

THE FUTURE OF THE MINING INDUSTRY

By F. T. NORRIS

THE future prosperity of South Africa mainly depends upon the development of her vast and indisputable gold wealth, for, albeit she possesses other resources in undoubtedly lavish abundance, the means for the utilisation of these latter are dependent, in a large measure, upon the effective exploitation of her auriferous reserves. This fact was explicitly stated by Sir David Barbour, the financial expert appointed by the Imperial Government to report in 1901 on the resources of the Transvaal, and that this impartial official opinion is echoed by all competent observers prior to and since his investigations only confirms its correctness. As to the magnitude to which the mining industries in the Transvaal may ultimately attain opinions differ, but, says this authority, and this view is confirmed by experts, it is certain that the production of gold will continue to increase largely for some years at least; that there will be a corresponding growth in the production of coal, and it is possible, and perhaps probable, that valuable mines of other minerals, and especially of diamonds, may be opened. He therefore opines that, from an economic point of view, the prospects of the future for a considerable period are quite satisfactory, and it is unnecessary to speculate as to what may ultimately happen.

Public opinion on the Rand is unanimous that absolutely vital questions for the mines' future are, for the moment, labour and taxation. A comprehensive and impartial view of the circumstances of the mines must force the conclusion that such contentions are perfectly sound. Naturally, however, the dimensions of the latter factor have less weight since the reduction of the customs tariff and the previous abolition of monopolies, and, with the pending solution of the question of dynamite, the mining industry is now not only in a vastly superior economic condition than it ever was, but has been placed in a position to sustain, not without some difficulty maybe at the outset, all the prospective burdens of projected Imperial taxation. In saying "not without difficulty," the crux of the present economic situation, as looked at by the leading and responsible section of the mining industry and competent individuals at large, is touched. For the judiciousness or otherwise of the

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immediately heavy incidence of the share of the cost of the war, which it may be contemplated to place on the Transvaal, is what causes the present misgivings; and, with the operative capacity of 1898 still some ten to fifteen months ahead, the immediate call for heavy contributions can only act as a drag upon progress. It is with this consideration in view that the Chamber of Mines, in a recent letter to Lord Milner, asked for a delay of five years before making a first payment, in order to allow time for the in-



PROSPECTING FOR GOLD: PANNING A SAMPLE

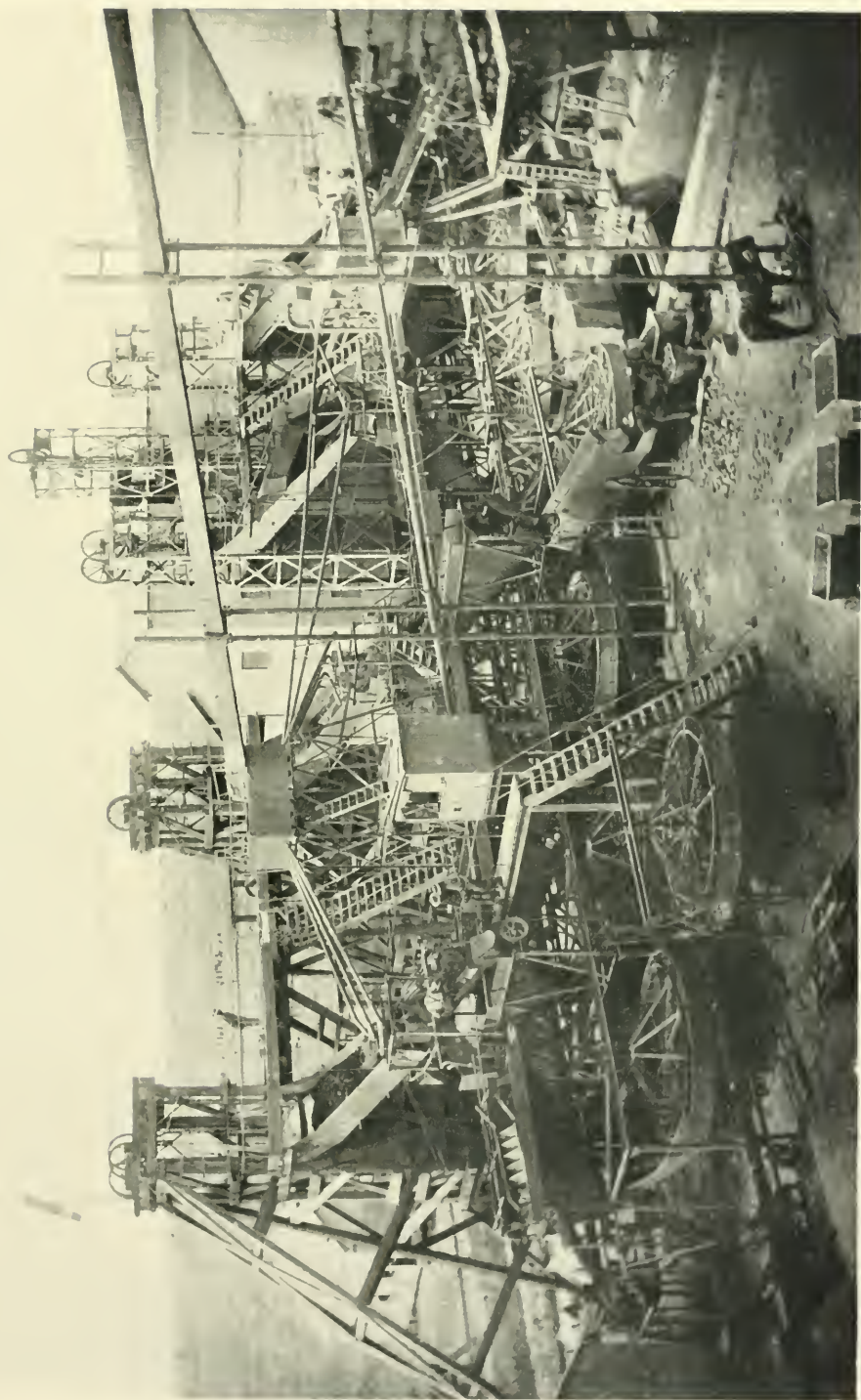
dustry to recover its former level, and that other authorities have also entered their protests.

The inference that an immediate and heavy increase of taxation is to be made to meet the war debt obligations may possibly be gratuitous, and probabilities confirm this supposition, for it is at issue with the Government expert's special recommendations. From this point of view, Sir David Barbour's observations are worth reciting for their direct bearing. He says: "The sound policy for the Transvaal is to so frame its system of taxation as not to increase unnecessarily the initial capital expenditure, or enhance the cost of working. I shall take it for granted that it

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is not intended to impose excessive or crushing taxation on either of the Colonies, or to exact such a share of their revenue as would cripple or starve the Administration. Subject to these considerations, I shall assume that any surplus of revenue over expenditure, or any special assets that the Colonies may possess, can fairly be taken towards meeting a portion of the cost of the war." Further: "If the additional taxation which I recommend . . . be imposed . . . it may be anticipated that after two years from the conclusion of peace that Colony will be in a position to set aside a portion of its ordinary revenue towards meeting the cost of the war. I am unable at present to form an estimate of the amount which it may be possible to set aside in this way. . . . On the assumption that the contribution of the Orange River Colony and the Transvaal towards the cost of the war is to be limited to the amount which they can pay without imposing excessive taxation or starving the Administration, it will be obvious from what is said in the preceding portion of this report, and especially in paragraph 62, that it is impossible at the present time to specify any definite sum as that which ought to be paid. I suggest that the Imperial Government should fix the maximum sum which, under any circumstances, they would require to be paid. Such portions of the total amount of contribution, so fixed as it may be found from time to time that the Colonies can bear, should be made a charge against them. . If, in the course of time, it is found that the Colonies are unable to pay the whole sum, under the conditions as to taxation and cost of administration which I have already specified, the balance should be written off." So far as the immediate incidence of war taxation is concerned, it is therefore highly probable that the Government, who have adopted their financial expert's views almost *in toto* with regard to fiscal reform, will do the same with regard to the levy of the war contribution.

But another phase of the same subject is revealed in the extent of the contribution which the Transvaal should be called to bear compared with that of the other South African Colonies. In the thoughts of some, tinctured still perhaps with a touch of the recent bitterness of the war, the Transvaal should bear the heaviest share; but it is to be observed that this is not the opinion of the responsible heads of the mining industry, who, while admitting the justness of assuming their proper proportion of the proposed burdens, appropriately point out that both the Orange River Colony and the Cape Colony (for a part of the latter's population) were fellow-sharers in the beginnings and the conduct of the war, and should bear a due portion of the resultant financial burdens, while Natal, it is contended,



WASHING PLANT OF DE BEERS DIAMOND MINES AT KIMBERLEY

Photo by Wilson, Aordren

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cannot fairly be allowed to escape contribution to the extent at least of the valuable Transvaal territory which has been allotted to her. Pending formal announcements of the Government's intentions—and it is to be observed a contribution from the Orange River Colony is contemplated in Sir David Barbour's report—many huge lump sums have been mentioned, which it is proposed to levy on the Transvaal alone. Such reports naturally have not only alarmed the mining industry, but disturbed the confidence of international capitalists, upon whom the future development of the wealth of the goldfields in the first place rests. The extent of the alarm which is felt is shown by the Johannesburg Chamber of Mines as a body pleading in their recent communication to Lord Milner for a "reasonable sum" to be fixed, and by the rough estimates of this sum propounded by others, as, for instance, Mr. Freeman Cohen, chairman of the Potchefstroom Exploration and Gold Mining Company, who indicates £30,000,000 as the specific figure, while Mr. Bleloch adventures the sum of £35,000,000. This last gentleman's summing up of the situation is that the mines can pay, and are willing and forward to pay, provided the incidence at the first be made light, and that the burden of the £55,000,000 estimate of the Government's financial expert be shared by the other Colonies in the proportion, say, of £5,000,000 from each, to lessen the burden on the mining industry as much as possible, especially the low-grade section, and also as a matter of equity, and he advocates in addition—to augment the disposable revenue—the levy of a 5 per cent. tax on the profits of other industries (banks, &c.), the creation of death dues and of a land tax; also the beneficial reservation to the Government of portions of each new mining field to be opened.

That the whole weight of the taxation of the Transvaal should not be made to fall upon one industry is, of course, consonant with reason, policy, and equity. Pending the pronouncement of its actual intentions, and in view of the alarmist rumours which are spread about, it behoves the Government, to allay the very natural apprehensions entertained, to give an early and explicit outline of its proposals, and in this connection the projected visit of the Right Hon. J. Chamberlain to the Colonies is of the best augury. From his place in Parliament that statesman has already disclaimed, on several occasions, proposals anent the immediate imposition of heavy taxes attributed to the Imperial Government, and the probabilities are that those recently published in London are as baseless as they are vague.

The dependence, to a large extent, of the development of the mining industry on the fostering and assistance, or otherwise, accorded by the existing Government is a point too painfully brought home

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to the Rand mining industry by past experience to need demonstration; wherefore the sound common-sense statesmanship of those now responsible for the prosperity of the Empire is a valuable guarantee that the various problems now absorbing the attention of the industry will be treated in a fair, just, and liberal manner.

The Rand mining industry, at the moment, is undoubtedly in the throes of one of those periodic waves of depression incident to all great gold-mining fields, though to the Rand in a less degree than to the others, on account of the certain results which may be reckoned upon from the stable nature of its geological formation. Capital required for its development is in many cases being withheld, investors looking askance at its demands with obvious misgivings. This attitude is undoubtedly due to impatience, and disappointment that progress has not been more rapid since peace has been declared.



THE INFANCY OF A GOLD-MINE: WINDING QUARTZ WITH A WHIM

Apparently it was assumed that only a cessation of hostilities was needed for the mines to hurry up and resume their old-time rate of production and prosperity. Such an assumption ignores the real difficulties of reconstituting a country and its industries, devastated and disorganised for three years by war, and setting up an entirely new order of things. As a matter of fact, the progress actually achieved has been marvellous, and as much, or even more, than could have been expected in like cases. It has apparently been forgotten that civil government has only within a few weeks replaced the military in the main administrative channels. The railway network of the sub-continent has only been thrown open to the free transport of merchants' goods within the past month, and the limitation of transit to the Rand, and the interior generally, is a most serious matter, by reason of the fact that the trunk railways

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from the coast are only single lines. For the clearance at the ports of the accumulations of mining machinery, mining stores, building materials, foodstuffs, and general merchandise, months are required, and this clearance must take place ere the railway traffic can fall back into its normal grooves. Abundance of labour, too—always a crucial question with mining operations, whether they be on the Rand, in Rhodesia, or elsewhere in the sub-continent—is, for a variety of causes, not yet available, although measures have been taken by the Government and the mining industry, acting in concert, which have placed this subject on a more satisfactory footing than it ever enjoyed. Other advances have been made in the improvement of the status of the industry, such, for instance, as the reduction of the customs duties, which enormously improve the industry's chances of future remunerative working. Some desiderata are certainly unfulfilled, such as reduced railway rates; but the instalment of reforms made affords a fair basis on which working can be resumed with admirable chances of remuneration and profit. This being so, the unreasonableness of the show of impatience that progress has not been more rapid, and the undeservedness of the distrust with which the industry is professed to be regarded in some quarters, are obvious. A sober view of the situation of the Transvaal at the present moment must undoubtedly force the confession that the amount of solid work done in solving the many problems simultaneously surging up for solution in a new colony besides mining,—repatriation, resettlement, &c.—and in rebuilding generally the body politic, is of substantial volume, and that the progress hitherto made, in removing the difficulties which beset the mining industry, are sufficient augury that whatever remains unalleviated will receive its due and satisfactory attention in the near future.

In an old (1876) edition of "Chambers's Encyclopædia," under the heading of "Africa—Productions," is the statement that "It would be hazardous to assert that Africa is deficient in *mineral wealth*, though, judging from our present imperfect knowledge, it does not seem to be extremely rich." Little did the compilers of this well-known work think that, in the space of less than twenty-five years, a town of about 150,000 inhabitants would spring up as the centre of a mining country which now takes rank as the first gold-producer in the world. The gold production of the Rand to date is indeed stated to equal one-ninth of the coined gold in circulation throughout the world, while its potential reserves are probably fourfold this amount. In 1887 the United States occupied first rank among gold-producing countries, Australia being second, and Russia third, the total gold production of the world being only £18,000,000. In 1898, South Africa occupied the premier position with 28 per cent.

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of the aggregate world's production, and her contribution, moreover, represented only $3\frac{1}{2}$ millions less than the world's aggregate in the first-named year. In 1899, owing to the war, it just managed to fall short of the headship. Since its start, the Rand gold-fields have produced gold to the handsome aggregate amount of £81,000,000 sterling. On the fortunes of South Africa, the influence exerted by this stupendous accretion to its wealth is past question, for the output of £20,000,000 of gold in 1898 formed 80 per cent. of the sub-continent's aggregate exports in that year, while 68 per cent. of it was disbursed in labour, foodstuffs, mining stores, and material in the course of its winning. It is only needful to glance back at the modest proportions of South Africa's trade movement before the discovery, first of diamonds and then of gold, to recognise how much it owes to its mineral wealth, and more particularly to that of gold, for its present-day prosperity. Its populations, its cities and ports, its railway network, its multifarious industries from agriculture upwards, and its merchant firms and commercial activity have each and all been stimulated and enlarged enormously by it. As in the case of Australia and other older gold-producing countries, the output of gold, primarily from the Witwatersrand fields, has acted like a perennial stream, fructifying and rendering teemful the arid wastes, and making the very wilderness to blossom as the rose.

The gold-bearing quartz-pebble conglomerate beds, called by the Boers "banket"—the discovery of gold in the outcrops of which in 1883 started the Witwatersrand mining industry—form a series of strata going down at an angle of about 30 degrees to hitherto unknown depths—over 8000 feet have already been plumbed—and extending over a tested lateral distance of more than 50 miles.

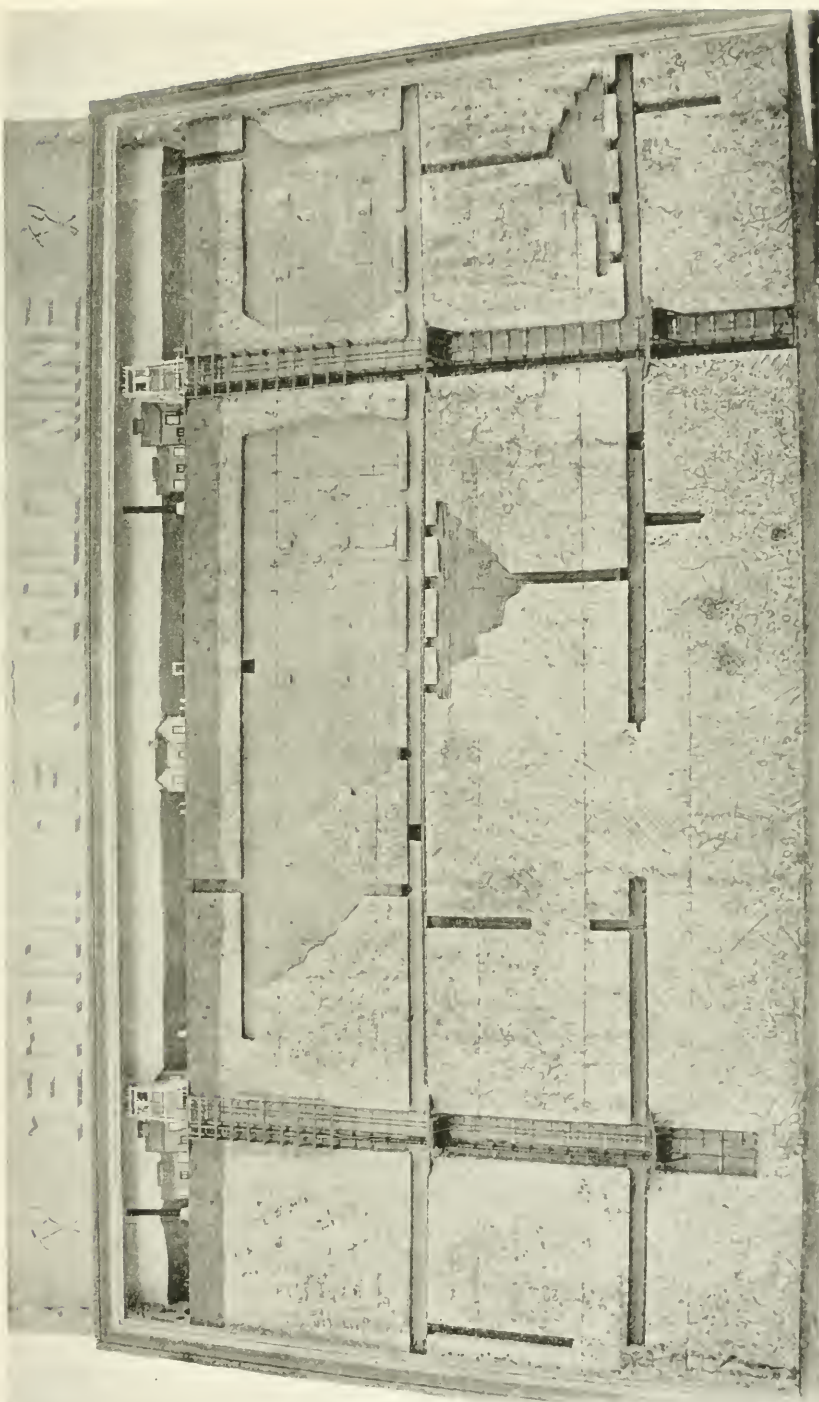
These beds lie in series, that particular one which contains most of the gold being called the Main Reef series, comprising the Main Reef proper and a number of subordinate reefs or bands. The thickness of the Main Reef is from 3 to 12 feet, that of the Main Reef Leader 3 feet on the average, and the South Reef thinner than the latter, but having a richer gold contents than either. These are the beds chiefly worked, the gold being disseminated throughout the matrix mainly in crystals, visible gold being only occasionally seen, but in fairly regular quantities, so that the results of working, whether in the richer or poorer reefs, are capable of being accurately forecasted. The knowledge of the nature and extent of the beds has only gradually been brought together, and is still incomplete in parts even for the 15 miles section of the Rand which has been longest under working, and discoveries are of almost daily occurrence extending the sum of information regarding their composition and incidence. In the section situated between the Langlaagte



CYANIDE WORKS (NEW COMET MINE) AT JOHANNESBURG

The tailings are run into the huge vats, and the cyanide of potassium a deadly poison—percolates through, and carries off the gold in solution.

Photo by Barnett & Co., Johannesburg



SECTION OF A GOLD MINE. (Photo by Horace W. Nicholls, Johannesburg)

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Estate Mine in the west and the New Comet in the east, one profitable mine after another follows almost without a break. The eastern and western extensions are, for the main part, still *terra incognita*; but the several mines scattered along their stretch have confirmed the identity and value of the formation, which is held by experts to warrant the belief in the existence of wealth even exceeding the Rand proper.

Knowledge as to the depth to which the reefs descend has been slowest in accumulating. When the outcrops were first worked in the central section, it was believed that there was little or no gold in the lower levels. Since 1898, however, deep and yet deeper depths have been explored, especially in following the richer reefs, and always with the similar result of meeting with the same, or a superior, grade of ore contents peculiar to the higher sections of the particular reef, so that the inference is strengthened to certainty that profitable exploitation is only limited to the ultimate depth at which modern mining can be carried on. The problem, therefore, is one for the engineers; for, apart from the increased temperature in the lower levels, which can be met by roomier shafts, and the occurrence of water, which is likewise capable of being dealt with, the only difficulty to be met with is that concerned with the hoisting appliances for such enormous depths. So recently as May last the London Chamber of Mines, and more recently the Johannesburg Association of Mining Engineers, were engaged on the solution of this question. It is needless to anticipate the results of their deliberations, the point turning upon the choice betwixt two systems, only so far as to state that means for solving the difficulties of the task are considered to be available, at least, to such depths as 5565 feet on the slope, and that the results of mining at these great depths can be made to show a substantial profit. It may be added, however, that in consequence of the increased cost to reach the ore, the need for the utmost reduction of working costs becomes paramount.

The circumstances of gold-mining on the Rand have, therefore, features quite distinct from those of quartz-reef, alluvial, or other kinds of mining, and approximate to those of coal winning, especially in the matter of the depth and regularity of the conglomerate formation. Its peculiarities have created a method of mining, the outcome of costly experiment, experience, and skill, which will remain a lasting asset to future ages.

The future gold production of the Rand mining industry is a subject which enchains the attention alike of the investor and the curious. In approaching the subject of the unexploited gold contents of the banket formation, figures are handled which simulate

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the fabulous, and almost excuse the disbelief with which all such estimates are received in some quarters. Confirmation of the approximate correctness of the computations may, however, be obtained in two ways: firstly, from the past yield of the gold-fields in the seventeen years since their start; and secondly, from the verification of former prognostications which subsequent outputs have furnished. So far as regards the former, the fact of the production of £81,000,000 of gold since the start of the industry up to now, under well-known circumstances is, in the first place, proof positive that the gold exists; and, in the second, affords inferential grounds for assuming that, given at all similar circumstances, mining operations will yield like results. This is, of course, taking the lowest ground, for it is indubitable that the circumstances will not be alike, but vastly improved, in which case the value of the results will be proportionately enhanced. As to the confirmation which results from the verification which later outputs have furnished, both of the trustworthiness of the bases on which former forecasts were made and of the prognostications themselves, there may be instanced the forecasts of such early computators as Mr. Hamilton Smith, Mr. C. D. Rudd, and others. The former, in 1892, in a report on the future production of the Rand fields, made by request of Messrs. Rothschild, adventured an opinion which is worth quoting textually. He said: "With the active and energetic men who have this industry in hand, and always supposing that the foregoing theories be correct, in *three or four years from now* the producing power of the mines and their reducing works will, I think, be increased to an output of *five or six million tons of ore per annum*, worth a gross yield of over £10,000,000. At this rate the available supply of ore, as conjectured above, will last for more than thirty years."

As an actual fact, in four years from the time of his writing the above, the Rand gold yield from 69 companies working amounted to 5,325,355 ozs., the total production being of the gross value of £10,583,616; so that, far from his estimate being too sanguine or exaggerated, it was a literal forecast of the actuality. He subsequently expressed the opinion that the full producing power of the Rand would be reached by the end of the century, when the output might be expected to exceed £12,500,000 per annum. As a matter of fact the total value of gold produced in the Transvaal in 1898 was over £15,000,000, most of which came from the Rand, and, had mining operations in 1899 not been interrupted by the war, the output in that year would have reached to over £18,000,000. Mr. Smith based his estimate on a working depth of 5200 feet, and on an area of the reef only 11 miles in extent, but since his time deep mining has been successfully prosecuted to

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7000 feet. Inference and analogy, therefore, both afford strong support to the correctness of estimates, based on the results of past working, of the future gold contents of the Witwatersrand reefs, which estimates, as appears, are more likely to be under-reckoned than otherwise, from the sheer immensity of the subject, and from the necessarily imperfect knowledge of the potentialities of so huge a problem.

The divergencies in the several estimates made from time to time in the past of the total gold available from the Rand banket beds have in part arisen from the sheer inability of those making the estimates to anticipate the striking developments which have successively been made. So far back as 1893, 325 millions, and subsequently 450 millions and 700 millions, have been adventured by various persons. The relative moderateness of these estimates, compared with more recent ones, is due, as in the case of that of Mr. Hamilton Smith, to the under-valuation of the potentialities of deep-level mining, which are only now becoming fully apparent. One of the more recent estimates—that of Mr. Bleloch—based on working depths of 3000 to 7000 feet, and taken over an area of fifty miles, embracing the district between Randfontein and Holfontein, computes an available gold yield of £2,871,000,000 sterling, or eight times as much as the estimate of 1893.

Although so enlarged, the total actually understates potentialities by being exclusive of possible discoveries beyond these limits, and also by the estimates being framed on the older ratios of gold recovery to ore tonnage, thus ignoring the application of the latest scientific methods to the treatment of the poorest ore, which would tend to enhance the results considerably. Apart from these limitations, this estimate of 2871 millions is made in the most systematic manner, from careful calculations, area by area, according to the thickness of the reefs, the tonnage per claim, and the value per ton as they have been shown from past working. The total tonnage of payable ore available is estimated at 1,378,000,000. The average gold value per ton of ore in the figures works out at 41s. 7d., but in the actuality this varies from 78s. in the richest mines down to actual loss in the least paying of low-grade ores. In these stupendous figures are included the contributions of the great deep-level mines, the growing proportions of whose contributions to the aggregate output is already becoming a noteworthy feature, while the extent of their development cannot be foreseen. Mining engineers are indeed already considering the specifications of equipments for negotiating depths deeper than 7000 feet, and even in 1899 the possibility of mining at 12,000 feet was considered. Certainly the mining of minerals in other parts of the world has shown



MINES ON THE LINE OF REEF AT JOHANNESBURG

Photo by W. H. H. H. H. H.

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the feasibility of operations at much greater depths than those mentioned.

The ascertainment of the proximate gold contents of the Transvaal mining area leads up to the question, How and when is this stupendous wealth to be rendered available? In other words, what is likely to be the gold production in the several years from now on, and how long will this rate of production continue? or what are the chances of the early exhaustion of the mining industry? To take the last item first, it is the growing conviction of Rand mining engineers that the amount of available gold is only limited by the extent to which mining operations can be prosecuted below the surface. Mining engineers had up till recently generally agreed to fix a depth of 8000 feet as the utmost limit to which mechanical appliances and other circumstances will allow them to follow the descent of the reefs, and the available gold yield is calculated on this basis. But there is no finality in this statement of depth, and already, as we have remarked, engineers are calculating for deeper delvings, and 9000 and even 12,000 feet have been spoken of. This latter increase of 4000 feet—from 8000 to 12,000 feet—would alone augment the gold estimate by 50 per cent. For the rest, and retaining the 8000 feet limit estimate as the measure of the exhaustion of the present Rand, this is naturally controlled by the rate of production per year, which itself is dependent on the particular circumstances of the industry during the period in question.

The yearly production of gold from now onwards offers no insurmountable obstacle to a fairly exact appreciation. It is merely a rule of three calculation: if in the past, under given circumstances, working results have been as follows; in the future, with the same or like circumstances, the results will be such. Various computations from time to time have been made on these bases, among the most recent being those of Mr. Cooper-Key and Dr. Hatch in 1899, Mr. Goldring and Mr. Bleloch in 1901, and quite recently Messrs. Leggett and Hatch (on 47 miles of the Rand only, and working to depths of 4000 to 7000 feet). Mr. Cooper-Key's forecast, which was made in 1899, was for the output of the three following years, the war not having then been anticipated. The basis of his calculation, like that of Mr. Goldring's, was the number of stamps or the milling power employed. If in 1898, he argued, there were in work on the Central, Eastern, Far Eastern, and Western sections of the Rand 6000 stamps, at the end of 1899 this number would probably be increased by 165, or to a total of 6165; at the end of 1900 the increase made would be 1730 and the total 7895; at the end of 1901 the total would have risen to 9845;

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and at the end of 1902 to 11,785. On the basis of 1800 tons milled per stamp, of an average value of £2 per ton, and with an average number of stamps of 7000, 9000, and 10,500 in the three years, the output would have been: 1900, £25,200,000; 1901, £32,400,000; and 1902, £37,800,000. Mr. Goldring, who is the Secretary of the Johannesburg Chamber of Mines, likewise framing his calculation on certain yearly increases in the milling power, calculated that in the five years following the full resumption of mining operations, 17,000 stamps would be at work, or an increase of 11,000 on the number before the war. Allowing for a fall in the grade of ore milled, in consequence of cheaper methods permitting of a lower grade of ore to be dealt with, the 17,000 stamps, he considered, would produce at least £50,000,000 sterling a year. Writing before the war, and basing his estimate on observations made by Mr. Eckstein that in five years the number of stamps in working would be 12,000, Dr. Hatch, likewise following the milling power basis, calculated for a yearly gold production of £36,000,000. Mr. Bleloch's opinion, taking the production in the nine working months of 1899 of £20,000,000 as a basis, is that the rate of production would probably double itself after the war. "If this be so," he adds, "in fifty years' time the product of the Rand will have reached over £2,000,000,000, and if such an accelerated progress is made, the whole of the vast amount now estimated may be dug out of the Rand within sixty or seventy years. The latest estimate published, that of Messrs. Leggett and Hatch, going on the basis of the average increase of production of £4,000,000 per year in the three years before the war, and that the production in 1899—a broken year owing to the war—was £19,000,000, concludes that, allowing eighteen months from January 1, 1902, for the industry to be restored to the conditions existing in August 1899, a similar increase of production will bring the output to at least £30,000,000 per annum by June 30, 1906, and if this rate of production were to be maintained from then on, the total production of £1,233,560,700 would give a life from January 1, 1902, of forty-two years and a half. But as the production will decline gradually, instead of coming to a sudden stop, the life of the industry is likely to be prolonged for some considerable number of years beyond the period indicated. If, on the other hand, the annual output should exceed £30,000,000 for any considerable period, as is, perhaps, within the bounds of possibility, this would partially offset the extension of life due to the gradual decline of production. It is to be added, in explanation of Messrs. Leggett and Hatch's estimate, that it contemplates working along a strike of forty-seven miles only, and to the restricted depth of from 4000 to 6000 feet.

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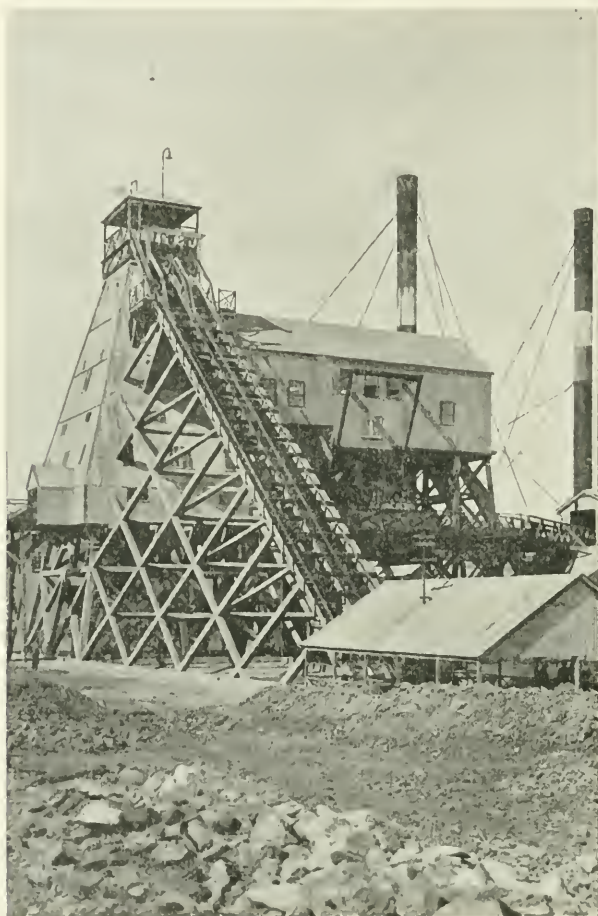
The following tabulated comparison of these several estimates will assist their comprehension, it being explained that Mr. Bleloch's estimate is reduced to the extent of 25 per cent. as a set-off for probably barren sections, &c. :—

Year.	Mr. Cooper-Key (1899).	Dr. Hatch (1899).	Mr. Goldring (1901).	Messrs. Leggett & Hatch (1902).	Mr. Bleloch (1901).
	£	£	£	£	£
1898	20,000,000	...	...
1899	19,000,000	20,000,000
1900	25,200,000	...	...	...	...
1901	32,400,000	...	...	...	...
1902	37,800,000	...	...	...	15,000,000
1903	50,000,000 each year	30,000,000 each year	20,000,000
1904	...	36,000,000			25,000,000
1905			35,000,000 each year
1906			
1907			
1908		
1909		
1910		
1911		
1912		
1913		
1914		40,000,000
1915		
1924	each year
1925		45,000,000
1934		each year
1935		40,000,000
1944		each year
1945		30,000,000
1954		each year
1955		30,000,000
1964		each year
1965		15,000,000
1974		each year

These several estimates are of course to be looked upon merely as approximations, and they are, moreover, not framed on exactly the same bases. They, however, agree in the main that the 1899 output of roundly £20,000,000 will be increased to some point between £30,000,000 and £50,000,000 within a few years' time, and maintained thereat, more or less continuously, for periods varying over 45 and 65 years. The production of the several estimates for the whole period gives an average of £37,000,000, which is only slightly higher than that of Mr. Bleloch, which is £35,714,285. This, consequently, is the handsome yearly output which the Rand mining industry offers in the near future—an amount which alone equals the total production of the whole world in 1897—if the circumstances are at least equal to those which previously prevailed.

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Having advanced the question of the future of the mining industry to the extent of showing a possible gold yield of at least 2,871 millions, spread over a period of seventy years at the rate of between 37 and 40 millions a year, at a moderate estimate, it is pertinent to inquire somewhat into the efficacy of the means for securing this return, the



HEAD-GEAR OF THE WITWATERSRAND GOLD-MINING CO.

(Photo by Horace W. Nicholls, Johannesburg)

location of anything and its appropriation being two distinct matters. As implied previously, the realisation of this huge prospective gold yield depends upon the circumstances of the industry being at least equal to those of the past. If found to be superior, the ultimate realisation will only be made the more certain. These circumstances may be conveniently classified as external and internal. So far back



DRIVING AN "END" IN MAY CONSOLIDATED MINE, JOHANNESBURG

In some places the holes for blasting are bored by Kaffirs, but as a rule the drives are made with the use of boring machines driven by compressed air. There are few accidents underground, as the rock is so hard that there is little fear of the "levels" falling in. The chief danger is from the gas after blasting, and the dust from the blast.

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as the Industrial Commission of 1897 it was recognised that the essentials for the development of the Rand were reduction of taxes and economy in working. The evidence of all the prominent heads of mining groups, both English and foreign, then tendered, in the sum amounted to this. Where the circumstances of a mine are such that they can only be worked at a higher cost than their returns, or with only an infinitesimal profit, either costs must be reduced or the mine compelled to close down. In many cases a reduction of working costs of so moderate an amount as 2s. per ton means the life of a mine, and less than this spells bankruptcy. Where mines had exhausted every effort to reduce working costs, it was also contended with justice that they had established a claim for moral and material assistance on the part of the Government, where it could be properly accorded; indeed, a personal interest, so to say, attached to Government interference, in that the national revenues were jeopardised when mines failed of successful working. The assistances asked for by the mining industry, and which the Government were able to accord, are now notorious, but are worth reciting for the bearing they have on our present subject. They were fiscal reforms conducing to cheapening of labour by reducing the cost of living both for whites and natives; increase in the effectiveness of native labour by the proper enforcement of the Liquor Law, the cancellation of the local spirit monopoly, and the withdrawal of the right of free imports of spirits from Mozambique and the Orange Free State; abolition of monopolies which tended to enhance the cost of materials used in the mines, including those of dynamite, cement, &c.; reduction of rail rates, and abrogation, by arrangement, of the transit dues levied by the coast Colonies, thus lessening first and working costs of mining equipments and materials; promotion of large public works directly or indirectly affecting the mines, such as provision of adequate water supplies, construction of railways, &c.; finally, an equitable and sympathetic attitude of the Governing Power to all and every question having relation to the country's staple industry. So far as these reforms were appraisable, they were reckoned to be equivalent to a saving of not less than 6s. per ton in working costs. What practical chance there was of gaining the relief sought under the old *régime* is shown by the futile results of the Industrial Commission's labours.

But the altered circumstances of the mining industry since the war are evidenced by the reforms already consummated and under weigh, comprising among them some of the leading demands of 1897. This fact is conclusive that, so far as external circumstances are concerned, the mining industry is not only in the enjoyment of equally favourable circumstances with those existing previously, but

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even greatly superior. By so much, therefore, is the perspective of the gold yield to which we have made allusion assisted towards becoming a reality.

As regards the internal circumstances on which the progress of the mining industry depends, these are the employment of the most improved methods and means of production. They comprise the most perfected machinery and appliances, and the latest processes of metallurgical and chemical science. Speaking generally,



KAFFIR COMPOUND, NEW PRIMROSE GOLD MINE, JOHANNESBURG

it may be said that on the Rand at the present time are employed the most up-to-date skill and technical knowledge, and the latest devised mechanical appliances. This, by the way, is only true of individual mines however. The equipment of the mass varies greatly, and necessarily so, since the conditions of one mine differ vastly from those of its neighbour; and distant and even contiguous localities require unlike treatment, according to the nature of the ore or reef worked and other local conditions. The improvement effected hitherto is evidence, however, of the initiation and energy

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which have been displayed by the heads of the mining industry in the past, and an earnest for the future, while the progress achieved abides as an invaluable guide for all future mining operations in like geological formations.

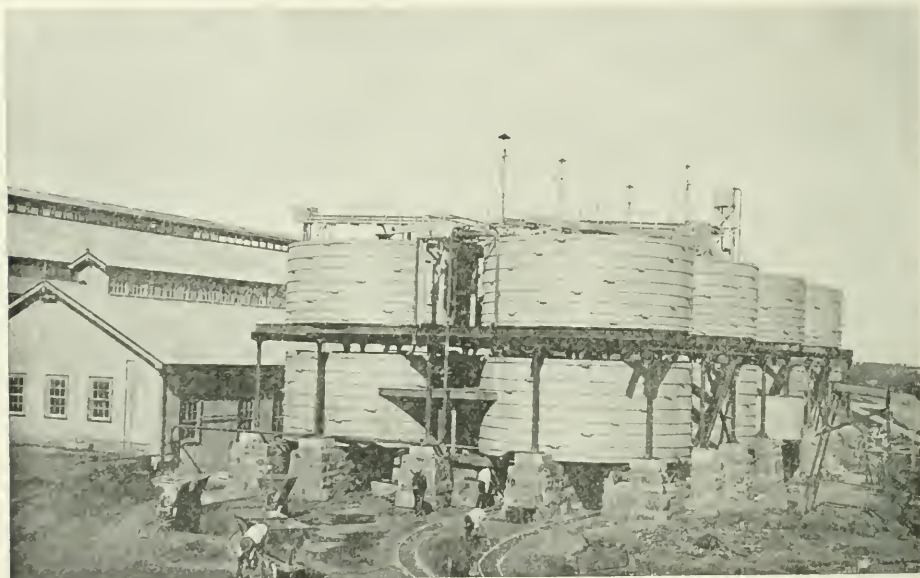
The knowledge of how best to treat the peculiarities of the banket reef has, however, only been slowly gained, and at the cost of much money and many unavoidable blunders. For instance, the only metallurgical operation for the extraction of gold employed up to 1889 was the stamping mill, and fine gold and amalgam were necessarily abundant in the tailings which were cast away on the spoil heap. The cyanide process, and that of the treatment of slimes, were only applied in 1891 and 1898 respectively. Their use has added millions to the yearly output of gold. The amalgamation process, the chlorination treatment of concentrates, and the use of frue vanners are other innovations gradually introduced as results of experiment and experience, and which have likewise increased the efficacy of the extractive operations. Similar progress has been shown in the improvement effected in the mechanical equipment. At first the mining operations were confined to the primitive digging of a huge trench over the site of the outcrop, with the simplest delver's tools furnished by the locality. This method has advanced to the stage of sinking shafts to the enormous depth of a mile into the bowels of the earth, equipped with the most elaborate hoisting plant, with underground equipment lit and worked by electricity, and the complementary surface establishments, at a cost running into hundreds of thousands of pounds. There yet lies before the industry the general adoption, not only of these but of other improvements which experience has shown to be desirable, such as the practice of sorting of ore, the use of heavier batteries on the score of greater economy, &c., and their utilisation is merely a question of time. As, therefore, all these improvements and betterments have been successively made, and the mining industry is only now gradually—it is not yet, so far as a large number of them are concerned—entering into the full use of them, it is obvious that future mining operations must not only enjoy the same favouring circumstances as those which enabled the huge mining output of the past, but a very much better environment, through the more general use of all those methods which experience and science have shown to be advisable. As a consequence, and in the measure of the value of these improvements, will the effective output be ameliorated from now onwards.

The value of the improved circumstances of the mining industry alluded to is convertible into figures in the terms of working costs and divisible dividends. The former may be said to be the baro-

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meter of the latter. In the past, in the early days of the mining industry, when the problems of mine equipment and gold extraction and winning were only imperfectly understood, the wasteful expenditure of money on inefficient methods and appliances swallowed up in many cases every vestige of profit.

It was incidental to the first operations on the then unknown geological formation of the Rand, when the very science of the gold-fields had to be created. Costs of working on the Rand are now, through the excellent system devised by the Chamber of Mines, tabulated so that the outlay of individual mines, or of the mining



CYANIDE WORKS. WITWATERSRAND GOLD-MINING CO.

(Photo by Horace W. Nicholls, Johannesburg)

industry in the aggregate, may be seen at any moment at a glance. For instance, taking the record for the eight years from 1890 to 1898 inclusive, for example, the working costs ranged from 80.8 per cent. of the total value of the gold produced by eighty-five companies in 1890 down to 68.1 per cent. in 1898, the last full year before the war, the decrease showing the extent of the progress made in reducing the working costs. Simultaneously the dividends increased from 19.2 to 31.9 per cent., testifying to the close kinship with the costs factor. These figures are a general average taken over the aggregate of the mines working, and do not represent the ratios of working costs of individual mines, which differ of course according to the greater richness of the ore, the fewer difficulties to

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be dealt with in winning it, and the methods employed to secure the end in view. This is exemplified by the fact that in a few of the best equipped mines costs have been brought down to as low as 17s. 6d. per ton, while on others they rise to 79s. 6d. and above. The Robinson mine is a case where, despite adverse circumstances, the enlightened employment of the latest appliances of science and mechanics has resulted in reducing costs to an extremely low level. In 1888 the working costs of the mine were 72s. 1d. per ton; in 1892 they were reduced to 46s. 5d., and in 1896 to 30s. 11d. They have subsequently been reduced to a still lower figure, and this despite the fact that the ore changed from an oxidised character to a pyritic, involving greater difficulty and cost to treat. This mine was the first to introduce frue vanners, the cyanide process and the treatment of slimes, expending as much as £80,000 in the last innovation. By means of these it raised its gold extraction from 65 to 90 per cent., and gave encouragement and impetus to all mining on these fields. The latest costs published for the month of September this year of thirty-six mines in working give an average of 26s. 3d. per ton, which shows that operating charges are now at about the same ratio as they were before the war. Although so reduced, however, they are still relatively higher than they may be expected to be when the mines settle back into their normal grooves. The reason for this is that only a few mines are now working up to their full battery power, and, while costs are on the full scale, results are less, surface dumps are being drawn upon for mill service instead of the mine itself, owing to lack of full supply of labour, &c. When, however, the effects of the important fiscal reductions just made have had time to exercise their effect in reducing the cost of imported mining stores, foodstuffs, and the smaller machinery and metal goods charged by the mines to the working account, further reductions in the working costs will be possible. Of the actual money value of this per ton of ore milled, various opinions have been ventured. It has been estimated by experts that it is possible under favouring circumstances to reduce the expense of working by some 10s. per ton, at which rate ore yielding over 5.6 dwt. per ton bullion could be made to yield a profit. The importance of this not only in improving the present position of all mining undertakings, but in stimulating the low-grade mines to come into the working stage, can hardly be overestimated. With the various difficulties besetting the mining industry removed, the future working cost level should be lower than at any preceding period, taking into account the benefit of the recent fiscal reductions and other governmental assistance in prospect.

Allusion has been made to the probable continuation of the

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Rand formation beyond its present area ; but, as a matter of fact, the Witwatersrand series of reefs, or an amplification of them, has been more or less proved for a distance of nearly one hundred miles to the north and south. The strike of the reefs is not uniformly continuous—in fact, the reefs are intersected by quite a numerous series of faults, and in many places they have been subjected to extensive denudation, to the extent of complete obliteration of the outcrop in places. Nevertheless at various points very remunerative mines have been established, and although, on the whole, the character of possessing a low-grade ore is attributed to these reefs, this is probably due more to the very incomplete prospecting to which the



GENERAL VIEW OF SURFACE WORKS. WITWATERSRAND GOLD-MINING CO.

(Photo by Horace W. Nicholls, Johannesburg)

area has been subjected than to any actual lack contrasted with the better known central section of the Rand. On this subject Mr. Bleloch makes the apposite observation that "it is not reasonable to think that only the richest portions of the Witwatersrand zones have been laid open on the surface, and that the sections which remain covered are poor. It is probable that many portions of these hidden areas contain reefs, if not rich at least payable, and this may especially be hoped for in that region where the reefs are completely hidden, and at the two ends of which, where they are exposed, they are found to be payable."

The eastern section of this greater Rand is about 30 miles in extent, or 140 miles if the contours of the outcrops be followed.

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In the western section the conglomerate may be followed for 90 miles as far as Klerksdorp, when the formation swerves back to the Vaal River. So far back as 1890 gold-bearing reefs on the banks of the Vaal River were known, and identified by experts as the south-western rim of the Witwatersrand basin; but lack of railway facilities and cheap coal then precluded their profitable working. This district is now surrounded by railways, and the circumstances are so improved that the possibility of creating a new Rand in the locality is regarded as feasible by both experts and capitalists, as, albeit only low-grade ore has as yet been met with, this is properly held to be hardly a fair index of what lies below, for experience in the Central Rand has shown that the reefs often improve lower down. The recently reported "new discoveries" of reefs actually refer to this particular district.

The prospect before these outlying areas of the Rand is further authoritatively confirmed by a recent report of the Commissioner of Mines, in which he observes: "While the expansion of the Witwatersrand is certain, the future of mining in the outlying districts will largely depend upon the introduction of a mining law which will give greater facilities and hold out greater rewards to the individual prospector and small capitalist." This observation is true regarding many other mining fields in the Transvaal besides that of the Greater Rand.

Although in speaking of gold-mining in the Transvaal the Witwatersrand is usually meant, it must not be lost sight of that the Transvaal possesses other gold-fields of great potentialities and of older date. The De Kaap fields in the Barberton district were the object of attention before those of the Witwatersrand were discovered, and at one time bulked hugely in the public eye. Unknown reserves, both of alluvial and quartz gold, exist, those reefs of the latter which have been worked yielding in many cases a much higher ratio of gold to the ton than do the famed banket beds of the Witwatersrand. The Sheba mine in this district, a case in point, is one of the most remarkable gold mines in the world, nearly 90 feet of ore having been taken out of some stopes. The quartz reefs extend over a distance of 30 miles, mainly in the hilly districts, while the alluvium occurs in most of the river valleys. The development of the district in the past has been hampered by a number of remediable causes, chief among which are unscientific working, monopolist concessions, excessive railway and customs burdens, and general governmental neglect. With the removal of these, gold-mining here is believed by experts to offer prospects not inferior, perhaps, to those of the Rand. The recent Government proclamation throwing open the district to pegging, with the contemplated modifications in

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the Gold Law favouring prospectors, are earnest that this splendid mineral reserve will at last have that justice done to it which is its due. Next in importance to the De Kaap gold-fields come those of the Lydenburg district. The gold exists here in a similar quartz reef formation, with, also, unusually rich alluvial tracts ; but not one-tenth of its resources are known, although since the start of the workings an output valued at £2,000,000 sterling has been achieved. A number of paying companies are at work, but the drawbacks under which the development of these fields labour are very much those which prevail on the Barberton fields. The northern gold-beds, including the Zoutpansberg, Klein Letaba, Murchison, Selati, &c., are likewise of the quartz formation, and they have been worked to a limited extent over a longer period than either of the two preceding fields. The Murchison gold-belt is particularly noticeable among these fields. The principal or southern reef, 18 inches in thickness, is said to extend for 18 miles, and to be workable down to 1000 feet, and to contain a gold contents of £25,000,000 sterling. The northern reef is estimated to be capable of producing £20,000,000 of gold. Development waits, in all these auriferous regions, primarily on the provision of railway facilities to get up machinery and mining requisites ; and the extension of the Pietersburg line, which has been promised, or the completion of the long-projected Selati railway from where it left off, would be as the breath of life to the mining industry here. Two other promising mining fields, generally separately grouped but really a portion of the De Kaap system, are the Komati or Steynsdorp and the Swazieland gold-fields. The former exists on the Swazieland border, not far from Barberton, and is rightly regarded as merely an outlier of the mineral formations of that district. The numerous reefs have, however, only yielded as yet low-grade and refractory ores. The Swazieland fields have only been prospected in the north-west of that territory, but the results have shown that a considerable body of ore exists. Its gold output in 1898 totalled 8256 oz. Minor fields are those of Malmani, on the western border near Mafeking, the Pretoria quartz reefs, and the banket beds of Vryheid (the last now incorporated into Natal). The prospects of all these fields are very large, and their requirements are alike. Conditions tending to lessen the cost of working, and facilities to induce the advent of the prospector and to justify the investment of capital, will reverse in their cases the dubious records of the past, while adding immensely to the wealth of the Transvaal's gold production resources.

The sum of the foregoing observations is that the future of the Transvaal mining industry presents a vista of incalculable prosperity. In the restricted area of the Central Rand alone there is a treasure



PRITCHARD STREET, JOHANNESBURG

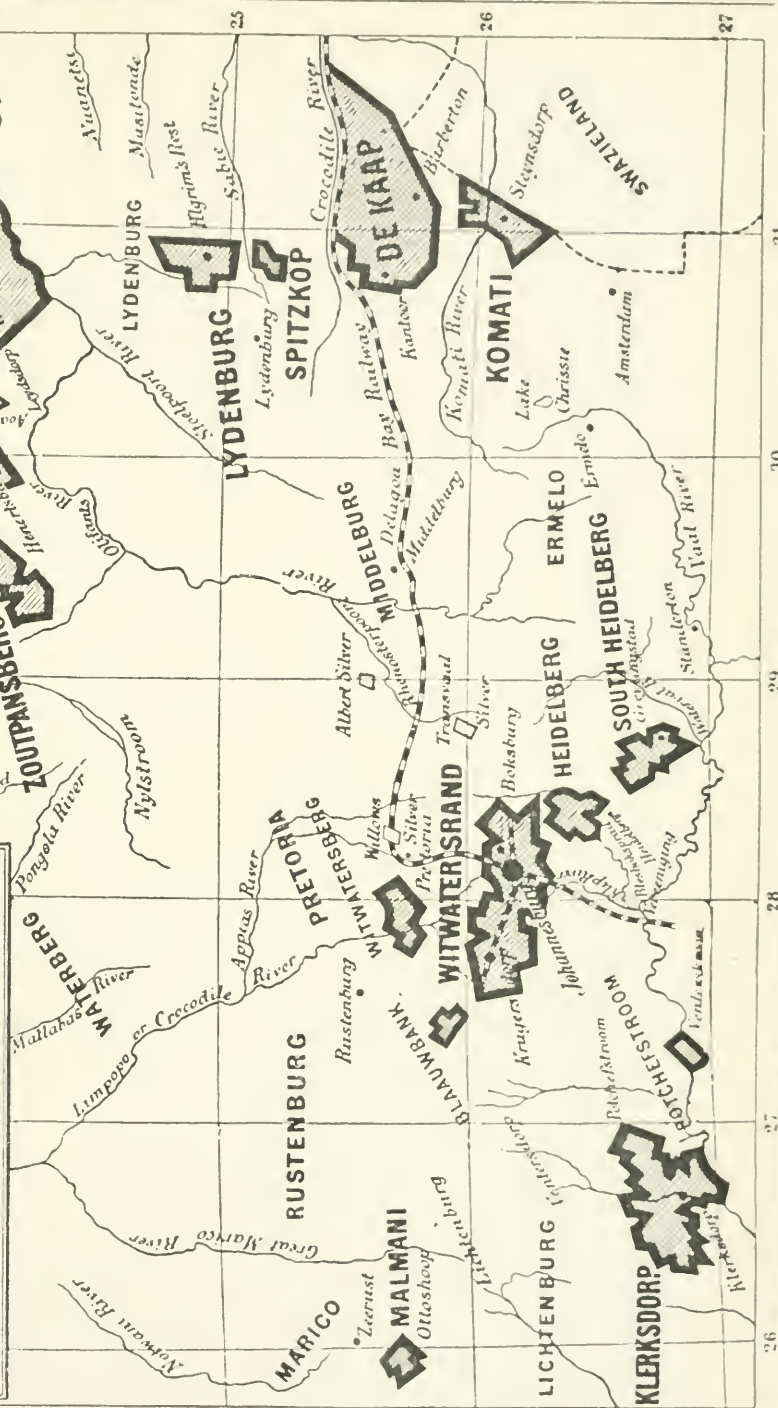
Photo by Herbert W. Nicholls, Johannesburg

MAP

SHEWING THE RELATIVE POSITIONS
 OF THE
TRANSVAAL GOLD FIELDS.
 THE VARIOUS FIELDS ARE ENCLOSED
 IN BORDER THUS



English Statute Miles.



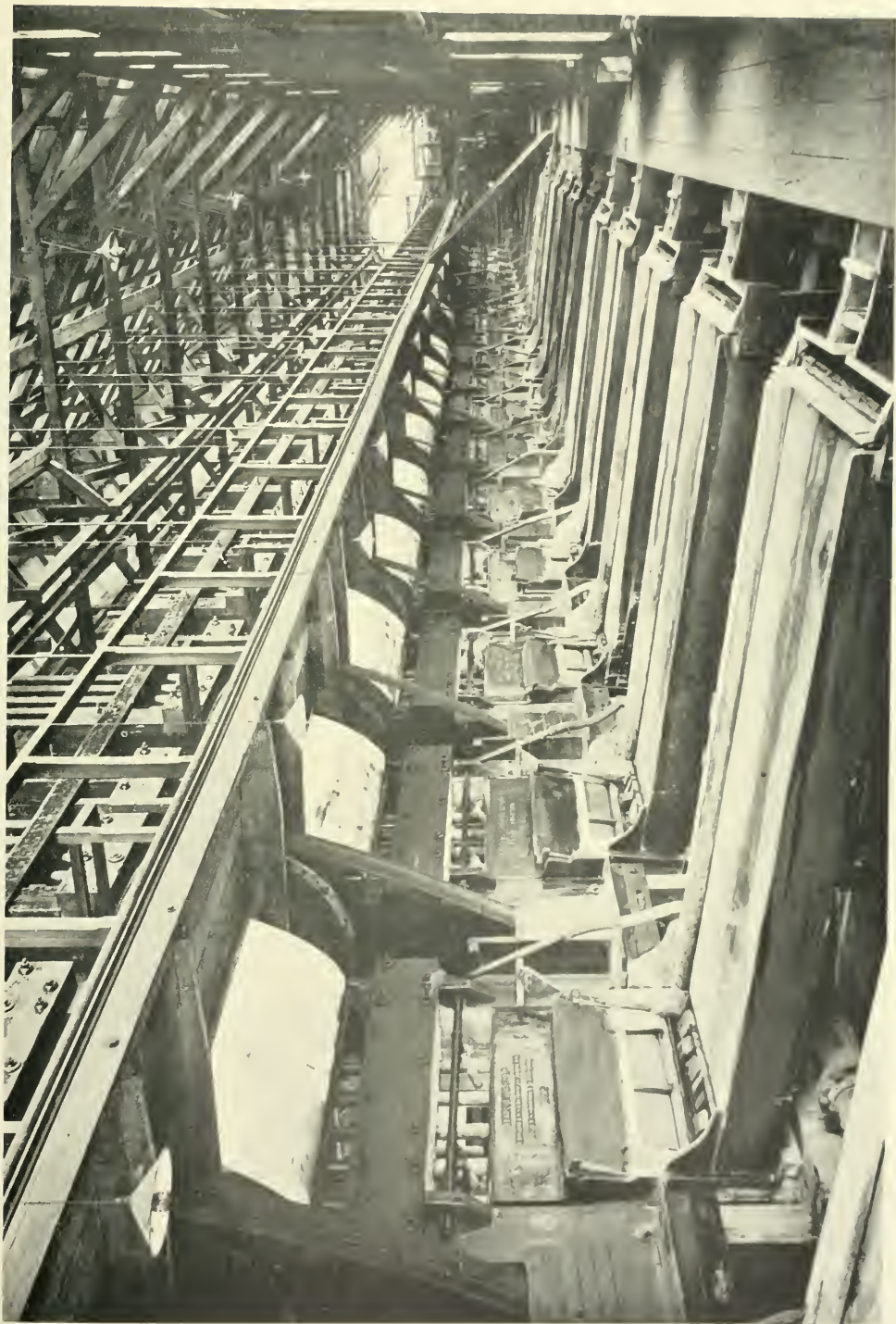
From "South Africa," by permission.

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of at least £2,871,000,000 awaiting appropriation ; and, beyond this huge sum, there are reserves in the Greater Rand which, reckoned on the basis of mileage alone, would sixfold this amount. Moreover, as the confines of the Rand reef formation have not yet been determined, should they be found to stretch into Natal and Zululand on the one hand, or into Rhodesia on the other, as recent discoveries would seem to indicate, the productive possibilities of the future are enlarged proportionately. Apart from its banket reefs the Transvaal likewise possesses huge gold reserves in its quartz reef fields in the De Kaap, Lydenburg, Zoutpansberg, and other districts to the south-east, east, and north, not to speak of the already opened and promising grounds on the extreme west, which await development when the Rand conglomerate beds are exhausted, if they do not—as in all probability they will—receive attention beforehand. The value of these resources is attested by the best of all evidence—that of actual productive yield in the past. In the matter of circumstances, means, and paying results from mining, it has been shown, and it is incontestible, that the industry now stands, in every particular, upon a much more advantageous basis than it ever enjoyed. As regards processes and mechanical appliances, the new era opens with the substantial asset in hand represented by the accumulated skill and knowledge of past painful and costly experience and experiment, so that new mines making a start may lay down their equipments with the greatest practical certainty and economy and assurance of successful results, even on low-grade properties previously deemed unremunerative. In respect of external circumstances, the conditions are already so improved, or in course of improvement, that working costs have been—and will be more so in the future, when all the beneficent proposals contemplated by the Government, and the local advantages resulting from the new order of things have had time to come into operation—lessened to the extent of yielding substantial accretions to the dividends of the already paying mines, while facilitating the development of the deeper mines, and the multitude of minor low-grade concerns hitherto incapable of profitable working. Estimates have been adventured in the earlier part of this chapter of the amount of the saving of working costs to the extent of 10s. per ton, but this is a pure approximation, and the actual outcome is likely to be twofold or more. Similarly the yield of gold per year from the Rand central district of 37 to 40 millions is only a rough estimate, the production in the future, as in the past, being likely to be much above the forecasts, taking into view the beneficent circumstances which will henceforth rule, the full appraisalment of which is at present impossible.

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Altogether, therefore, the outlook is one of undimmed brightness, for the misgivings entertained in some quarters regarding new taxation burdens to be imposed, calculated to hamper or hinder the progress of the industry, must be allowed to have no shadow of substance. The pronouncements of the Government hitherto, and the recommendations of their Transvaal adviser, are clear on this head. Taxation will naturally have to be borne, and the tax on profits was accepted in principle by the mining industry before the war. Its incidence, whatever be the amount, will only reduce to a fractional extent that portion of the yield set apart for dividends, which will bear the burden, whatever it be, with the greater ease in view of the accretion of dividends rendered possible by the new conditions. There are, indeed, grounds for assuming that a part of the agitation on foot is lacking in singleness of aim, and engineered by persons who have some secondary object to gain. The rank and file of the mining industry, as well as the best sense of the Anglo-Saxon community, has, however, confidence in the Government that it will do nothing harmful to the best interests of the new Colonies in general, and its staple industry in particular, and, moreover, will be true to the English principle of inviting the taxed to its councils. It is in this particular light that the visit of the Secretary of State for the Colonies to South Africa has such special interest at this juncture.



MILL (OR BATTERY) OF A GOLD MINE (SALISBURY AND JUBILEE, JOHANNESBURG)

The powdered ore is washed down over the plates. The deafening roar from the stamps sounds in quiet evenings, from a distance, like the roar of the sea on a rocky coast.

Photo by Barnett & Co., Johannesburg