. in diameter and are equipped with a special design of feedwater inlet for discharging sands and admitting the water, an invention of Mr. Merrill. These classifiers throw off another portion of water and slime material (overflow No. 4), while the spigots furnish a product which, though carrying a considerable proportion of fines, is readily percolable and passes directly to the sand tanks.

The slimes which have, by different steps in the classification, been carried over in the overflows are in a very dilute condition, about 30 parts water to 1 part solids, all solids being under 200 mesh. Economy in its subsequent treatment, as well as conservation of water, requires the unwatering of this material to a large extent, this being accomplished by means of large clarifying tanks. Overflows No. 1 and 2 are joined and conveyed by pipe line to a group of 18 of these tanks, nine of which are 18 ft. in diameter and 20 ft. deep, the other nine being 26 ft. in diameter and 20 ft. deep. They are built of California redwood and have vertical sides, containing however, false cone-shaped bottoms whose function is to prevent any sudden slide of solid slimes into the spigot opening below. Being evenly distributed to these tanks, the thin slime pulp assumes a state of relative quiescence and to a large extent drops its burden of solid material which settles to the bottom and is drawn off with enough water to give it easy transport. The overflow is comparatively clear water and is discharged into a pond immediately below, formed by damming a portion of the gulch, from which it is subsequently drawn for sluicing purposes at the new plant at Deadwood, as well as for other purposes in connection with the company operations. The combined spigot product enters another pipe line and by gravity passes down the gulch to sands plant No. 1, being there joined by overflows No. 3 and No. 4, the combination passing to a second set of clarifying tanks, six in number and identical with the larger ones of the previous set. These throw off another large portion of water in nearly clear condition, which is used in the above sand plant. The underflow from these tanks contains practically all the solids of the combined overflows and has a consistency of about 3 parts water to 1 part solids, in which condition it is conducted by a 12 in. cast iron pipe line, on minimum grade of $1\frac{1}{2}$ per cent., a distance of some 3 miles to the new plant at Deadwood.

A glance at the flow sheet will show that the scheme of treatment of the Terraville pulp differs but slightly from that of the southern division. The only real point of difference being the omission of the intermediate set of settling cones, corresponding to the difference in volume of pulp. There is also a slight difference in dimensions of some corresponding parts which in other respects are identical. The mill at Central sends its pulp directly to settling cones at Sands Plant No. 2, its course being easily traced on the flow sheet.

The final slime product emerging from this division corresponds closely with that coming from the other and is conveyed by gravity, in a 10 in. pipe line, for a distance of about two miles to the plant at Deadwood.

The two pipe lines, bearing material from the northern and southern mills, converge and eventually discharge into separate sludge storage tanks at the slimes plant.

The Filter Press Plant.—This new plant occupies four main benches, excavated from the side hill and faced, where necessary, by concrete retaining walls. The uppermost bench carries the two sludge storage tanks, before mentioned, identical with the larger clarifying tanks used in the classification, also a third tank of the same dimensions placed alongside for the storage of wash water. Directly back of and over the sludge tanks is the equipment for furnishing lime, in the form of emulsion, to the pulp as it passes to the presses below. Thirty feet below and some distance in front of this top bench is another carrying the solution storage tanks, two in number, for weak and strong solution, each being 32 ft. in diameter and 14 ft. deep. On a floor directly over these tanks are placed the two precipitation filter presses. Another 30 ft. below and in front is the main or press bench on which are placed the 24 large filter presses; while directly in front of and 24 ft. below these is the lowest bench, carrying the two precipitation or weak solution tanks, $22\frac{1}{2}$ ft. diameter by 18 ft. deep; two standardising or strong solution tanks of the same size as the last; also a large waste-water storage tank; solution pumps; compressor; boiler, etc.; also the assay department in a separate concrete building. This bench directly overlooks the creek.

At some distance back from the main portion of the plant and at an elevation of 150 ft. above the press bench is placed the sluicing water storage tank having a capacity of 100,000 gallons. This receives its supply of water through a 10 in. tile pipe line connecting it with the overflow dam at Lead, previously mentioned, and in turn furnishes water, under sufficient head, to accomplish sluicing operations in connection with the presses below. From the 10 in. main which leads this water down the hill, a side connection leads off to the wash water storage tank on the upper bench, the supply being automatically regulated by a float.

The pulp is drawn from the centre of the bottom of each sludge tank into a 10 in. pipe. These pipes merge at once into a single 12 in. main which passes down the slope to a point above and midway of the line of presses, where it divides at right angles to form a straight 10 in. line running both ways as far as the two end presses. From this line, 6 in. laterals lead off at right angles, the line of each lateral paralleling and being equidistant from two adjacent presses, to each of which it delivers the pulp through flexible hose connections. The necessary amount of lime emulsion is added to the pulp just at the point of its exit from the sludge tanks.

*The Filter Presses.**—In most respects these immense presses resemble an ordinary press of the flush-plate and distance-frame type, the only salient point of difference in their operation being the use of the automatic sluicing device already mentioned. In fact it is upon this feature that the economic success of the entire scheme of slime treatment may be said to hinge.

In its larger details a press consists of an outer supporting frame, 91 flush plates, 92 distance frames, a follower head with thrust screws, together with the necessary connections for entrance and exit of solutions, pulp, etc.

The supporting frame consists of massive front and rear standards, spaced 46 ft. apart, between faces, and joined by side rails made from 15 in. channels. Between these rails are suspended the plates, frames, and follower head, each of these units being cast with projecting side ears which transmit the weight of the piece of the rails through roller bearings. Owing to

* See this *Journal*, p. 174, vol. vi.

the great weight of the assembled units and the necessity of preventing any sag or bulge, the side rails are provided with two intermediate, adjustable supports which, extending upward, are also tied across the top.

In general outline the plates and frames are similar, being rectangular in form, and measuring 4 ft. by 6 ft., outside. Each plate has a 2½-in. circular opening through each of its four corners, also two other circular openings on its vertical centre line, the upper one being 4 in. and the lower one 6 in. in diameter. With the exception of a narrow plane area surrounding these openings, and continuing as a border around the outer periphery, the entire surface of the plate is corrugated by channels.

The two opposite faces of a plate are identical, and communication between their corrugated portions is afforded by six small openings, thus insuring an equalisation of pressure on the two faces. Two small openings at the side corners also communicate directly with the adjacent circular channels through cored holes in the plate rim; these will be termed solution holes, as it is through them that the solutions pass to and from the slime cake.

There are three types of frame used in a press, known respectively as standard, top-feed-and-bottom-discharge, and top gate frames. They are all 4 in. in depth and have circular openings, symmetrical with, and of the same size as the corresponding ones in the plates, also the plane peripheral border, so that when any number of plates and frames are brought into close contact, these openings make continuous channels extending from end to end of the nest of units. In any frame, however, the centre bottom opening is not continuous through a full thickness of the frame rim, as the latter is slotted in the thickness of the metal from the top to the bottom of the opening to allow play to the sluicing nozzle, later described. The centre bottom opening simply passes through two semi circular guards, each ½ in. thick, leaving the slot 3 in. wide in the centre.

The top-feed-and-bottom-discharge frames, besides the openings already mentioned as common to all, each have two bottom corner discharge outlets, a centre, bottom, pulp, discharge outlet, also a centre, top, pulp inlet. In all frames, communication between the inner space of the frame and the top central opening is established by mean of three small cored holes.

The standard frames are similar to those just described, with the omission of the top feed and bottom discharge openings, while the top gate frames are of the standard type, with the addition of two gates in the top rim through which the interior space of the frame may be examined at any time. The front standard and follower head are also provided with top pulp inlet and bottom pulp discharge openings, their inner faces conforming exactly to those of a plate.

The number of each type of frame used in a press, together with their arrangement, is such as to provide, including those of the front standard and follower head, six pulp inlets, ranged along the top centre line, six pulp discharge openings below, also four discharge openings along each lower side.

In assembling the units of a press, the plates and frames alternate, each plate being so turned, relative to its neighbours, that the solution holes of any two adjacent plates alternate as regards the right and left side of the press. Thus, the even numbered plates will communicate through these holes with the circular channels on one side, and the odd numbered ones with these on the other side of the press.

A strip of No. 8 canvas is hung over each plate, covering its two faces, circular openings in cloth coming opposite the corresponding ones in the plate. The assembled units, backed by the follower head, are then brought firmly together, the canvas strips serving as so many gaskets, and held in position against the front standard by two large thrust screws extending from seats in the follower head, back through brass nuts set in the rear standard, and terminating at the rear of the press in capstan heads, worked by hand levers.

Automatic Sluicing Device.—Extending throughout the upper portion of the lower central channel is a 3 in. pressure pipe, the rear end of which bears in a seat in the follower head, while the front end passes out through a stuffing box in the front standard, and directly connects with the water supply coming from the sluicing water tank on the hill above.

Projecting into each frame compartment from this pressure pipe is a small nozzle which may be directed towards any portion of the compartment by turning the pipe about its axis. The excess in size of the channel over that of the pipe leaves a crescent-shaped opening from end to end of the press, the same being continuous through the plates but opening directly upward into each frame compartment, and also having the six discharge openings below. All external communication to this space is closed at all times, save when sluicing out the slime cake.

Cycle of Operations.—The press is filled by admitting pulp from the overhead lateral main, through hose connections with the six feed openings, all of which will be opened by one movement of a lever, into the upper central channel, whence it passes downward into each frame compartment through the cored holes; the pulp entering the press under a gravity pressure of about 35 lb. per sq. in. During the filling of any compartment, the water of the pulp finds its way through the canvas bounding faces, along the plate corrugations back of them and out into the corner channels through the solution holes. Thus, all four channels may be utilised for discharging this water, but ordinarily the two top ones will be closed, and all effluent water will pass into the lower ones, and find exit through the eight discharge openings into 5 in. collecting pipes, paralleling each lower side of the press, from which it will be finally discharged. This water, which is perfectly clear, will ordinarily be run to waste, but in case of shortage it may be led to the large waste water storage tank on the lowest bench, and from thence pumped back to the sluicing water storage tank on the hill above. The solid portion of the pulp is retained in the press and ultimately fills all compartments, the pressure of filling rendering any artificial method of packing the cake unnecessary.

The press being filled, the cakes are subjected to six hours' treatment consisting of lixiviation, oxidation, and washing, in exactly the same manner as open vats are treated, except that all operations must be conducted at higher pressures than in vat percolation.

The period of six hours for all treatment in the press has been determined to be the best for Homestake slimes, but would vary with the nature of the slimes in the case of other ores, probably being less in some cases and more in others. Bearing in mind the arrangement of the plates, it is evident that the corner channels on either side of the press may be used for entrance of solution, etc., those on the opposite side serving for the discharge of same.

In order, however, that any liquid may pass through the press via these channels, any portion of it must force its way through a cake and its cloth-bound faces. Usually but one channel on a side will be used, the other being closed.

Sluicing Out the Slime Cake.—Preliminary to this operation the six discharge openings along the lower central channel are opened, all other channels being closed. The discharge openings will be controlled by the operator through one motion of a lever. Water from the sluicing water tank is then turned into the pressure pipe under a pressure of about 50 lb. per sq. in., and issues from each nozzle as a powerful jet direct against the cake in each compartment. By means of a small capstan, fixed to the pressure pipe at the head of the press, it is first turned backward and forward a few times by hand through a gradually increasing angle, in order to loosen the cake directly around the nozzle and clear the bottom channel. This preliminary breaking accomplished, the motion throughout an arc of some 200 deg. is continued automatically by means of a pinion set on the pipe and gearing with a rack, which derives a reciprocating up and down motion from a pitman, whose upper end has a projecting roller engaging a groove cam developed on the face of a cylinder, which is revolved about its vertical axis by gearing from an electric motor. This cam device travels bodily on an overhead track, one machine serving eight presses.

The slime as it is broken down from each compartment is washed between the semi-circular guards, into the central crescent shaped channel surrounding the pressure pipe, whence it passes along and finds exit from the press through the nearest bottom discharge opening, the progress of the operation being gauged by the density of the escaping pulp.

The amount of water necessary for sluicing operations is about 4 tons per ton of slimes; but with the use of two nozzles for each frame, it will be reduced to 3 and possibly 2½ tons, of which all but 1 ton or less may be pumped back and re-used after first settling in tanks or dams.

Each press has a capacity of about 25 tons of dry slimes, and the time required for a complete cycle of operations is about 8 hours divided as follows: filling 1 hour, treatment 6 hours, and sluicing out 1 hour. Thus each press has a capacity of about 75 tons of slimes per 24 hours, or a total for the plant of between 1,700 and 1,800 tons per day. One man has complete charge of at least four presses.

Recovery of Gold and Circulation of Solutions.—The solution drawn from the strong solution storage tank and used in the first lixiviation operation, leaves the presses as weak solution, and having been discharged into the precipitation or weak solution tanks below, is pumped up to the third bench and forced through the precipitation filter presses. As this solution enters the suction pipe of the pump it receives a carefully gauged supply of zinc dust, in the form of emulsion, brought down from the surface through a small pipe. The zinc becoming thoroughly mixed with the solution, precipitates most of the gold before the presses are reached. These presses, also of a design patented by Mr. Merrill, have plates and frames of a triangular form. The solution with its burden of precipitates enters the press via a channel in the upper corner and is led downward to the apex of each frame through a small channel cored in the side rim. By thus introducing the solution into the frame from below and taking into consideration the shape of the compartments, Mr. Merrill proposes to get a constant and more intimate contact of the entering solution with any undissolved zinc. The precipitates being retained in the frame compartments are permitted to accumulate for some time, or until the frames are filled when they are removed by hand, cupelled, melted down and refined.

The clear solution escapes through the cloth-bound faces of each compartment and leaves the press through a row of cocks near the lower line of the press, each cock communicating with the corrugated faces of a plate. This solution now passes to the weak solution storage tank beneath the floor, from which it again passes to the presses below as weak solution. Emerging from a press in a still more weakened condition, it is now run to the standardising or strong solution tanks below, where it is brought up to strength by fresh additions of potassium cyanide and from here it is pumped up and discharged into the strong solution storage tank, thus completing the circuit.

Two electrically driven triplex pumps, size 8 in. by 6 in., serve to elevate the solutions.

Compressed air is furnished by an electrically driven duplex compressor, size 22 in. by 18 in.; and steam for heating all the buildings is supplied from a 250 h.p. vertical, water tube boiler.

The power necessary to run the plant will be about $\frac{1}{10}$ h.p. per ton of slimes.

Several of the presses are completed and have been in commission long enough to demonstrate their efficiency in all respects, an extraction of 90 per cent. being authoritatively reported, thus verifying the results and predictions deduced from the 10 ton trial press which was operated over a year and treated some 6,000 tons of slimes.

The total cost of treatment will be in the neighbourhood of 25 cents per ton.—MARK EHLE, Jr., E.M. —*Mines and Minerals,* March, 1907, p. 358. (J. Y.)

EXTRACTION OF GOLD FROM REFRACTORY ORES. —"A patent of J. W. Worsey and E. Hoal (846,768, March 12, 1907) describes a process primarily intended for extraction of gold from refractory ores, but stated to have a wider application. The ore is first crushed and screened and freed from aluminium silicates in any known manner. It is then 'subjected to the action of nascent bromide of chlorine produced in the body and presence of the ore by mixing with the powder or crushed ore chlorate of soda and bromide of soda, or a chlorate and bromide of other equivalent alkali or a chlorate and bromide of an alkaline earth.' The mixture is quietly stirred and some acid is added, and the temperature is raised from time to time until it rises to about 150 deg. F. After this treatment has been carried out four hours, the temperature is raised to near boiling point for the purpose of completing the dissolving of the gold and finally to free it from excess of gaseous products. The whole is then allowed to settle; the clear solution is decanted away and the residue is washed with hot water. The solution and the wash water are mixed together, and any acid present is neutralised by means of a quantity of a solution of an alkali. A weak solution of a lead salt is then added and the whole vigorously stirred, and H_2S is added to the solution with proper stirring (by blowing air through) for 10 to 20 minutes. The whole then turns quite black, and in this condition the precipitated gold and lead sulphide settle out, and are collected, dried, and the gold recovered by a smelting operation. To recover any residual gold contained in the ore previously separated from the gold solution, it is treated and washed in a vat with a weak solution of double or single ferro-cyanide of ammonium and commercial soda carbonate* after the manner of ordinary leaching. The effect of this is that all the residuary gold in the ore is dissolved out of it, and this is effected quickly, namely, within 24 hours. The gold is dissolved out in the first stage as bromo-chloride, and afterwards when heated it resolves itself into auric chloride, $AuCl_3$. In this treatment the ferro-cyanide of ammonium acts as an expeditor or saver of time, and by it the residual ores of this and other gold extraction processes can be economically treated and gold extracted, and within a greatly reduced time. The solution resulting from this leaching operation can be treated like the previous solution with sulphide of hydrogen (H_2S) for the separation of the auriferous lead sulphide."—*Electro-chemical and Metallurgical Industry*, April, 1907, p. 149. (J. A. W.)

MINING.

Preservation of Mine Timber from Decay.—"The Philadelphia and Reading Coal and Iron Company, and the United States Forest Service, in February, 1906, planned a series of experiments to be conducted along practical and economical lines, with the primary idea of saving timber and money. Actual tests have been carried on to discover just what methods of handling and treatment would give the greatest service at the least expense. The factors destructive to timber used by anthracite coal companies are (1) decay, (2) breakage, (3) wear, (4) insects, (5) waste. Sets of round gangway timber, used in the main haulage ways, were tested as a basis for this experimental work.

In the experimental work the following were the main points studied :—(1) The benefits of peeling timber ; (2) the benefit of seasoning timber or drying it out ; (3) the benefit of treating timber with various preservatives applied by several processes. The preservative treatments tested and their relative costs are given in the accompanying table :—

COST OF PRESERVATIVE TREATMENT OF TIMBER.

Method of application.	Preservative.	Cost per cub. ft. Dols.
Preservative heated to 180 degs. Fahr. and applied in two coats with a brush.	Creosote (dead oil of coal tar) ...	0·01½
	Avenarius carbolineum ...	0·04½
Immersion in an open tank without pressure — successive baths of hot and cold fluid.	Solution of common salt 15 per cent.	0·02
	Solution of zinc chloride, 6 per cent.	0·03½
	Creosote (dead oil of coal tar) ...	0·11
In a closed cylinder under vacuum and pressure.	Solution of zinc chloride, 6 per cent.	0·07
	Creosote (dead oil of coal tar) ...	0·15

Ventilation is a large factor in the destruction of timber by decay. In badly-ventilated air-courses, where there is sufficient moisture and temperature, decay is at a maximum. For wood-destroying organisms to exist, they must have air and water. If it were possible to keep the timber always wet or always dry, it would not decay ; it is the alternation of wet and dry conditions which produces rot.

By direct experiment, it has been definitely proved that in durability, peeled timber is superior to unpeeled timber. In unpeeled timber the space between the bark and the wood favours the development of wood destroying organisms and furnishes a breeding place for many forms of insect life. Peeled timber is 7 to 8 per cent. lighter than unpeeled timber. Great benefits may be derived from seasoning the timber or drying it out. Seasoned timber is far more durable than green timber, and is considerably stronger. A period of from two to five months is necessary for proper seasoning. In that length of time it may lose from 30 to 35 per cent. of its green weight. In case the company handles its own timber from the woods to the mines, the possible saving in freight due to peeling and seasoning may easily be estimated.

Of the treated timbers, those preserved with creosote and a solution of zinc chloride by the open tank method have been very successful. A good penetration of the wood by the preserving fluid from 2 to 5 in. has been easily secured, and timbers so treated effectively resist decay. Timbers treated by the cylinder processare alsostanding well, but in order to be a profitable investment they will have to show a considerable increase in life over those treated by the far less expensive open-tank process. The success of the superficial brush treatment has yet to be proved. Timber so treated is not as effectively resisting decay as the other treatments. On account of their comparative cheapness and ease of application, requiring no plant, they may be of benefit to small operators or in a situation where the timber is likely to be broken. Acting on the results obtained from this series of experiments, the Philadelphia and Reading Coal and Iron Company is considering the advisability of taking up treating work on a larger scale. Plans have been drawn for the construction and erection of an open tank treating plant at one of its collieries. If erected, either creosote or zinc chloride solution will be the preserving fluid used.

The successful application of a preservative treatment to mine timber is largely dependent upon the regulation of the timber supply of the consumer, and a timber supply that will admit of this regulation. Under these conditions, timber cannot be rushed from the woods into the mines. There must be time for treating it and for preparing it for treatment. This means the storage of a reserve supply of felled timber at one or more points.

It should be distinctly understood that this series of experiments especially applies to the southern anthracite coal region, where the Pennsylvania and southern pines are the leading mine timbers. To regions where conditions and species of timber differ, the results of these experiments may not be applicable."—J. M. Nelson (Lecture).—*Colliery Guardian*, May 24, 1907, p. 961. (A. R.)

Observations on the Future of New Zealand Dredging.—"Perusal of the New Zealand Mining Handbook, 1906, furnishes information on various points affecting the future of New Zealand dredging. Collected together, the observations gleaned from the various reports indicate the need of more powerful dredges, of systematic prospecting, and of improvements in gold-saving appliances, more especially for fine gold.

In these fields, in the opinion of Mr. R. McIntosh, Inspector of Mines, and author of the prize essay on the Mineral Resources of New Zealand, greater constructional strength, capacity, and power are needed

* Cyanide (?)—Ed. Comm.

to deal with bank claims, and to further the work of gorge dredges.

On the one hand, the bank claims are now the principal scene of operations; and for these, large, powerful dredges are required, as an enormous amount of low grade or worthless material has to be shifted to secure the auriferous wash. On the other hand, since 1900, the gorges of the various rivers have afforded the most numerous instances of dredging failures. In the gorges many obstacles are met, such as hard bottom, tight wash, travelling drift, and short seasons, all of which call for increased power.

Recent discoveries have emphasised this need, for the breaking through of a hard crust or false bottom at Waitri, on the Karawau River, and at Waenga, on the Clutha River, with the disclosure of rich underlying wash, suggests that many dredges have hitherto been working on this false bottom, leaving the under wash, to attack which more powerful machines are necessary.

The enforced employment of a larger and heavier type of dredge will have, as offset to its higher initial cost, the advantage of increased durability. By the adoption of machinery suitable for deep, heavy ground, the life of dredges in the most successful locality, the large basin between Clyde and Alexandra, has been indefinitely prolonged. The same remark applies to the powerful dredges successfully working in the Clutha Basin, around Lowburn. Large capacity dredges, moreover, are needed where, as at Big Waikaka, Southland, the ground must be turned over rapidly to secure good returns.

The importance of systematic prospecting in the development of the dredging industry is frequently accentuated by the District Wardens. The extensive flats and swamps of Southland, says Mr. McIntosh, offer a large field for exploitation. It is difficult to say where suitable gravels do not exist. Systematic boring, in the hands of capable operators, is the cheapest and easiest method of testing these gravels. Systematic drilling, such as has been carried on at Waikaka with reliable results, would prove the existence or otherwise of an extensive dredging field on the Upper Nevis. And again, the opinion is still held by those who know the Cardrona field, that the whole length of the valley—a distance of over 20 miles— will pay for working, provided the extent of auriferous wash is located by boring rods, and suitable dredges used. There is an enormous area of dredgable ground in the Matanra Valley, but only by systematic boring can the payable areas be located.

The problem of gold, more especially of fine gold, recovery is an ever-recurring one, and the solutions still leave room for improvement. From the many reports, writes Mr. McIntosh, as to the payable prospects obtained from the (Matakanui) claims, before the dredge commenced to work, I should be inclined to think that our present method of treating the wash obtained in dry land dredging is not sufficiently advanced. And elsewhere, as a dredging field, the (Lake George) portion of the (Waiau) district has great possibilities, provided suitable appliances are available for saving the fine gold."—C. C. Longridge. —*London Mining Journal*, April 13, 1907, p. 486. (J. Y.)

MISCELLANEOUS.

The New English Patents Bill.—"At a meeting of the Society of Chemical Industry held at Burlington House, Mr. R. J. Friswell, who presided at the meeting, read a paper on the Patents Bill of 1907. He pointed out the possible hardship of a rigid interpretation of the demand for samples in a chemical invention. The draftsmen appeared to think that chemical samples were equivalent to mechanical drawings, whereas they were quite different. If samples were to be deposited it was necessary to settle their fate. We knew very little of the stability of chemicals. Many classes of aldehyds, many cyanogen compounds, many dyestuffs, and even some hydrocarbons, nitro-compounds, azo-compounds, nitrites, and sulphites were notoriously unstable, and being accustomed to use chemicals freshly prepared, very little was known as to the stability of the remainder. What was the object of keeping the samples? Were they to be used against the patentee in the event of litigation? It was generally undesirable to separate chemical patents into a separate class from patents in general. Clause 2 distinctly did this. The clause as to compulsory licences was likely to lead to increased litigation, and thus to be as costly as heretofore. The words 'adequate extent' are retained in the Bill. How is working in the United Kingdom to an adequate extent to be determined? If these actions became frequent a new Court would be required. At any rate, the Comptroller was not a good authority. Working of foreign-owned patents should be compulsory, or the Act of 1883 should be left alone. Clause 9 opened the way to very vexatious proceedings against a patentee. He might be working his patent when a trade rival might apply for revocation, thus forcing him to compromise or to face litigation. This clause was as much at the disposal of powerful syndicates as of any one else. At any rate, existing patents should be relieved from the operation.

A letter from Mr. Levinstein was read. He objected to a paper by Mr. Bloxam and Mr. Imray, and urged the necessity of controlling the foreign owners of patents in the interests of British industry. Mr. Bloxam urged the undesirability of compulsory working. It had become a farce abroad. If we took this attitude the Colonies would follow and patentees might be expected to have to work in all Colonies or forfeit their patents. Mr. Salomon urged the need to allow easier means of obtaining extensions of meritorious patents. Often much of the life of a valuable patent goes in getting it to work; a trivial patent often succeeds at once and had a long life. The returns on a patent should not be the sole criterion as to its extension. He was impressed by the chairman's words as to the instability of samples, but this could be met by requiring their analysis. Mr. Guttman opposed compulsory working. After remarks from Mr. Hugh Moulton and others, Mr. Astbury, M.P., said he had been greatly interested by the paper. The chairman alone appeared to have seen the true bearing of many of the clauses. Mr. Lloyd-George was animated by a single-minded desire to help British industry. It was not too late to improve the Bill, and he was sure that the suggestion as to analysis of samples would be of use, and Mr. Pearce's suggestion of the insertion of words making it certain that the samples were only for the use of the Comptroller was valuable. He had also been struck by the same point as the chairman had urged—the undesirability of the putting of decisions as to adequate working on the Comptroller. He would not be able to keep counsel, experts, and so on in order, as well as a Judge. He hoped that that would be altered before the Bill took its final form.

The chairman summed up. He said that all were agreed on the undesirability of the deposit of samples.

Some differed on the compulsory working clauses, and he thought that as to the rest there was practical unanimity. He was glad to see that Mr. Astbury was at one with them as to the difficulties of the proposal as to the Comptroller becoming a kind of Judge, and to hear that the revocation clause had been modified."—*Times Engineering Supplement*, May 15, 1907. (J. A. W.)

NEW ENGLISH PATENTS BILL.—"The second reading debate on the Patents and Designs Bill in the House of Commons leads one to apprehend that the compulsory working clause will be passed substantially in the form in which it has been drafted. For reasons, some of which are given below, I fear that the effect of this clause would on the whole be detrimental to the interests of this country, and I therefore hope that it will be given further and very careful consideration before the passing of the Bill.

Many other countries have somewhat similar provisions under which patents may be revoked unless they are 'worked,' *i.e.*, their inventions carried out, within a given time in the countries in question.

The experience gained from the working of such laws may be gathered to some extent from the opinion expressed by the International Association for the Protection of Industrial Property, which holds congresses from time to time in different countries and consists of a large number of experts, including patent barristers, patent agents, and manufacturers, of various nationalities. This association, at its congress in Berlin in 1904, passed, by a large majority, a resolution affirming that the omission to work a patented invention shall not lead to the revocation of the patent, but to the granting of compulsory licences. This resolution was confirmed at the congress at Milan in September, 1906.

As a result of the compulsory working law in France, where probably the law in respect to the working of patents is as stringent as anywhere, important manufactories have, indeed, been established, but not only have they been established and worked by foreigners, to whom their profits have been sent abroad, but, although a native industry was previously flourishing, the foreign competition thus created has obtained the command of the market. The manufacture in question is a chemical one, and it is well known that it is in regard to such manufactures that the demand for compulsory working has arisen in this country.

In Canada, I am informed, the difficulty of getting inventions taken up and manufactured within the time allowed is found to be so great that many large companies who are so near at hand as in the United States, no longer take out Canadian patents.

It may be said that it is rather to our advantage that the patents of foreigners, against which the present Bill is directed, should be declared void. Is not this, however, a short-sighted view? The late William Siemens once said that it was rarely that any success attended inventions that were not the subject of monopolies; and he added, "If I found an invention in the gutter, I would rather give it to one man than to the public, for in the latter case it would be practically lost."

One effect of the proposed alteration of the law seems probable—that is, as in the case of Canada, foreign inventors will cease to take out British patents, and particular in the case to which the proposal is specially directed—namely, inventions relating to dye-stuffs—and that foreign manufacturers will simply keep their processes secret. Consequently the technical knowledge of this country will not be enriched, as at present, by the published specifications of the patents in question.

Another result will probably be that not only the Colonies but the United States will, in some way or other, act in retaliatory manner—perhaps by simply following in our own steps.

Now, the disadvantages above indicated do not attach to the plan of compulsory licences, the proper carrying out of which would be the true solution of the problem; for not only would it enable inventions to be worked in this country whenever such working were really required, but it would still preserve the patents for the inventions and so, according to the quoted opinion of Siemens and the general experience, do much to ensure the successful establishment of the invention in the industry of this country.

It is true that compulsory licensing has been tried in the country and failed. Its failure, however, has been due to the expense of the procedure. Now, the present Bill provides an inexpensive procedure for obtaining revocation—namely, by placing the power to revoke in the hands of the Comptroller, subject to a single appeal—and I submit that if, instead of this, the Comptroller were given the power to grant a licence to any suitable applicant to work a patent that, for a given time after its grant, had not been worked in this country, a satisfactory solution would be found to a really difficult problem."—*Times Engineering Supplement*, May 15, 1907. (J. A. W.)

PRINCIPLES UNDERLYING THE AMALGAMATION OF GOLD IN THE STAMP MILL.—"Amalgamation is a physical—not a chemical—process, the catching of gold by mercury being almost instantaneous. While this is true with respect to a given particle of gold, yet, with respect to the whole mass of the ore, it is a continuous process.

The purpose of wet-stamping or crushing is to free the gold from its adherent gangue, the pulp, as it passes through the battery-screens, consisting of particles of gangue and particles of free gold, which, mingled with, say, eight times their weight of water, flow over the mercury-coated apron-plates in a film, or layer. The metal alone is capable of being wetted by the mercury, the ore particles of low specific gravity not being at all affected. The gold, as soon as it comes in contact with the amalgamated surface, is immediately wetted by it, just as ordinary substance is wetted by water. The action is assisted by the fact that gold and silver, owing to their greater specific gravity, soon come in contact with, and are wetted and caught by, the mercury of the amalgamated surface. If the particle of gold is less in diameter than the thickness of the mercury film, it produces no disturbing effect upon it; if greater, it forms a projecting point.

A liquid, such as this mercury film, has a tendency, due to surface-tension, to provide itself with a horizontal upper bounding surface. In the attempt to do this, in that part of the surface which has been raised up because of the gold grain lying beneath, the pull of the surface-tension, resolved into its components, tends to press down the grain upon the plate with considerable force. This force begins the instant the grain of gold is wetted by the mercury, continuing to operate as the grain is drawn beneath the surface, and constituting the so-called 'attraction' of the mercury for the gold. Because of this force, grains of gold adhere to each other and to the plate with great tendency, especially where the pulp drops upon it.

Gold tellnride, or gold alloyed with bismuth, becomes incapable of being wetted by mercury, and so is not caught. Again, in ores which have been subject to alteration, the grain of gold may be coated with oxides, sulphides, or base metals, so as to be incapable of being wetted. In one case the gold grains were coated with a film of chalcedonic silica. Soluble salts in the ore react with mercury, causing it to be lost in solution and precipitating other elements in it, tending to make it 'sick.' This sickness is of two kinds; another metal may become alloyed with the mercury, making it less active, or more viscous and brittle, so that flouring may readily be induced. The fine slime also adheres more readily to the surfaces of sick mercury, and the metals in it frequently re-oxidise, forming a coating which prohibits the coalescence required.

The finer the gold the more rapidly does the mercury take it up, so that more mercury is needed to amalgamate fine gold than coarse.

The chief difficulty in the use of plain copper plates is due to the fact that a small amount of copper from the plate goes into solution in the mercury, and this is easily attacked by oxidising agents, and by soluble salts of the ore, forming a tarnished film of copper-salts on the surface of the mercury, and preventing the gold from being caught. The difficulty is overcome by silver-plating the copper. Silver is less soluble in mercury than copper, and is less affected by the soluble salts abovementioned, and not at all by oxygen. The effect of silver-plating on the absorption of mercury by the copper plate is to restrain it at first, since the mercury has to diffuse the silver; eventually, however, the amount absorbed is approximately the same.

From a physical standpoint the temperature of amalgamation does not matter as long as it remains constant. A disturbance of plate-equilibrium arising from changing temperature is detrimental, since, in such a case, the thickness of the mercury film, as well as the absorption of mercury by any other metal, changes; and the millman then has to deal with varying conditions. Where chemical action is negligible, it might be advisable to conduct amalgamation at higher (but constant) temperatures, since the wetting of the gold particles by mercury is slightly facilitated with a rise of temperature; but a comparatively low one is better where the influence of soluble salts in the ore has to be considered."—(*Mining and Scientific Press*) *New Zealand Building, Engineering and Mining Journal*, Jan. 28, 1907, p. 118. (W. D.)

TO KEEP IRON FROM RUSTING.—"There are many causes of the rusting of iron. It may be produced by atmospheric action alone, but in a majority of cases galvanism plays a large part in the destruction of the metal. Long experience has shown how rapidly iron nails employed in fastening sheets of lead and copper upon roofs are destroyed, the other, the electro-negative metal, remaining comparatively unaffected. The electrolyte, or exciting fluid, which by acting on the iron and not on the other metal, or by acting more upon the former than upon the latter, causes the electric current, is either actual water from rain or snow or the water vapor always present in the atmosphere. The decomposition of the water causes the liberation of oxygen at the positive pole, which is the iron, and this nascent oxygen rapidly combines with the iron. Now, it is claimed that red lead is an excellent material for protecting iron from rust and electrical action. Unfortunately, however, red lead is more electro-negative to iron than either copper or lead. Hence, should moisture by any chance get between the red lead and the iron, the destruction by rust is more rapid than when iron is in contact with copper or lead. This electro-chemical action is at the same time strengthened by the purely chemical action between the red lead and the carbonic acid always present in the air, an action which converts the red lead into ceruse, whereby an additional quantity of nascent oxygen is set free to rust the iron. It is also highly probable that the carbonic acid has an independent action upon the iron, thereby much facilitating its oxidation. It must not be forgotten that every porous place and still more every crack in the paint becomes sooner or later an entrance for water and carbonic acid. A good oil varnish is by far the best protection for iron, but it must, of course, be properly used. Not only must the iron be scrupulously, practically, and chemically clean and dry when the varnish is applied, but the covering must be without a flaw. Varnish will not adhere to greasy, rusty, or wet iron, and the contraction of the varnish on drying will cause minute cracks at such places and the iron-destroying gases will find their way through these cracks and get between the iron and the non-adherent varnish. Again, the varnish must be thoroughly dry before the iron is exposed to the weather. The varnish may be coloured if the colour does not interfere with the strength, continuity, and elasticity of the protecting skin, but is best dispensed with."—(*Architectural Art*) *Mining and Scientific Press*, April 13, 1907. (W. D.)

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 specifica tion, and* (C) *complete specification. The numbe given is that of the specification, the name that of th applicant, and the date that of filing.)*

(C.) 265/07. J. McConnochie. Improvements in apparatus for concentrating diamondiferous or metalliferous material. 26.6.07.

(P.) 266/07. G. A. Sheeley. Improvements in prospecting drills. 26.6.07.

(P.) 267/07. A. M. Day. Improvements in means for distributing pulp in cyanide tanks and the like. 27.6.07.

(P.) 268/07. A. C. Whitehead. Improvements in machines for washing and concentrating alluvial and other diamondiferous material. 27.6.07.

(P.) 269/07. A. D Wilson. An improved method of separating under water pressure precious minerals, metals and other substances from lighter materials or soils. 27.6.07.

(P.) 270/07. W. Charles (1), A. Lumley (2). Improvements in means for preventing overwinding. 27.6.07.

(P.) 271/07. C. H. N. Williams. Improvements in the treatment of copper ores. 27.6.07.

(P.) 272/07. A. Harvey. An improved gold and diamond saving machine. 27.6.07.

(P.) 273/07. J. S. Walker (1), T. A. Walker (2), E. R. Walker (3). Improvements in appliances for steadying, controlling or buffering valves of air engines or other mechanism liable to sudden deleterious shocks. 28.6.07.

(C.) 274/07. J. Ashworth. Improvements in lift pumps. 28.6.07.

(P.) 275/07. H. Bell (1), J. Bell (2), H. Airth (3). Engine rock drill. 28.6.07.

(C.) 276/07. E. S. G. Rees. Improvements in rotary condensers and in condensing steam turbines. 28.6.07.

(C.) 277/07. H. S. Rankin. Improvements in valves. 28.6.07.

(C.) 278/07. H. Herrenschmidt. Improvements in or relating to the extraction of metals and metalloids from their ores or compounds. 28.6.07.

(C.) 279/07. C. H. Haeseler (1), A. H. Taylor (2). Improvements in portable pneumatic motors. 29.6.07.

(C.) 280/07. C. H. Haeseler. Pneumatic tool. 29.6.07.

(P.) 281/07. J. van Waart. A device or construction to create perpetual motion by force of gravitation or by magnetism or by both combined. 29.6.07.

(P.) 282/07. D. Mills (1), A. J. Irvine (2). Improvements in or appertaining to steam boiler furnaces. 1.7.07.

(P.) 283/07. B. G. Richter. Hand cultivator. 5.7.07.

(C.) 284/07. A. O. Tate. Apparatus for treating liquids electrolytically. 5.7.07.

(P.) 285/07. A. J. Arbuckle (1), A. Osborne (2). Improvements relating to the generation of steam for working rock drilling machines, engines, pumps and the like in a mine and apparatus therefor. 5.7.07.

(C.) 286/07. C. A. Parsons. Improvements in and relating to blading for turbines, compressors and the like. 5.7.07.

(P.) 287/07. J. Temple. A new or improved counting frame or like calculating device. 6.7.07.

(P.) 288/07. W. E. Bleloch. Improvements in means for recovering diamonds or other precious stones or gold or other metals from loose matter. 6.7.07.

(P.) 289/07. T. R. Lewis. A gauge for holding the wires of a fence in position while inserting plain wire picket which has to be twisted up. 8.7.07.

(P.) 290/07. K. E. Fawns (1), G. Kermode (2), R. J. Dickie (3), J. H. Brown (4). Improvements in coin-freed machines for vending postage stamps, tickets and the like. 8.7.07.

(P.) 291/07. R. B. Ballantine. An improved process and apparatus for rock boring or drilling in mines and the like. 9.7.07.

(C.) 292/07. J. Fuchs. An automatic conveyance for returning the balls used in playing the game of billiards or similar games that may be played on a billiard table having pockets for the reception of such balls as are driven off the table in play by the striker to the strikers or baulk end of the table. 10.7.07.

(C.) 293/07. R. Pickard. An improved taximeter for cabs. 12.7.07.

(C.) 294/07. H. J. Rabone. Improvements in flexible steel or metal measuring tapes. 12.7.07.

(C.) 295/07. A. Hayes. Improvements in or relating to the manufacture or treatment of iron or steel. 12.7.07.

(C.) 296/07. J. B. Moyet (1), H. Bonvier (2). Improvements in automatic couplings for railway wagons and the like. 12.7.07.

(C.) 297/07. A. H. Gibson. Improvements in and relating to percussive machines operated by reciprocating fluid columns such as electro-pneumatic track channellers. 12.7.07.

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