

Manpower utilization in South Africa with special reference to the mining industry

By H. H. McGREGOR, B.Sc.(Eng.)(Rand), (Fellow)

SYNOPSIS

Changes in the national productivity (gross national product per head of the population) have been assessed in order to derive a target figure for the required annual increase. The conclusion reached is compared with the targets of the economic development programme of the Republic. Productivity and management structure in the gold mining industry is then analyzed together with investment in plant, machinery and equipment for rock handling purposes. The conclusion is drawn that productivity improvement does not appear to have accorded with the massive expenditures in plant and equipment, and in augmented management.

The productivity of the manufacturing and construction sectors of the economy has been examined. The principal difficulty is that the main avenue of approach is the value of product divided by the total labour force. This introduces inflationary questions, and the use of a suitable deflator becomes of prime importance. Several different methods of assessing the productivity improvement in the industrial sector have been used with what is regarded as a comparatively high degree of compatibility.

Improvements in productivity in the manufacturing industry up to 1966 appear, from the information available, to have substantially exceeded comparable figures for the mining industry. There is however evidence that thereafter productivity of the manufacturing industry has not maintained this satisfactory rate of increase.

If the economy is to achieve the planned rate of expansion, there is no doubt that greater attention to this aspect will be required in the future than has been accorded to it in the past.

INTRODUCTION

The world today is rapidly becoming a single economic unit. The Western nations particularly are so closely knit by trading and financial links that national economic health or ill health, as the case may be, are quickly felt beyond a country's immediate borders.

For this reason, national economies are now examined by potential investors from the standpoint of their ability to sustain a rate of growth which accords with or is in excess of the requirement of a continually rising standard of living for the whole population. With the passage of time, and with improved communication and all that this means, standards of living in the industrialized countries are not only improving rapidly, but for practical purposes are committed to continue improving at an increasing rate. Politicians everywhere have become acutely aware of this, since it is the overriding factor which in most countries strongly influences government policy.

The standard of living in a country is directly related to its manpower productivity and the gross national product per head of population provides a measure of both. The question is then asked: 'What should the annual increase in manpower productivity be, if the economy is to achieve its planned rate of expansion and consequently the expected improvement in standard of living?'

Having analyzed a target that can be achieved in these terms, the manpower productivity in the gold mining industry is examined in some detail. Interesting trends are discernable in relation both to the foregoing target and the investment of the industry in ore handling mechanization and augmented European and Bantu supervision.

Some investigations have then been made into productivity in the manufacturing and construction industries, for which relevant statistics abound, but which are of varying orders of accuracy. An assessment of changes in productivity in manufacturing industry is therefore somewhat complicated, and various methods of approach have been used to obtain a mean result. This analysis has not,

to the writer's knowledge, been made in this form previously and may provoke criticism of some of the methods used. However, it does represent a conscientious effort to assess the productivity changes in these sectors.

The changes in productivity in manufacturing and construction are then compared with the changes achieved by the mining industry over the same period. Certain general conclusions are then drawn.

In 1958, the late Professor R. A. L. Black presented a paper entitled 'A review of progress in mechanization in the mining industry of South Africa'¹. The author has regarded it a fruitful and interesting approach to the whole problem to bring Professor Black's statistics, which covered the years 1947 to 1956, up-to-date as far as is currently possible. The reason for this is that the basic theme of Professor Black's paper was an analysis of the effects on productivity within the mining industry of advances in mechanization. He came to certain conclusions, having given the basic logic behind them, which in the light of today's information are very interesting indeed.

The principal difficulty of presenting a paper of this nature is the massive quantity of statistics which have been examined and which cannot possibly all be reproduced. The unpublished information is, however, available to anyone who may wish to pursue these lines of investigation further.

NATIONAL PRODUCTIVITY

The general standard of living of a nation is directly related to its level of productivity which, from a statistical point of view, is best expressed by comparing the rise (or fall) in the real domestic product with the rise in the population. To obtain the real domestic product, the figures at current prices must be normalized to a base year, in order to eliminate the effects of currency depreciation.

Between 1918 and 1968, the number of people in South Africa approximately trebled, but the gross

*Chairman, P-E Consulting Group S.A. (Pty.) Limited.

domestic product of the country, at constant price, increased more than eightfold. The result was a rise of some 2.2 per cent per annum for the whole 50-year period. It is particularly important to note, however, that for the past 20 years this annual rise was approximately 2.8 per cent per annum. (Throughout this analysis, when assessing percentage improvement over a period, the figure given will be the compound interest, i.e. the actual improvement each year over the previous year.)

The foregoing figure of 2.8 per cent per annum is most important, since it is a measure of the annual increase in real output per head of the total population, and consequently of the real increase in the standard of living. Moreover, during the last 20 years, the economy has been, by and large, in a healthy state. The figure thus provides an acceptable answer to the question: 'What is the expected annual increase in productivity in a healthy economy?'² and may be regarded as the target of the future economic development programme of the Republic.

Over the past two decades, the gross domestic product at current market prices increased from R2 178 million in 1948 to R10 283 million in 1968. However, over this period there was a substantial inflationary trend, and the gross domestic product, reduced to 1958 constant prices, shows an annual growth rate for 1948 to 1957 of 4.4 per cent, from 1957 to 1962 of 3.9 per cent and from 1962 to 1968 of 6.2 per cent per annum. Corresponding rates of increase of tonnage milled in the mining industry are approximately 2.75 per cent, 1.37 per cent and 0.75 per cent respectively. In assessing the achievement of the gold mining industry it is important to establish these figures because all managers are aware of the relative ease of increasing manpower utilization with rapidly expanding output. Forecasts are that the output of gold mining is likely to fall slightly. This at once accentuates the difficulty of achieving a rise in productivity and at the same time increases the need for it from a national point of view.

THE PRODUCTIVITY PATTERN IN THE GOLD MINING INDUSTRY

Equipment

Professor Black's paper¹, produced information which showed, in juxtaposition, the total tonnage milled by the gold mining industry, and the number of units of electric motors, locomotives, scrapers, haulages, loaders and winches, and cooling and air-conditioning plants purchased. This analysis enabled him to draw some conclusions relating expenditure on mechanization to manpower utilization. He stated that: 'The large increase in mechanization (between 1947 and 1956) does not therefore appear to have been reflected in a corresponding large increase in productivity.'

Comparable figures of the value of equipment purchased under the foregoing headings is available for the period 1957-1968. In order to analyze the total series, the first ten years of which were set out in Professor Black's paper, values have been taken out for the whole period, i.e. 1947 to 1968, and these have been deflated by a wholesale price index constructed to cover it (Table I)³.

The foregoing information has been plotted, for convenience, on log normal paper in Fig. 1. The fact that the information has been corrected to the wholesale price base of 1948, enables some interesting information to be deduced, of which the following is the most important:

TABLE I
VALUE OF EQUIPMENT PURCHASED BY GOLD MINES, AT CONSTANT PRICE (1948 = 100) AND £1 = R2.00

Year	Millions of tons milled	Value of equipment purchased—complete units at constant price (1948 = 100)				
		Electric motors R000	Locomotives R000	Scrapers etc. R000	Cooling and air conditioning plants R000	Wholesale price index
1947	54	233	388	368	1	—
1948	55	299	337	429	7	100
1949	57	506	318	545	177	102.7
1950	60	617	444	566	52	107.0
1951	59	674	566	664	15	116.9
1952	60	797	887	1 176	69	137.5
1953	59	907	883	1 292	123	143.1
1954	62	842	953	1 151	132	144.2
1955	66	617	617	1 272	19	151.2
1956	68	628	726	1 220	86	154.5
Total 1947 = 1956 incl.		6 120	6 109	8 683	681	
1957	66	850	1 320	1 124	368	157.8
1958	66	1 028	664	1 465	407	158.8
1959	70	1 090	611	1 706	136	157.9
1960	71	915	787	1 752	108	160.7
1961	73	793	874	1 898	230	164.2
1962	76	723	810	2 075	75	164.5
1963	78	939	727	1 957	357	166.8
1964	80	510	864	1 891	360	171.8
1965	80	638	804	1 761	159	176.3
1966	78	526	643	1 707	295	183.5
1967	77	557	846	1 395	126	188.6
1968	79	643	887	1 633	540	190.8
Total 1959—1968 incl.		7 343	7 853	17 775	2 386	

Sources: (1) Value figures from Transvaal and Orange Free State Chamber of Mines Annual Reports.

(2) Composite wholesale price index (1948 = 100) constructed by Union Acceptances Limited—Statistics Branch from South African Statistical Year Book.

- (i) The rate of annual increase indicated in Professor Black's paper was not maintained beyond about 1954/5, except in scraping, loading, haulage and winch equipment. The rate of increase of annual purchases of these items continued until 1962 and and only then tapered off.
- (ii) Since the figures shown represent annual purchases, it is difficult to do more than obtain a broad indication of whether or not the total valuation of equipment under these headings at work in the mines has increased. However, making the approximation that the equipment should be written off after 10 years, certainly on balance conservative, the 10-year moving average of the deflated values of equipment purchased gives some idea of the capital valuation at 1948 standard, and consequently of the total quantity of equipment in use. The arithmetical approximations in this exercise are fully appreciated, but nevertheless the figures are indicative.

Between the two comparative periods of the 10 years ending 1956 (Professor Black's period) and the 10 years ending 1968, electric motors in use appear to have increased by 20 per cent, locomotives by 29 per cent, haulages, scrapers,

loaders, and winches by 104 per cent, and cooling and air-conditioning plants by 250 per cent. In proportion to tonnage milled, locomotive and motors in use have remained almost constant, whilst scrapers, haulages, loaders and winches have almost doubled, and cooling equipment has trebled.

(iii) Analyzing this scraper and related equipment figure still further, the capital investment at 1948 prices has risen from approximately R8.6 million to approximately R17.7 million. The actual expenditure at current prices has gone up from R11.6 million to R30.5 million.

Labour complement

A broad analysis of labour at work⁴ is given in Table II.

From this table it is evident that:

- (i) The number of boss boys in work underground has nearly doubled from 15 500 in 1944 to an estimated 30 400 in 1969, the greater part of this increase being between 1959-1969.
- (ii) Locomotive and winch drivers have increased from 3 300 in 1944, to an estimated 29 920 in 1969, the greater part of the increase being between 1959-1969.

Over approximately the same period as that of Table II, underground officials, exclusive of engineering department, rose from 3 790 to 6 602 (74 per cent). Approximately over the same period machine and spanner labour rose by 16 000 to 35 200 (119 per cent)⁴.

The foregoing information corroborates strongly the figures given under the heading of Equipment Purchases, indicating that the operative and supervisory labour structure changed substantially commensurate with the quantity of mechanical equipment at work.

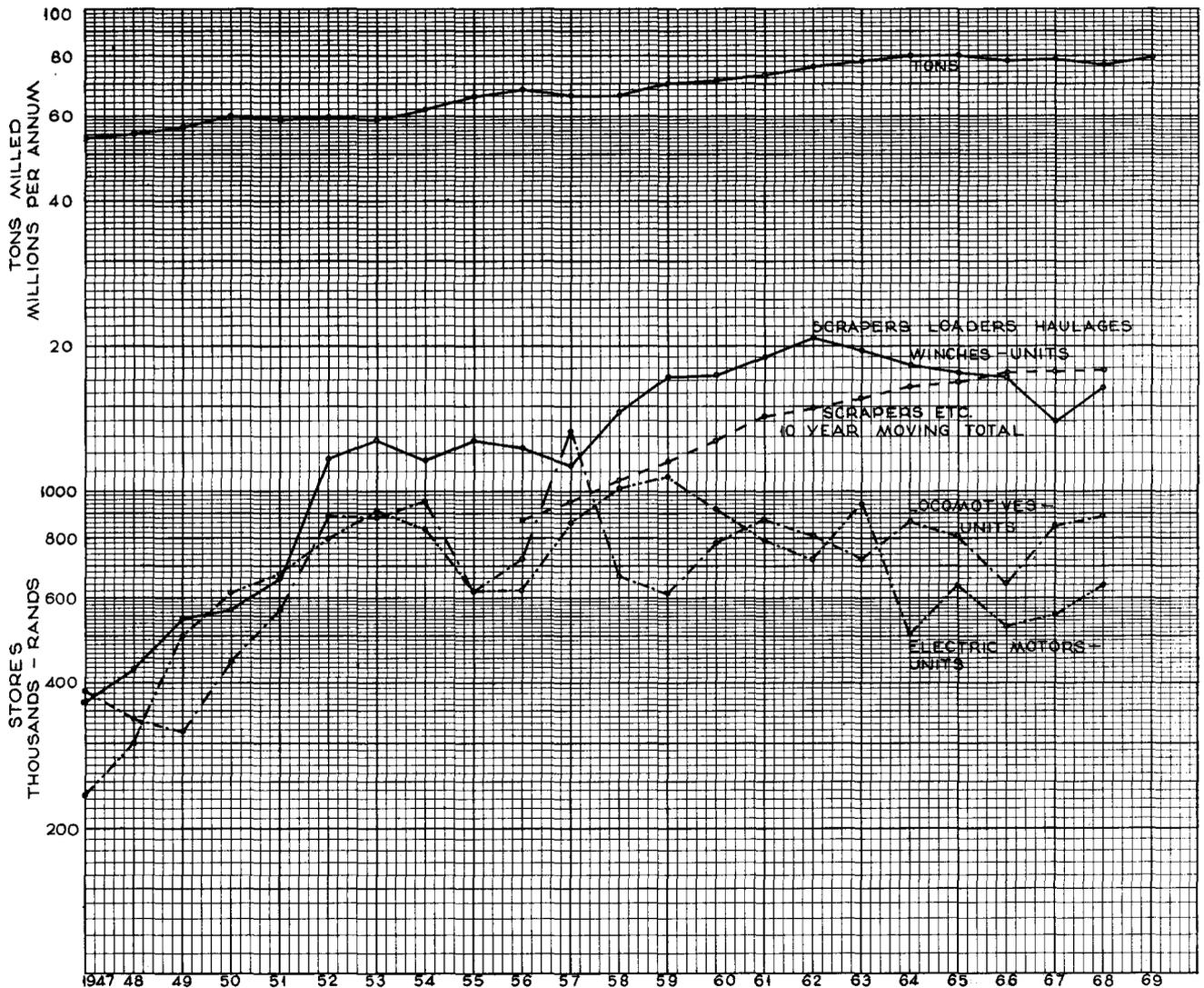


Fig. 1—Tons milled and stores purchased by gold mines, members of the Chamber of Mines

Notes: 1. Stores purchased refer to value of complete units only.
2. All values are corrected by the Wholesale Price Index 1948 = 100.

Source: Chamber of Mines Annual Reports.

TABLE II

NUMBER OF BANTU AT WORK ON GOLD MINES MEMBERS OF THE CHAMBER

Occupation	1944 ¹		1949		1954		1959		(Estimated) 1964 ²		(Estimated) 1969 ³	
	Under-ground	Surface	Under-ground	Surface	Under-ground	Surface	Under-ground	Surface	Under-ground	Surface	Under-ground	Surface
Boss Boys	15 500	1 700	18 600	2 100	20 500	4 500	22 100	3 450	28 500	2 100	30 400	3 480
Labourers:												
(i) Loco and winch drivers*	3 300	49 500	200 000	63 000	8 200	64 000	12 000	67 500	25 000	54 000	29 920	55 080
(ii) Others	210 000				186 500		248 500		218 500			
Monthly paid Bantu, Coloureds and 500 Asiatics		2 500		3 000		4 000		6 000		8 000		10 000
Grand total	228 800	53 700	218 600	68 100	215 300	72 500	282 600	76 950	272 000	64 100	278 680	68 560

*This figure was obtained from the occupation 'Hoisting, including winch drivers'.

(1) The 1944 figure is obtained from the 1943 Witwatersrand Native Wages Commission.

(2) The 1964 figure is calculated from an average sample of 6 months for the period July to December, 1965.

(3) The 1969 figure is calculated from an average sample of 6 months for the period January to June, 1969.

Source: Chamber of Mines—Statistical Department.

Electrical energy

During the 10 years covered by Professor Black's paper, from 1947 to 1956, the megawatt hours per total employee in the major gold mines, rose from 9.3 to 16 (72 per cent). From then to 1968, the figure rose to 25.7 (61 per cent). The megawatts per thousand tons milled rose from 55.8 in 1947 to 88.4 in 1956 (58 per cent). From then to 1968, the corresponding increase was to 129.0 (46 per cent).

Changes in productivity

Fig. 2 shows the changes in productivity for the various categories of mining activity in South Africa, and also for the Rhodesian gold mining industry.

It is interesting to note from the results of all sections of the mining industry, that a discontinuity in the trends appears to show itself in the period 1957/58. In some instances, this goes on as far as 1961, as in the gold mining industry, whereas in the coal mining industry its limit seems to be 1959. In the iron ore industry, this period extended for the full seven years from 1957 to 1964, during which productivity showed no significant trends one way or the other. In the gold mining industry, the static trend continued until 1961, and only after that year did improvements emerge.

The foregoing is almost certainly connected with the recessive trend which took place in the country between the years 1958 to 1962. Quoting Union Acceptances Limited's analysis of this period: '... the rate declined to 3.9 per cent (growth in gross domestic product) during the years 1957/62. A recession in the United States and the consequent slow-down in other industrialized countries reduced the demand for South African exports in 1958 and a net capital outflow occurred in 1959. The latter accelerated during 1960 and the first half of 1961, as the result of the decline in the confidence of foreign investors.'

During this same period employment of both Whites and Bantu tended to a peak in the gold mining industry, reaching a figure in 1961 of a total of 433 476 at work. This figure has never again been equalled and in 1968 was down to 395 142. Improvements in output did not correspond, which accounts for the falling productivity during that period shown on the graphs in Fig. 2.

Assuming that productivity in gold mining is broadly measured by tons milled per employee, the summarized information in Table III has been extracted to give the comparison between Professor Black's ten years, and the following 11 years.

TABLE III
COMPARISON OF PRODUCTIVITY 1947, 1958 AND 1968—
MAJOR GOLD MINES

Year (Incl.)	Yearly tons milled per employee			Approx. annual percentage increase between years		
	White	Bantu	Total	White	Bantu	Total
1947	1 590	185	166	—	—	—
1958	1 610	197	176	< 4	4	1 1/2
1968	2 270	219	199	3	1	1 1/4

Source: Chamber of Mines Annual Reports.

The difference in the yearly rates of improvement between the two periods is interesting. Whilst there has been a significant improvement in White labour utilization, the figure for Bantu shows negligible change, and the doubling of the overall rate of increase is due almost entirely to the White achievement. Professor Black's comment in 1957, quoted earlier that: 'the large increase in mechanization does not appear to have been reflected in a corresponding improvement in productivity' seems still to be correct. Furthermore, the increase falls far short of the national target improvement in GDP per head of 2.8 per cent postulated in paragraph 2.

It is worth examining these questions more closely. The apparently disappointing performance of the mining industry is however attributable to certain aspects of the statistics which are difficult to analyze. Operations are being carried out at deeper levels with greatly increased power requirements for ventilation and hoisting, the inflows of water appear to be increasing resulting in higher expenditure, and the proportion of waste hoisted also seems to be rising. In addition, the proportion of waste sorted from the ore hoisted is increasing, and this

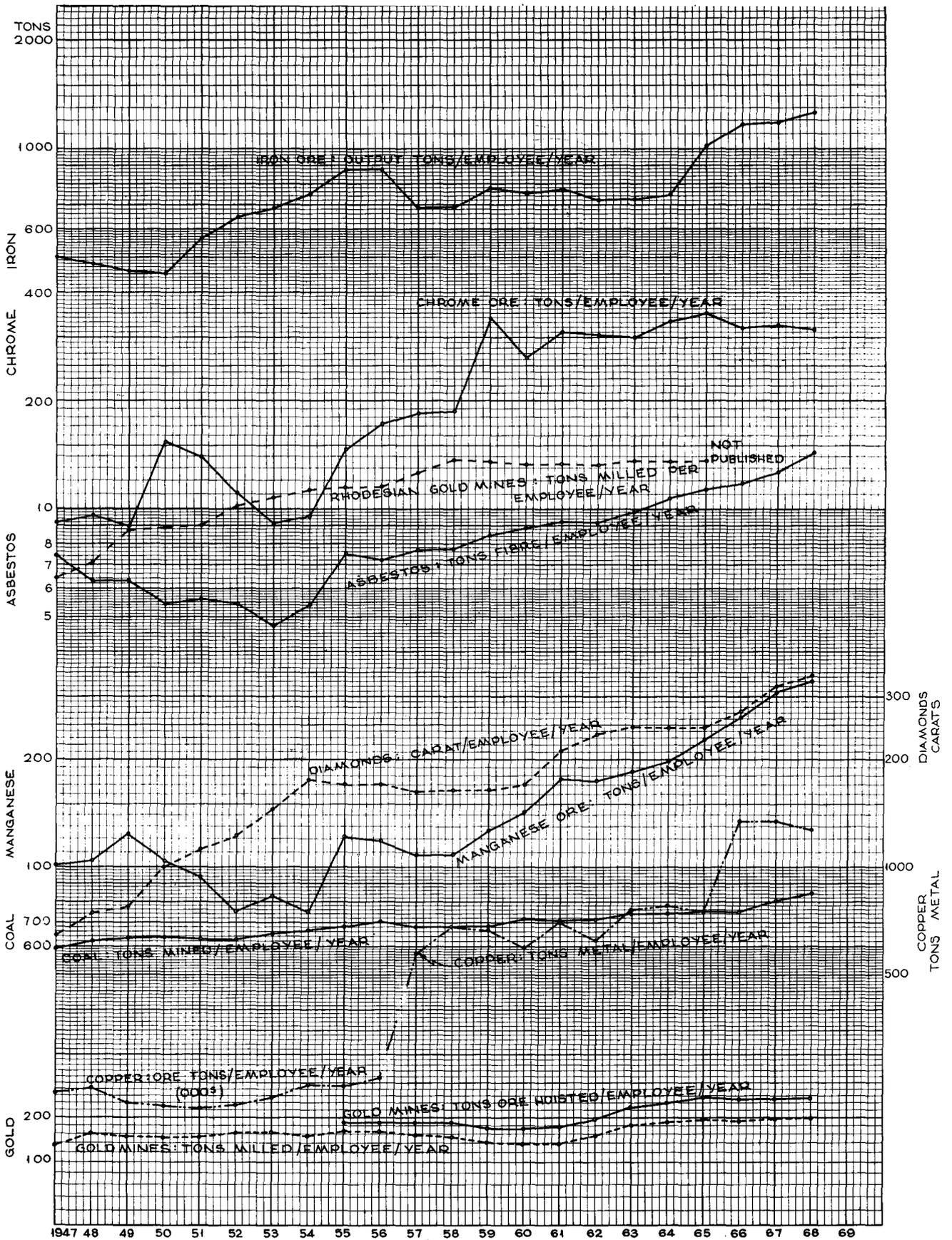


Fig. 2—Employee productivity—mining industry

Source: Department of Mines Annual Reports.

depresses the productivity index used, since much of the total work on a ton of ore has already been performed before it reaches the mill. If at this stage a larger proportion is sorted out and dumped, the remaining index of tonnage milled is unduly depressed. With the assistance of the Statistical Department of the Chamber of Mines, a careful analysis was made of this question, from which it appeared that using the figure of ore hoisted before sorting as the output index, the output per employee was 192 tons per annum per total employee in 1958 and increased to 227 in 1968. This raises the improvement over the period to approximately 1.37 per cent per annum. This figure is still significantly below the increases in mechanical equipment and directly related labour at work in the mining industry, and also significantly below the average national increase in gross domestic product per head of the population at fixed prices.

This appeared to indicate that the picture of productivity in the mining industry needed still further analysis. This was carried out, again with the assistance of the Statistical Department of the Chamber of Mines, to show the performance of tons milled per Bantu and White employee, in the various regions of the gold mining industry, viz. Witwatersrand, Orange Free State, Far West Rand, Evander and Klerksdorp.

Table IV indicates these results.

From them it would appear that:

- (i) The increase in White productivity has been considerable, and in every case except one, exceeds or approaches the target figure of 2.8 per cent mentioned earlier in this paper. Even the Witwatersrand area, the one falling well below this figure, does not indicate an unimpressive achievement, having regard to the age of the properties involved. The conclusion is therefore that a satisfactory rate of improvement in European manpower utilization has been achieved, with variations, throughout the industry.
- (ii) In one case only, namely the Orange Free State gold fields, has Bantu productivity improvement at 2 per cent approached the target. In three areas the figure achieved is less than 1 per cent each year, whilst in the relatively new gold field of Evander, the figure achieved is 1.33 per cent each year. (1969 figures were not available but could modify these conclusions.)

Conclusions

The gold mining industry has not achieved over the last 11 years an overall increase in its manpower productivity corresponding to the massive expenditure on mechanical equipment, related labour categories and augmented management.

For those who study this question, many reasons for this situation can be found, and undoubtedly the most important centres around the fact that the gold mines, despite their large number of employees, are highly capital intensive. It is therefore much more important to be reasonably certain of achieving the planned tonnage throughput and consequently revenue producing capability of a mine, than to save labour, thereby risking, in a seasonal shortage, falling below the planned throughput rate. Such an eventuality may cause a loss in revenue far exceeding any saving in labour. The seasonal trends in labour supply to the industry clearly aggravate the problems of achieving a continually improving manpower utilization. Nevertheless, the fact remains that certain areas of the mining industry have found themselves capable of approaching the required targets. Whether or not significant reasons for this exist, which differentiate them from other areas, or whether the facts disclosed indicate the need for some re-orientation of emphasis, must be for subsequent investigation.

Improvements in White labour productivity, by both officials and union men, represent a worthwhile achievement by the industry over the past 11 years in manpower utilization. The following table, though not quite for the interval under review, gives an interesting indication of areas which contributed most to the improvement.

The total reduction in White labour at work during the period was 6 747 of which the above categories therefore account for about two-thirds. Each category has something in common, such as major change due to capital investment, e.g. larger and more automated reduction works, use of computers for administration, and deeper single lift shafts. The improvements achieved are therefore more in capital utilization than in direct raising of manpower productivity on comparable tasks. If allowance is made for the effect of these capital investments, the improvement in the annual tons milled per White employee shown in Table III drops from 3 per cent to 2 per cent.

TABLE IV

TONS MILLED PER EMPLOYEE

Area	1958 Tons milled per employee		1968 Tons milled per employee		Percentage increase for			
	Whites	Bantu	Whites	Bantu	White employees		Bantu employees	
					Period	Yearly†	Period	Yearly†
Witwatersrand	1 865	218	2 431	229	30	1½	5	<½
Orange Free State . .	1 442	176	2 693	243	87	6	38	2
Far West Rand	1 320	196	1 918	203	45	3½	4	<½
Evander	2 225*	223	3 412	270	53	4	21	1½
Klerksdorp	1 308	167	1 759	184	35	2½	10	¾

*1959.

†Approximate from interpolation of tables.

TABLE V

PRINCIPAL CATEGORIES IN WHICH WHITE LABOUR HAS BEEN REDUCED
(Average numbers of Whites at Work)

Category	1959	1969	Reduction
Surface			
Uranium and reduction works—			
Officials	1 013	641	372
Union men	2 608	1 278	1 330
Clerical—			
Officials	4 016	3 241	775
Mechanics, etc.—			
Union men	5 215	3 694	1 521
Underground			
Winding engine drivers, etc.	1 031	679	352
Total	13 883	9 533	4 350

Source: Chamber of Mines—Statistical Department.

A further point that emerges from examination of the achievement of individual areas (Table IV) is that the utilization of both White and Bantu is higher on the older mines of the Witwatersrand than on those in the Klerksdorp and Far West Rand areas, and is not very different from that in the Orange Free State area. This fact tends to cast doubt on the contention that productivities are adversely affected by increasing depth and age—the older mines seem to be achieving creditable results compared with some of their younger contemporaries.

MANUFACTURING AND CONSTRUCTION INDUSTRIES

General

Many attempts have been made from time to time to assess the productivity of manufacturing industry in the Republic. A difficulty arises due to the absence of any common measure, and the investigator is forced to use the device of analyzing the gross value of production in the industrial and construction categories, and relate this to the total labour employed. This method has been followed except in one case, which depended on the physical production index supplied by the Bureau of Statistics. A further problem arises in that the information available from the Bureau is approximately four years in arrear. Consequently the assessment of an up-to-date position is greatly complicated by extrapolations, with all the possible sources of error which such a course involves.

The greatest difficulty however is the selection of suitable factors for offsetting inflationary effects to convert the figures to the equivalent of physical output in a base year.

The various methods used are discussed below. The degree of correspondence in the productivity changes shown by the methods used, has been remarkable, particularly over the last ten years. To illustrate this, all have been plotted in Fig. 3, and it is believed that the overall result obtained is a close approximation of the true position.

Method of extraction of information

The curves of output per employee at constant prices plotted on Fig. 3 were derived as follows: Figures were extracted from the Bureau of Statistics reports of the value of gross and net outputs in the construction and manufacturing industries and the employment totals in each category. The outputs were divided by the employment totals to provide an index at *current prices* of the value of output per worker, on both a gross and net output basis in the categories of manufacture and construction.

These figures were then adjusted by one of the various appropriate deflators, namely the wholesale price index for South African manufactured goods, the wholesale price index for construction and building materials, the gross domestic products deflator or the Du Pisanie deflator used by Union Acceptances Limited for various purposes.

An alternative approach to the whole question of productivity in the manufacturing sector, is the use of the estimated physical volume of production index (excluding construction) synthesized by Union Acceptances Limited, from two basic series of indices—1952/53 = 100 and 1956/57 = 100. This index of production, which has the advantage that it can be extended with reasonable accuracy to 1968, was then divided by the total employment figures in construction and manufacturing industry to give an index of productivity. Since the original figures used represented an index of the physical volume of production, questions of price inflation do not obtrude in this method.

An analysis of information contained in the Bureau of Statistics' news release dated 19th March, 1969 was then made to obtain the value added in the manufacturing industry. This again was related to the number of employees in manufacturing industry described earlier, and adjusted by the wholesale price index.

Discussion of results

In Fig. 3, all the results are plotted for the period 1945 to 1968, over the ranges of dates through which they are available (a summary is given of the basis of calculation used for each curve.) Curve No. 7, which is the physical volume of production index divided by the employment figures for the period 1946 to 1968 is considered the most reliable. The productivity growth figure from this curve will be used in the present analysis. The other curves are shown largely because of the interesting correlation of results over the last 10 to 12 years. Before that period there is considerable variation and divergence with anomalies of various kinds, analysis of which would make an interesting economic exercise, but which would not materially assist the present investigation. Suffice it to say that for various reasons the index of manufacturing and construction productivity appears to be reliable from about 1956/57 onwards. The various indices of production shown vary between 25 and 45 per cent for manufacturing, and between 20 and 25 per cent for the construction industry over the full periods plotted. The comparable information on an annual basis, is that manufacturing industry varies from 2.25 per cent to 3.75 per cent per annum, while the construction industry appears to vary from 2 per cent to 2.25 per cent per annum.

In the case of Curve 7, the figure of 45 per cent relates only to the eight years 1956 to 1964. From then onwards, the productivity index tapers off, and remains sensibly static. This is because the physical volume of production

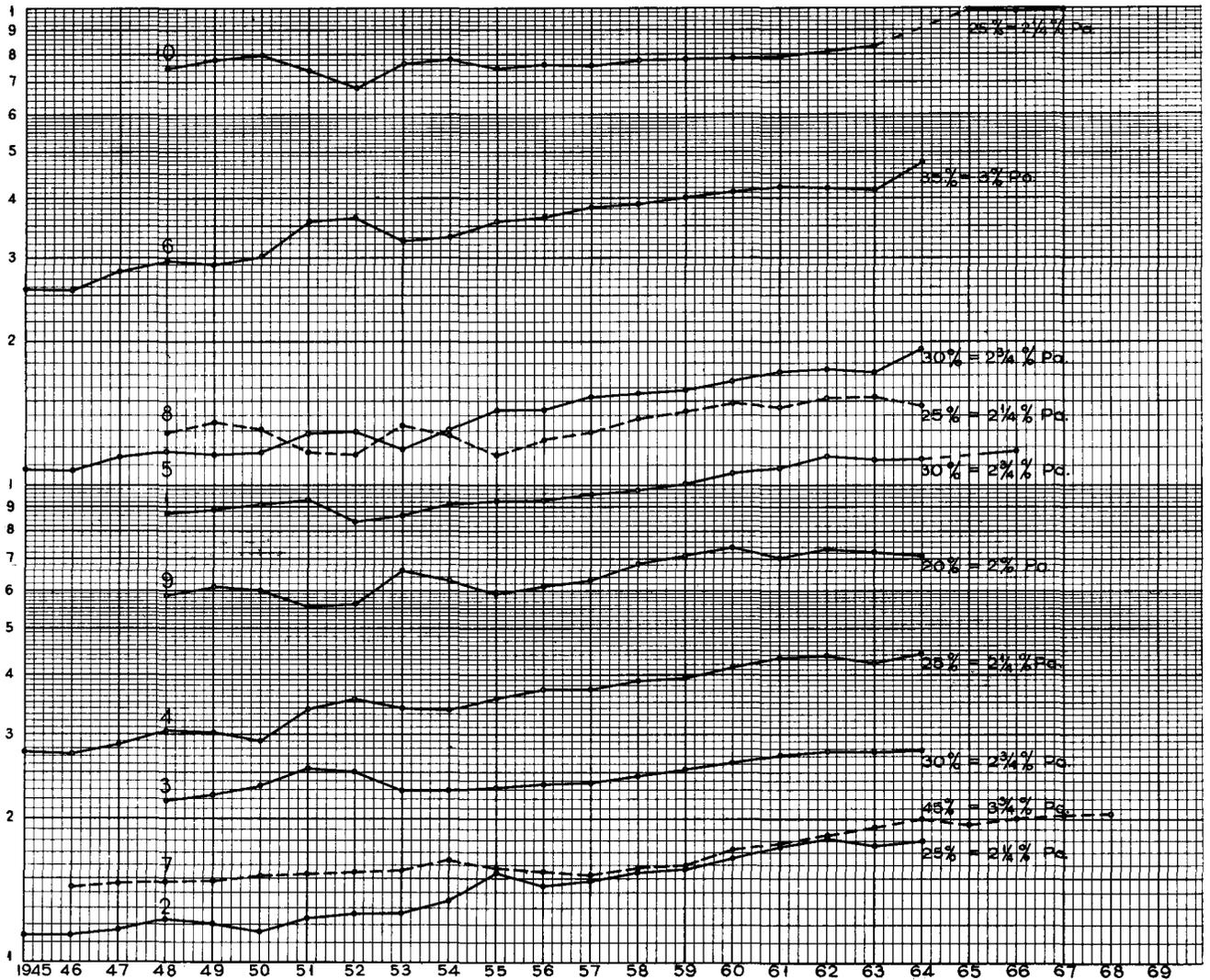


Fig. 3—Manufacturing and construction industries: Output per employee at constant prices
Basis of curves.

1. Manufacturing industry—net output corrected by U.A.L. whole price index.
2. Manufacturing industry—net output corrected by the Du Pisanie GDP deflator.
3. Manufacturing industry—gross output corrected by the wholesale price index.
4. Manufacturing industry—gross output corrected by the Du Pisanie GDP deflator.
5. Manufacturing industry—net output corrected by the Du Pisanie deflator.
6. Manufacturing industry—gross output corrected by the Du Pisanie deflator.
7. Manufacturing industry—estimated physical volume of production related to total labour employed (period 1956-64).
8. Construction industry—gross output corrected by the wholesale price index (source: U.A.L.).
9. Construction industry—net output corrected by wholesale price index.
10. Manufacturing industry—the total value added in the industry divided by total employment, and corrected by the wholesale price index.

Sources: South African Bureau of Statistics and Union Acceptances Limited.

Note: The percentage increases shown against the curves relate to the last 10-12 years, as explained in the paper.

index tapered off during the periods 1966, 1967 and 1968, to 7 per cent per annum*, in spite of fairly substantial increases in employment.

A discussion of the reasons for this is interesting but open to varying interpretation. For the period 1962 to 1965, the gross domestic fixed investment in the manufacturing and construction industries was R157-million, R209-million, R327-million and R400-million per annum respectively. Thereafter, investment was R442-million in 1966, R445-million in 1967 and only R359-million in 1968. The important change was therefore in the annual *rate of increase* of investment—strongly positive to 1965 and thereafter tapering off and becoming negative. The incidence of this change which resulted in a lower rate of annual investment (by about R75-million), appears to be related to the credit squeeze. This might well have affected manufacturing industry by preventing expenditure on capital account in respect of measures which would have resulted in substantially improved productivity of labour. In default of this capital expenditure, labour has probably been allowed to rise in order to achieve increased production, but not at the same efficiency as previously. It is also possible that the dispersal of industry, encouraged by the Planning Act, may have resulted in less emphasis on labour efficiency than had been the case previously in urban areas. Such statements must however be regarded as speculative, since elucidation of the true facts would require a substantial economic exercise.

GENERAL CONCLUSIONS

On the basis of the facts that have emerged, superficially at least, manufacturing industry seems to have used its labour reasonably effectively, maintaining a satisfactory annual rate of improvement. The gold mining industry, on the other hand, seems to have attained only marginal increases in productivity, except in respect of its White employees, over the last 10 years. However, more careful examination indicates that none of the three categories, manufacturing, construction and mining, has any grounds for complacency. Figures are not available for the performance of the construction industry since 1964/5. For the manufacturing sector, there would appear to be no real increase in manpower utilization. In the mining industry, substantially the same picture applies in that the overall improvement of the last 10 years is of the order of 1 per cent per annum. Should this position continue, it is clear that increases in wages will not be justified without creating inflationary pressure.

Regarding the mining industry, it is interesting to note that Professor Black in 1957 drew attention to two main avenues for further substantial improvement namely, within the reduction works where automation was possible, and amongst surface clerical labour, where increasing use could be made of centralized computers. Figures for these sectors are given in Table V and show his forecasts to have been substantially correct. Much of the reduction in surface mechanics can no doubt also be ascribed to larger and more automated reduction plants. The potential reduction in underground strength to which he alluded does not appear to have materialized. The total numbers of officials and union men employed in the underground mining and engineering departments has fallen from 22 861 to 20 390, representing a reduction of 12 per cent. Most of these are underground mine workers, but the numbers who are members of the Mechanics' Union appear to have remained relatively constant.

It is difficult to see avenues for substantial future reduction, or ways in which the mining industry could conceivably achieve the productivity increases which secondary industry appears to have maintained in recent years and which are called for by the targets postulated. Conversely, however, improvements achieved in the Orange Free State district, which at present is the largest of the five gold mining areas, would, indeed, if extended to other areas, over the next 20 years produce some very spectacular results. For instance, extrapolation of the native labour rate of improvement achieved over the last ten years in the Orange Free State, would approximately double the productivity of this type of labour in 20 years, or improve it by more than 25 per cent in 12 years. Continuation of the rate of improvement achieved for White employees would achieve a doubling of the present output per head in 12 years. At constant tonnage and based on 1969 costs this would result in enhanced profit for the industry equivalent to raising the price of gold from \$35 per ounce to \$39.2 per ounce in 12 years and to \$41.3 per ounce in 20 years.

Gold has recently become a commercial commodity the price of which is subject to supply and demand. Estimates appear to indicate that the industrial consumption of gold is rapidly approaching the annual production and that this demand, in a relatively few years, will almost certainly bring about an increase in price above the \$35 per ounce for monetary gold. Improved manpower utilization could, coupled with this, be a very significant factor in extending the life of the gold mining industry, and certainly its value to the economy of South Africa. Professor Black proposed a mining research institute consisting of two parts *viz.* an operations research team of mining, mechanical and electrical engineers and scientists to analyze problems in the field and to test new methods and equipment and, an engineering research laboratory whose task would be to design and develop new equipment.

The second of Professor Black's proposals is now to a large extent being undertaken by the Chamber of Mines Research laboratories. There has however been no real advance towards realisation of the first of the proposals. Until extensive operational research is undertaken of actual mining work underground, in order to allocate and quantify responsibilities for areas of improvement as between technical development and day-to-day management, no constructive or lasting results will materialize.

A systematic approach to the whole situation cannot but yield significant results and the present stage is probably a very suitable one at which to initiate such a programme.

The proved technical competence of the industry is certainly capable of such a self-reappraisal. Experience has shown that those sectors that achieve this process successfully, are the greatest and most dynamic profit earners of the future.

A productivity institute for the manufacturing industry has been established in Pretoria. Whilst some good work has been done by this institute, its impact on the industry as a whole is as yet negligible. It is difficult

*Subsequent information indicates an increase in output of 10.6 per cent and an increase on employment of 5.3 per cent for the first 11 months of 1969, compared with the corresponding eleven months of the previous year. The net increase in productivity of some 5 per cent compares with the mean for the eight years to 1964 of about 3½ per cent. This improvement is stated to be due to absorption of surplus capacity.

to escape the conclusion that the facilities provided are on too small a scale significantly to affect the position in the near future. On the strength of the statistics presented in this paper, it is clear that a dynamic approach to the problem of improving labour productivity is absolutely essential to the well-being of the country. Any failure in this direction must result in a slowing down and possibly even a reversal in the improvement in the standard of living which has been established in the country over many years.

The population of the Republic at the turn of the century is forecast to be more than 45 million. If the standard of living of this number of people is to increase by $2\frac{1}{4}$ times over these 30 years (i.e. at the same annual rate as during the last 20 years) the economy must over this period expand by some 550 per cent. This is equivalent to an expansion of nearly 6 per cent each year. This is probably double that of the population increase and $\frac{1}{2}$ per cent in excess of the possible target envisaged in the last Economic Development Programme, provided special attention were given to training of manpower and that net immigration is maintained at 30 000 per annum. An improvement in individual productivity of the working population of the order of 3 per cent appears to be the least that should be expected. If mining is less than this, as it now is, the shortfall must be made up by manufacturing which is itself already somewhat below target.

In the circumstances, extension of the work of the National Productivity Institute seems to be a matter of

urgency. The establishment of an organization by the mining industry with like terms of reference would seem to be even more important.

ACKNOWLEDGEMENTS

The author wishes to record his sincere appreciation to the following, without whose very material assistance completion of this investigation would not have been possible:

Mr M. Dagut, Economist, Union Acceptances Limited, and his staff for assistance in the investigation and codification of the production results in manufacturing and construction industries.

Mr W. H. Keeley: Chief Statistician, Chamber of Mines, for extraction of statistics and advice in relation to conclusions.

REFERENCES

1. BLACK, R. A. L. 'A review of progress in mechanization in the mining industry of South Africa,' *J. S. Afr. Inst. Min. Metall.*, vol. 58, March 1958, p. 345.
2. Union Acceptances Limited—'Scope for investment—South Africa's growing economy,' November, 1969.
3. Union Acceptances Limited—'Scope for investment in South Africa—consumer price index, all items 1948 = 100: Source—South African statistical year book.'
4. Statistical Department, Chamber of Mines.