

in a worse position than does no allergy, and the higher his allergy the worse his position. On the other hand, there is some evidence that the presence of allergy may be associated with *commencing* resistance to virulence. Septicæmic tuberculosis was met with in 4 per cent. of the cases that arose in the "strongly positive" group, in 5 per cent. of the cases that arose in the "ordinary positive" group, and in 24 per cent. of the cases that arose in the "negative" group, while the comparatively benevolent local glandular tuberculosis was met with most often relatively in the cases that arose in the "strongly positive" group. Despite this evidence of there being some resistance to virulence associated with allergy, the fact remains that, nevertheless, most of the cases of tuberculosis in allergic subjects generalized freely and early with the disease running an acute course to a fatal termination.

The results of these investigations indicate that in the Native of South Africa the part played by invasion with the virus of tuberculosis appears to be equivocal, inasmuch as tuberculo-allergy and poor resistance to infection go together, whereas tuberculo-allergy is associated with some increase of resistance to virulence. In subjects virgin from the tuberculosis point of view it is a minority only that has poor resistance and a majority good resistance to infection. In subjects invaded by the virus a minority has good resistance to virulence and a majority poor resistance to virulence. As far as can be judged from tuberculin tests, the adult Native appears to be about as much tuberculized as is the adult European, yet, under conditions favourable for the dissemination of tuberculosis, the Native contracts more tuberculosis and develops a different type of tuberculosis. As between the two the difference of behaviour in the face of tuberculosis appears to be related rather to differences of the soil in which the seed is sown than to any deficiency in the sowing.

Quite apart from association with tuberculosis as a definite disease, tuberculo-allergy waxes and wanes. Dr. Allen's work at Witbank (see Appendix 4) illustrates this phenomenon, and the fact is well established by experience elsewhere. Rigid testing has shown that a positive reactor may become definitely negative. This is important because it leads direct to the conclusion that there are two types of negative reactors: those who are and always have been "virgin" from the tuberculosis standpoint, and the "barren," who have, at one time, been pregnant with tuberculosis but have aborted with complete success. One cannot affirm that a negative reaction to tuberculin signifies that a subject not only is but always has been "virgin" from the tuberculosis standpoint. Our experience shows that the less tuberculo-allergy the less the likelihood of effective infection by tuberculosis. At the end of the allergy road come the negative reactors, and hereabouts the road forks into the virgin negative reactor and the "barren" negative reactor. The virgin has never been on the allergy road at all, the barren has travelled the whole length of it to the end and back again. Tuberculo-immunity is reached *via* tuberculo-allergy, but our experience suggests that as far as the South African Native is concerned, this immunity has to be considered under two heads. On

the one hand, there are factors that confer ability to resist effective infection. Tuberculo-allergy is a measure of this ability; the less the allergy the greater the ability. On the other hand, there are factors that confer ability to modify the course of the disease; in our experience allergy is a negligible measure of this ability. The typical age-curve of tuberculosis incidence the world over suggests that ability to modify the course of the disease is purchased at the price of a greater liability to get the disease. It is possible that while the virgin have least resistance of all subjects to an effective infection, the barren, at the terminus of the allergy road, have most resistance to effective infection. The above hypothesis goes some way in accounting for our rather unexpected experience with the negative reactors of our Native labour force.

The suggestion is that tuberculo-allergy may go but leave behind it tuberculo-immunity factors that have been called into being in association with the allergic state.

#### SECTION B.—TUBERCULOSIS IN THE WITWATERSRAND NATIVE LABOUR ASSOCIATION'S HOSPITAL.

##### I. "OBSERVATION" CASES.

At the initial examination of recruits at the W.N.L.A. depôt, Johannesburg, a considerable number of Natives with chest conditions suggestive of tuberculosis are detained in hospital for observation and investigation to determine the presence of tuberculosis; these comprise cases of pleurisy, pleurisy with effusion, thickened pleura, unresolved pneumonia, localized crepitations, incipient tuberculosis, silicosis and tuberculo-silicosis. These individuals are all carefully examined and X-rayed and a bacteriological examination of the sputum made. Many are cases such as are included under the heading "Defective Lungs" in Table 6, p. 86.

The cases that present the most difficulty are those with localized persistent crepitations of the lungs, which are extremely common and which, in the majority of instances, give a negative result upon X-ray and bacteriological examination. Various attempts have been made to determine the significance of these crepitations, but without convincing results. That some of these cases are tuberculous—or become so after the Native has been working—is undoubtedly true, but it is impossible to say which are likely to develop tuberculosis. The condition is far too common in otherwise apparently healthy Natives of good physique to warrant the exclusion of all such Natives from mine work.

Enlarged tuberculous glands of the neck are fairly common among recruits who have had no previous medical examination, and a considerable number have healed tuberculous scars. Recruits showing the latter condition, if of good physique, usually complete their contracts for underground work and put on weight; rarely is there any recurrence of the disease or extension to other organs.

## 2. REPATRIATION OF TUBERCULOTICS.

All cases of tuberculosis and tuberculosis-with-silicosis detected on the gold mines, either while in hospital or at the periodical weighings, or on examination of the time-expired Natives, are sent into the W.N.L.A. hospital for examination by the Miners' Phthisis Medical Bureau in terms of the Miners' Phthisis Act. On completion of this examination and after the payment of compensation (if any)—which formality usually takes about a fortnight—the Natives are sent to their homes in charge of a European conductor. A number of the Natives are in an advanced state of the disease on admission to hospital and are unable to undertake the journey home; these are detained and cared for until death supervenes.

The early cases seem to improve slightly and to put on weight during their stay in hospital. No special treatment is given beyond a course of tonics, good feeding, fresh air and cod-liver oil. The more modern methods of treatment, such as sanocrysin, sodium morrhuate and artificial pneumothorax have been tried, but the Natives clamour to be sent home as soon as they have been dealt with by the Bureau, and refuse to stay in hospital long enough for adequate treatment. The Native firmly believes that when once he gets back to his kraal the witch-doctor will cure him.

All tuberculous cases, incipient or otherwise, detected at the initial examination are also repatriated and advised not to return for mining employment. This advice is not always followed, especially in incipient cases, and many of them return in three or four months' time and, if the abnormal physical signs have disappeared (and there is no method of immediate identification beyond accidental recognition) they may possibly be passed as fit for mine work.

In addition to the conditions above referred to, there are many cases of tuberculous glands in the neck and of abdominal tuberculosis in Natives received from the mines. Such Natives are repatriated every week with the ordinary convalescent Natives.

Tuberculosis of the spinal vertebrae and of the genito-urinary tract are fairly common, but tuberculosis of the wrist, knee and ankle joints is only occasionally met with. Many cases with these conditions, especially those with glands in the neck, improve considerably after repatriation. Many cases that have left the mines with enormous enlargement of the cervical glands have returned for work a year or so later with a few healed scars, the Native being in excellent condition; while such cases, if allowed to remain on the mines, gradually get worse, run a temperature, become more emaciated and eventually develop generalized tuberculosis.

## 3. LENGTH OF SURVIVAL OF CASES DYING IN W.N.L.A. HOSPITAL.

The duration of survival of tuberculous cases sent from the mines to the W.N.L.A. hospital depends on the condition of the patient and the extent of the disease on arrival at the hospital. Some die on the

day of admission, others within the first week, while a number linger on for a month or six weeks. The average duration of survival is 16 days.

Among recruits there have been cases, especially among East Coast Natives, admitted into hospital a few days after arrival with apparently commencing broncho-pneumonia, who have died of acute miliary tuberculosis in three weeks.

#### 4. POST-MORTEM EXAMINATIONS.

A post-mortem examination is held at the South African Institute for Medical Research upon every Native who dies at the W.N.L.A. hospital, and the lungs, if found to be tuberculous or silicotic, are sent to the Miners' Phthisis Medical Bureau for scrutiny. For the last three years all these post-mortem examinations have been conducted by Dr. Mavrogordato and Dr. Pirie, of the South African Institute for Medical Research, and their findings are considered in the Pathological Section of this Report (see p. 153 and Appendix 7).

### SECTION C.—TUBERCULOSIS IN MINE HOSPITALS.

The main interest of the mine medical officer and the mine hospital from the point of view of the prevention of tuberculosis centres round the problem of early detection and the disposal of cases when diagnosed. Various measures are employed as aids in helping towards an early diagnosis, one of the most important being that of periodical weighing.

#### 1. PERIODICAL WEIGHING AS A MEANS TOWARDS EARLY DIAGNOSIS.

The practice of periodical weighing was first introduced on the mines as a compulsory measure in 1916. It was originally intended that the weighing should be done regularly once a month, but it was found to be much more convenient from the mines' point of view to have the weighing done when the Natives were assembled to receive their monthly pay. As pay is really *per* so many shifts worked, and as the majority of Natives do not work on Sundays, this works out in actual practice at about once in every five weeks.

Many difficulties were encountered when the practice was first instituted, *e.g.*, a Native would send a friend to impersonate him when drawing his pay, or he would not draw his pay for several months on end. These and other loopholes were taken advantage of by Natives who feared that the weighing might result in their being sent home. Gradually, however, the system has been tightened up and to-day it is exceptional to find a boy who has escaped the scales.

On the majority of the mines now, the periodical weighing and the keeping of the records is carried out by a skilled White, usually a hospital attendant, or by Natives under such a supervisor who also picks out all weedy-looking Natives for special examination irrespective of their weight.

At first it was left to the discretion of individual mine medical officers to fix their own standards of what should constitute a drop in weight sufficient to necessitate a further examination, but the Regu-

lations under the Miners' Phthisis Act of 1925 laid down that any Native showing a drop of 5lb. or more in weight between two consecutive weighings, or of 6lb. or more between three such weighings, must be set aside for individual stethoscopic examination by the mine medical officer.

A definite standard was not fixed under the earlier Act, partly because there was not sufficient information available to go upon and partly because in those days there was probably a more marked difference between the working conditions on the various mines.

Even at the present time, undue variations in weight sometimes occur in numbers quite apart from tuberculosis. For instance, Dr. Frew has reported to this Committee that on the East Rand Proprietary Mines he has found sometimes that "lost weights" come along "by hundreds instead of by the more usual tens." The explanation of these variations is not obvious, but he is inclined to attribute them to spells of either very hot or very cold weather. Such occurrences lead to a great increase in stethoscopy and rather tend to defeat the primary purpose of the weighings. Nevertheless, they draw attention to the existence of some factor which may be remediable.

Periodical weighing is accepted as a valuable agency in the detection of tuberculosis. Every Native picked out is stethoscoped and as a result of this examination either sent into hospital or marked for further examination. If sent to hospital they are kept either until their weight has picked up and their general condition improved or until further examination makes clear that the condition is actually tuberculosis.

It cannot be stated definitely what proportion of the tuberculosis cases are picked out solely through the periodical weighings, but it is reported in the Report upon the work of the Miners' Phthisis Medical Bureau for the two years ended July 31st, 1926, that "special investigation has shown that approximately 66 per cent. of bacteriologically-verified cases of simple tuberculosis in mine Natives show a loss of weight of the prescribed amount at their periodical examinations, and should therefore automatically be made available for special stethoscopic examination."

## 2. OTHER METHODS EMPLOYED FOR THE EARLY DETECTION OF TUBERCULOSIS.

(a) All recruits received from the W.N.L.A. are stethoscoped on arrival at the mine by the mine medical officer, although they have already run the gauntlet of the W.N.L.A. examination. Any case the mine medical officer regards as doubtful is either X-rayed at the mine, if apparatus be available, or referred back to the W.N.L.A. for further examination.

Non-recruited Natives applying directly to the mine for underground work are first examined on the mine and then sent to the W.N.L.A. for confirmatory examination.

(b) All Natives admitted to hospital, no matter for what complaint, surgical or medical, are stethoscoped either on their arrival, during their stay, or on their discharge from hospital.

The journey may be made by road if the mine is close at hand, by train or trolley if the mine is further out or, if necessary, by ambulance.

Each patient or batch of patients is accompanied by a mine police boy or other attendant, who is responsible for seeing them to their destination.

With each patient is sent a history sheet giving a complete record of his mine service, hospital history, monthly weighings, temperature chart and any other details of the case that the mine medical officer may consider important.

These particulars are available for the benefit of the medical officers of the W.N.L.A. and of the Miners' Phthisis Medical Bureau.

#### 5. LENGTH OF SURVIVAL OF CASES DYING IN MINE HOSPITALS.

In view of the fact that practically only hopeless cases of tuberculosis are detained in the mine hospitals, no full returns of the survival periods have been called for, but some figures submitted by four mine hospitals show that for 145 consecutive cases of deaths from tuberculosis in these hospitals, the average survival period was 28 days.

Dividing the cases into (a) purely pulmonary cases (including, however, tuberculosis with silicosis, as well as simple tuberculosis), and (b) miliary and other forms, we find that 95 pulmonary cases had an average survival period in hospital of 19 days and 50 miliary and others an average of 37 days.

1 miliary case in this series was returned as dying 2 days after admission, and another 9 days after admission.

Of the pulmonary cases, 19 died within 10 days of admission, and the majority within 3 weeks. 1 very exceptional case (for a mine hospital) lived for 288 days.

#### 6. POST-MORTEM EXAMINATIONS IN MINE HOSPITALS.

In many mine hospitals the carrying out of post-mortem examinations on all medical cases that die is part of their routine procedure.

Where post-mortem examinations are not done as a matter of routine, the Miners' Phthisis Medical Bureau has the right to ask for one in any case where there is still doubt as to the diagnosis.

In practice, this works out that in all cases of suspected possible tuberculosis, where a positive sputum has not already been obtained, a post-mortem examination is asked for and carried out.

During the years 1927, 1928 and 1929 special records were kept at the request of this Committee. The records were sent in to the Committee and are considered in the Pathological Section of this Report (see p. 153 and Appendix 7).

Two series of reports on post-mortem examinations made in mine hospitals may be referred to at this point for comparison with the pathological records of this Committee.

One, by Orenstein<sup>53</sup> deals with 95 autopsies made in 8 different mine hospitals during 1922 and 1923. Tuberculosis was the actual cause of death in 62 of the cases, but all showed some tuberculous lesion.

The series is regarded as showing three noteworthy characteristics : (a) The relatively large proportion of involvement of abdominal organs, especially of the spleen—32 cases out of the 95. This is very similar to our findings. (b) The relatively large number of cases in which the mediastinal glands were involved—39 cases. The term “ mediastinal ” is apparently used to cover any thoracic glands other than the peri-bronchial, which are tabulated separately. These are probably largely cases comparable with those described by Bushnell<sup>1</sup> as “ great packets ” of caseous glands, a form very characteristic of “ primary ” tuberculosis. (c) The relatively large number of cases of miliary tuberculosis of the lungs—15 out of a total of 42 cases showing pulmonary lesions. The Committee found a similar high proportion among the reports of cases sent in to them by mine medical officers ; they are mostly young Natives with very short mining service.

The analysis is stated to appear to indicate (a) that infection by ingestion of tuberculous material may play a not inconsiderable rôle in the incidence of tuberculosis among Native mine-workers, and (b) that tuberculous infections still run a markedly acute course in them.

With regard to the first inference, presumably drawn from the frequency of involvement of abdominal organs, it may be pointed out that the investigations of this Committee show that although involvement of abdominal organs is certainly common, it can, in most cases, be traced to a thoracic source and only very seldom implies infection by ingestion.

The other report by Fischer<sup>54</sup> deals with 1,402 autopsies made at the City Deep Central Native Hospital during the years 1922-28. Tuberculosis is given as the main cause of death in 302 of these cases. Of these 302 cases acute miliary tuberculosis constituted 45 per cent. ; general tuberculosis (caseating pulmonary tuberculosis with miliary lesions in other organs), 13·9 per cent. ; pulmonary tuberculosis, 15·9 per cent. ; pulmonary tuberculosis with silicosis, 9·9 per cent. ; and abdominal tuberculosis (tuberculous peritonitis with tuberculous foci in some of the abdominal organs), 7·3 per cent.

A remarkable feature of the miliary cases was the great enlargement of the spleen.

The diseased lungs revealed in 104 cases (40·8 per cent.) the lesions of chronic phthisis, and in 152 cases (59·2 per cent.) those of the acute form. The chronic form was in 30 cases associated with more or less pronounced silicosis.

The only finding in this series showing any essential variance from those of the Committee is that of the larger proportion of cases of chronic phthisis uncomplicated by silicosis. This is probably explicable partly

by a real larger occurrence, owing to these cases being drawn entirely from a mine hospital and not mainly from the W.N.L.A. hospital, but partly by a difference of standard in the definition of the earlier stages of silicosis.

#### SECTION D.—INCIDENCE AND MORTALITY FROM TUBERCULOSIS ON THE RAND.

##### I. DIFFICULTIES IN COMPILING ACCURATE STATISTICS.

The compilation and comparison of statistics concerning tuberculosis in Natives in South Africa bristles with difficulties. Several of these are referred to, in passing, in other parts of this Report, but they may be recapitulated here.

There are, in the first place, the lacunæ in the basic statistics regarding the population. These, in a European country, would be readily obtainable from the census or Registrar-General's Department. Here, owing to the lack of any complete system of birth and death registration, it is impossible to obtain readily any definite information about age-distribution, causes of death, etc.

On the mines it is usually a fairly easy matter to get at a close approximation of a Native's age, because, although he may not think in calendar years, he can tell you that he was born in the year of such-and-such a chief's death, or that he started to herd goats when the South African War began, or in some such way it can be arrived at. This helps considerably in dealing with purely mine statistics, but it does not help in making comparison with the general Native population.

But even within the statistics accumulated by the mining industry there are difficulties.

It is highly desirable, for instance, in addition to age-distribution to have some idea of the distribution of the complement in terms of total duration of employment. This information should be obtainable from the "cards," one of which each mine-boy is given and on which his record of service is entered up. This card, however, he regards with much suspicion and loses it so regularly that it has to be re-written on the strength of such information as he chooses to give each time that he signs a contract.

It is very often impossible to be certain from his card, therefore, whether any particular boy is in the first year of his employment on the Witwatersrand or merely in the first year of his *present engagement*. The former would be a raw recruit to the industry who had never worked on a mine before; the latter might be a raw recruit or on his *n*th engagement.

Then there is the difficulty that some returns in connexion with tuberculosis on the mines include all forms of tuberculosis, while others are statutory and only include "tuberculosis under the Act." The



Miners' Phthisis Act, No. 35, Section 76, Sub-section 3, p. 74, lays down for purposes of compensation that a Native is deemed to be suffering from tuberculosis if he is (a) expectorating tubercle bacilli, or (b) has closed tuberculosis of the lungs or respiratory organs to such a degree as seriously to impair his working capacity and render prohibition of his working underground advisable in the interests of his health.

It is very important to realize, therefore, in considering any returns, whether one is dealing with "tuberculosis, all forms," or "tuberculosis under the Act."

A general difficulty applying to all statistics of the Native mining force is that one is considering a migratory population living in semi-enclosed communities. This particular issue is further complicated by the fact that the "closed population" to be studied circulates within the group of semi-enclosed communities, in addition to the general circulation between the group of communities and the widely-scattered homes.

In many semi-enclosed communities—schools, for instance—the change of population occurs at certain regular periods, but in our case the change is continuous and the rate varies between from about 80 per cent. and about 115 per cent. per annum.

This is brought out in Table 13.

In compiling this section of the Report the Committee has had the advantage of calling in an expert statistician in the person of Professor Dalton, of the University of the Witwatersrand, to help the Statistical Sub-Committee in sorting out the mass of material submitted to them.

It will be fairly obvious, on perusal, which data have been considered sufficiently exact to lend themselves to expert statistical analysis, but the Committee has not confined its report entirely to the consideration of figures of this degree of exactitude, but has also included certain others. It was felt that, even though they might not be of equal value, they were worthy of consideration as being the best obtainable and as being sufficiently nearly accurate to be illuminating on certain questions.

## 2 AGE AND DURATION OF EMPLOYMENT DISTRIBUTIONS.

It is estimated by experienced men that, at any one time, about 25 per cent. of the Native complement are boys under 25 years of age, about 70 per cent. between 25 and 40, and not more than 10 per cent. over 40 years of age.

A census of the Native labour force of the Rand Mines Group was arranged for by Dr. Orenstein, and he has put on record the duration of service claimed by about 80,000 mine-boys.

Graph 1 is an attempt at a "standard curve" of age-distribution (showing in addition rates of tuberculosis mortality), and Graph 2 at a "standard curve" of duration of service.

TABLE 13.

RATE OF CHANGE OF NATIVE COMPLEMENTS ON THE MINES OF THE WITWATERSRAND GOLDFIELD FOR THE YEAR 1929.

| Company.   | Average Native-Labour Strength. | Each Mine Percentage of Totals. | New Engagements. | Each Mine Percentage of Total. | New Engagements as Percentage of Native-Labour Strength. | Average Labour Strength as Percentage of New Engagements |
|--|---------------------------------|---------------------------------|------------------|--------------------------------|--|--|
| Brakpan Mines, Ltd. ... ..                         | 6,485                           | 3.42                            | 6,773            | 3.9                            | 104.44   | 95.75  |
| Daggafontein Mines, Ltd. ... ..                    | —                               | —                               | —                | —                              | —  | —  |
| Springs Mines, Ltd. ... ..                         | 6,045                           | 3.19                            | 6,714            | 3.86                           | 111.07   | 90.04  |
| West Springs, Ltd. ... ..                          | 3,678                           | 1.94                            | 3,851            | 2.21                           | 104.7  | 95.5   |
| New Kleinfontein Co., Ltd. ... ..                  | 3,934                           | 2.08                            | 3,915            | 2.25                           | 99.52  | 100.49   |
| City Deep, Ltd. ... ..                             | 8,971                           | 4.73                            | 7,026            | 4.04                           | 78.32  | 127.68   |
| Consolidated Main Reef Mines & Estate, Ltd. ... .. | 5,128                           | 2.71                            | 3,916            | 2.25                           | 76.37  | 130.95   |
| Crown Mines, Ltd. ... ..                           | 16,166                          | 8.53                            | 12,738           | 7.33                           | 78.8   | 126.91   |
| Durban-Roodepoort Deep, Ltd. ... ..                | 3,816                           | 2.01                            | 2,973            | 1.71                           | 77.91  | 128.36   |
| East Rand Proprietary Mines, Ltd. ... ..           | 11,565                          | 6.10                            | 10,877           | 6.26                           | 94.05  | 106.33   |
| Ferreira Deep, Ltd. ... ..                         | —                               | —                               | —                | —                              | —  | —  |
| Geldenhuis Deep, Ltd. ... ..                       | 4,977                           | 2.63                            | 4,184            | 2.41                           | 84.07  | 118.95   |
| Modderfontein B. Gold Mines, Ltd. ... ..           | 4,258                           | 2.25                            | 3,248            | 1.87                           | 76.28  | 131.1  |
| Modderfontein East, Ltd. ... ..                    | 4,349                           | 2.30                            | 4,104            | 2.36                           | 94.37  | 105.97   |
| New Modderfontein G.M. Co., Ltd. ... ..            | 7,838                           | 6.14                            | 8,065            | 4.64                           | 102.9  | 97.19  |
| Nourse Mines, Ltd. ... ..                          | 4,841                           | 2.55                            | 5,032            | 2.89                           | 103.95   | 96.2   |
| Robinson G.M. Co., Ltd. ... ..                     | —                               | —                               | —                | —                              | —  | —  |
| Rose Deep, Ltd. ... ..                             | 3,522                           | 1.86                            | 3,175            | 1.83                           | 90.15  | 110.93   |
| Village Deep, Ltd. ... ..                          | 4,336                           | 2.29                            | 3,463            | 1.99                           | 79.87  | 125.21   |
| Wolhuter Gold Mines, Ltd. ... ..                   | —                               | —                               | —                | —                              | —  | —  |
| Aurora West United G.M. Co., Ltd. ... ..           | —                               | —                               | —                | —                              | —  | —  |
| Meyer & Charlton G.M. Co., Ltd. ... ..             | 1,321                           | 0.70                            | 1,000            | 0.58                           | 75.7   | 132.1  |
| Van Ryn Gold Mines Estate, Ltd. ... ..             | 3,025                           | 1.60                            | 3,412            | 1.96                           | 112.79   | 88.66  |
| West Rand Consolidated Mines, Ltd. ... ..          | 6,034                           | 3.18                            | 5,098            | 2.93                           | 84.49  | 118.36   |
| Government G.M. Areas (M.) Cons., Ltd. ... ..      | 12,291                          | 6.49                            | 13,285           | 7.64                           | 108.09   | 92.52  |
| Langlaagte Estate & G.M. Co., Ltd. ... ..          | 7,686                           | 4.06                            | 6,835            | 3.93                           | 88.93  | 112.45   |
| New Primrose G.M. Co., Ltd. ... ..                 | —                               | —                               | —                | —                              | —  | —  |
| New State Areas, Ltd. ... ..                       | 5,744                           | 3.03                            | 5,242            | 3.01                           | 91.26  | 109.58   |
| Randfontein Estates G.M. Co. (W.), Ltd. ... ..     | 17,051                          | 9.00                            | 14,659           | 8.43                           | 85.97  | 116.32   |
| Van Ryn Deep, Ltd. ... ..                          | 4,527                           | 2.39                            | 4,780            | 2.75                           | 105.59   | 94.71  |
| Witwatersrand G.M. Co., Ltd. ... ..                | 3,398                           | 1.79                            | 3,075            | 1.77                           | 90.49  | 110.5  |
| Robinson Deep, Ltd. ... ..                         | 5,692                           | 3.00                            | 4,369            | 2.51                           | 76.76  | 130.28   |
| Simmer & Jack Mines, Ltd. ... ..                   | 5,499                           | 2.9                             | 4,787            | 2.75                           | 87.05  | 114.87   |
| Sub Nigel, Ltd. ... ..                             | 4,252                           | 2.24                            | 4,973            | 2.86                           | 116.96   | 85.5   |
| Geduld Proprietary Mines, Ltd. ... ..              | 4,730                           | 2.5                             | 5,212            | 3.00                           | 110.00   | 90.9   |
| Modderfontein Deep Levels, Ltd. ... ..             | 2,293                           | 1.21                            | 2,134            | 1.23                           | 93.07  | 107.45   |
| Luipaards Vlei Est. & G.M. Co., Ltd. ... ..        | 2,148                           | 1.13                            | 1,716            | 0.99                           | 79.89  | 125.17   |
| Witwatersrand Deep, Ltd. ... ..                    | 3,881                           | 2.05                            | 3,244            | 1.86                           | 83.59  | 119.64   |
|  | 189,481                         | —                               | 173,875          | —                              | 91.76  | 108.98   |

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