Report of the Coloured Labour Compound Commission appointed to enquire into the cubic amount of air-space in the compounds of the mines of the Witwatersrand.

E. R.

THE TRANSVAAL.

REPORT

OF THE

COLOURED LABOUR COMPOUND COMMISSION

APPOINTED TO ENQUIRE INTO THE

Cubic Amount of Air-space in the Compounds of the Mines of the Witwatersrand.

PRETORIA:
PRINTED AT THE GOVERNMENT PRINTING AND STATIONERY OFFICE.

1905.

MEMBERS OF THE COMMISSION.

ADAM JAMESON, Esq., M.D., M.L.C., Commissioner of Lands (*Chairman*).

Surgeon-General J. DALLAS EDGE, C.B., M.D.

Sir KENDAL FRANKS, Kt., C.B., M.D.

CHARLES LANE SANSOM, Esq., M.D.

GEORGE TURNER, Esq., M.B., M.L.C., Medical Officer of Health for the Transvaal.

JAMES MOIR, Esq., D.Sc. (*Secretary*).

MAJORITY REPORT

OF THE

Commission Appointed to Enquire into and Report on the Accommodation and Air-space required in the Compounds for Coloured Employés of the Mines of the Witwatersrand District.

TO HIS EXCELLENCY THE HONOURABLE SIR RICHARD SOLOMON, KNIGHT COMMANDER OF THE MOST DISTINGUISHED ORDER OF ST. MICHAEL AND ST. GEORGE, COMPANION OF THE MOST HONOURABLE ORDER OF THE BATH, ACTING LIEUTENANT-GOVERNOR OF THE COLONY OF THE TRANSVAAL.

Majority Report.

MAY IT PLEASE YOUR EXCELLENCY :

1. This Commission was appointed by His Excellency the Lieutenant-Governor, with full powers under the Commissions Ordinance (1902), on the 26th July, 1904, and public notification thereof was given by Government Notice No. 909 of 1904, published in the *Government Gazette* of 28th July, 1904.

2. The Commission consisted of :—

ADAM JAMESON, Esq., M.D., M.L.C., Commissioner of Lands (*Chairman*).

Surgeon-General J. DALLAS EDGE, M.D., C.B., Principal Medical Officer to the Forces in South Africa.

Sir KENDAL FRANKS, M.D., C.B., etc.

CHARLES LANE SANSOM, Esq., M.D., Medical Officer of Health for the Witwatersrand District.

GEORGE TURNER, Esq., M.D., M.L.C., Medical Officer of Health for the Transvaal,

with JAMES MOIR, Esq., D.Sc., Chemist to the Mines Department, as Secretary.

3. The terms of reference to the Commission were as follows :—

To enquire into the cubic amount of air-space to be allotted to each coloured labourer in the Compounds on the various mines in the Witwatersrand District.

4. The procedure to be adopted was arranged at the first meeting on August, 9th, 1904. At the subsequent meetings evidence was heard in public, and your Commissioners have endeavoured to obtain evidence on all matters concerning the questions before them.

5. Your Commissioners have personally visited a number of existing Compounds of all classes, with the view of obtaining direct knowledge of their actual condition.

6. The Commission examined witnesses, experts in their various professions, from whom the Commission received the most valuable information and assistance.

7. The enquiry owed its inception, in the first place, to the high death rate amongst Kaffir labourers in the Mines on the Rand during 1902 and 1903, which, in some quarters, was attributed to insufficient and improper food, want of clothing, faulty housing, etc.; and, in the second place, to the anticipated large influx of Chinese labourers, and to the anxiety of the authorities that the high death rate experienced in 1902–1903 among the Kaffirs should not be repeated among the Chinese.

Majority Report.

8. Recognising that in some of the mines the housing accommodation for Kaffir labourers left much to be desired, and believing that this may have had something to do with the former high death rate, it had been proposed by the Medical Officer of Health, Transvaal, that 300 cubic feet of air-space per head should be allotted to the Chinese in compound huts.

It may be well to state here that the term "Compound" generally used throughout South Africa, and which, in many quarters at Home, seems to have been misunderstood, means nothing more in relation to Kaffir or coloured labourers than the term "Barrack" or "Cantonments" implies in relation to soldiers.

9. The Chamber of Mines considered that 300 cubic feet per head was excessive, and that, under the conditions which exist on the Rand, 200 cubic feet would be sufficient. The Chamber, therefore, proposed to submit the question to experts to decide. With this object, they approached the Transvaal Medical Society, and, at the meeting specially summoned for the purpose, the President of the Chamber of Mines attended by invitation, and informed the Society that he was authorised by the Chamber to state that the question of cubic space would be left entirely to the Society to determine, and that the Chamber was prepared to abide by any decision which the Medical Society's experts might arrive at. He informed the Society that the Chamber calculated that to give the Chinese 300 cubic feet. instead of 200 cubic feet, would involve an expenditure of about a million and a quarter; that his Chamber was anxious to avoid this expense if really unnecessary, but that if the Society decided that 300 cubic feet was necessary, then the Chamber would, without demur, incur the increased expenditure.

10. The Society appointed a Sub-Committee, who carefully considered the question, and who reported unanimously, on theoretical grounds and subject to the controlling test of practical experiment, that, in their opinion, 200 cubic feet per head was amply sufficient, provided that the huts were built on certain lines laid down by the Society, and that a specified system of thorough ventilation were adopted, with which the occupants of the huts could not easily interfere. Other points respecting general sanitation were also dealt with and insisted upon.

11. In view of the discrepancy between this opinion and that of the Medical Officer of Health, Transvaal, Your Excellency appointed this Commission.

PART I.

Standard of Vitiation.

12. Although the reference to the Commission was one of cubic space only, it became obvious to the members, from the first, that other matters bearing upon this question had to be considered and decided before a complete and conclusive answer could be given to the question involved in the reference. Foremost among these, it was necessary for the Commission to fix a standard of vitiation by carbonic acid gas, since it is universally agreed that this is the only available criterion of the suitability or otherwise of air for breathing. Therefore, upon this question the Commission heard evidence.

13. Dr. Charles Porter, Medical Officer of Health to the Municipality of Johannesburg, a gentleman recognised at Home as an expert of the highest order, stated that .6 per 1,000 was the figure for total carbonic acid relied upon by the Medical Society in the calculations upon which their original recommendations were based. He quoted several authorities to show that this figure is quite arbitrary, and, in point of fact, very difficult of attainment in practice: the only reason advanced in support of it being that forty years ago or more de Chaumont found that the air of barrack-rooms began to smell offensively when the proportion of CO_2 in the air reached .6 per 1,000. On the other hand, Dr. Porter pointed out that Dr. Kenwood, Professor of Hygiene in University College London, says, as the result of numerous trials, that the offensive smell referred to by De Chaumont is not noticeable until the CO_2 reaches .8. Dr. Thomas, Assistant Medical Officer of Health to the London School Board, places the CO_2 figure at 1.0 per 1,000, and that, moreover, is the figure given by Professor Pettenkofer, perhaps the greatest authority on these subjects.

Majority Report.

14. Dr. Porter recommended .8 per 1,000 as an absolutely safe standard for total CO_2, but pointed out that .9 per 1,000 is the official requirement for English factories, according to Dr. Whitelegge, and he does not see any reason why Chinese and Kaffirs should have better conditions than English workers. Dr. Haldane still considers that 1.2 parts per 1,000 is low enough for a maximum standard, since it admits of a reasonably strict average standard of CO_2. The Incorporated Society of Medical Officers of Health has recommended .9 per 1,000 for factories.

15. Mr. Alexander Heymann, Master of Arts, Master of Chemistry and Pharmacy of the Imperial University of Moscow, and now Chief Analytical Chemist in Messrs. H. Eckstein & Co.'s laboratory, gave evidence to show the standards adopted in some of the countries of Europe. "In Pettenkofer's classical works 1.0 per 1,000 (CO_2) is mentioned as hygienically admissible. In later works, such as Professor Esmarch's, 0.7 per 1,000 is allowed in sick rooms and 1.0 per 1,000 in rooms used for prolonged habitation, or from 2 to 3 parts per 1,000 for shorter periods. Professor Brusanin gives 1.25 to 1.5 per 1,000." Mr. Heymann suggested, in the presence of these figures, that 1.25 parts per 1,000 might be taken as the maximum standard, as this requires only five changes of air per hour at 200 cubic feet per head. There used to be stricter standards in Russia, but the modern tendency is towards elasticity in this matter.

16. Dr. W. Pakes, Government Bacteriologist, a Diplomate of Public Health of the University of Cambridge, and an Honorary Fellow of the Institute of Chemistry, considered that, with the assistance of mechanical ventilation, it might be possible, he would not even say probable, that only 100 cubic feet per head might be necessary. He pointed out that, when De Chaumont fixed on .6 per 1,000, because he could perceive an odour in the vitiated army barracks, he probably smelt the exhalations from the bodies and clothing of the then dirty soldiers, because the bathing accommodation provided for them at that time was nothing like what it is now. Subsequent authorities ,experimenting in more hygienically constructed premises, have certainly failed to detect the presence of vitiation until the CO_2 has reached .9 or 1.0 per 1,000.

17. In his evidence, Dr. Pakes says: "I have pointed out how De Chaumont's figure of .6 was arrived at, and I have said that that was an impracticable limit, one never acted upon in England. I have always taught and recommended that a standard not exceeding .9 should be adopted as a reasonable standard, and one that, under proper circumstances, should be obtainable."

18. Dr. Pakes stated that there is no relationship whatever between the proportion of CO_2 in the air and the number of microbes which may be present, and also that, although certain microbes grow better in pure CO_2, air containing even up to 10 or 15 parts per 1,000 would have no influence whatever upon the growth of these organisms.

19. In a paper read at the recent Oxford Meeting of the British Medical Association on "Standards of Ventilation," published in the "British Medical Journal" of July 30th, 1904 (No. 2,274), which was handed in as evidence by Dr. Charles Porter, at page 253, Dr. Haldane defended the standard of 12 parts of CO_2 per 10,000 (1.2 per 1,000), recently proposed by Osburn and himself, as the best practicable and attainable standard under all conditions of labour and climate in factories and workshops. Dr. Matthew Hay (M.O.H., Aberdeen, and Professor of Public Health in the University of Aberdeen) approved of this standard, as it was based not on opinion, but on experimental work. Dr. C. J. Thomas, B.Sc., D.P.H., Assistant Medical Officer of Health to the London School Board, from investigations in schools, considered that the pollution of air was due, not to respiration, but to body pollution, and that bad smells did not arise until the CO_2 had risen above 1.0 per 1,000. Dr. Symons, F.I.C., D.P.H., Medical Officer of Health for Bath, thought there was some justification for the standard recommended by the Incorporated Society of Medical Officers of Health (.9 per 1.000), as sanitation was advanced, not by experiment only, but by practical experience. With these views, the President of the M.O.H. Society, Dr. Groves (M.O.H., Isle of Wight) concurred.

20. 1.0 per 1,000 was the figure recommended by Carnelley, Haldane, and Anderson for dwellings.

21. The Commission resolved that their standard should be one of respiratory, *not total*, carbonic acid; and having regard to all the evidence, the Commission

Majority Report.

considers that it would not be justified in fixing the standard for carbonic acid in the air of the compounds at a lower figure than .6 per 1,000 of carbon dioxide as respiratory impurity.

PART II.

The Compound Huts and Cubic Air-space.

22. The Report of the Transvaal Medical Society was handed in as evidence to the Commission (see Appendix A.)

23. In this report the Committee of the Transvaal Medical Society recommended that the huts be built on certain lines, and that means should be adopted, which they specified, in order to secure adequate ventilation. These recommendations being adopted, the Committee considered that 200 cubic feet per head of the full complement of boys occupying each hut would be amply sufficient to secure that the air should never appreciably exceed the standard of vitiation; the standard upon which the Committee worked, and which they adopted, being .6 per 1,000 of *total* CO_2—a very severe test. The Commission were aware that this proposal of the Medical Society (200 cubic feet per head) is less than is required in common lodging-houses in towns in England, and, although the surrounding conditions in the Transvaal are so very different, the compounds standing in the open veld at a considerable distance from other buildings, decided to hear evidence on this point.

24. The Committee of the Transvaal Medical Society summarised their conclusions and recommendations as follows:—

"(1) Cubic air-space allowance is, *per se*, no sufficient guarantee of adequate ventilation.

"(2) That the essential requirement is adequate air change, and that the amount of carbon dioxide (CO_2) present in the air is the best objective criterion of its efficiency, the permissible limit of *total* CO_2 being, according to De Chaumont, 0.6 parts per 1,000 volumes of air; according to Haldane, 1.2 parts per 1,000. (The Commission, as already stated, has adopted 0.6 per 1,000 above the outside air as their standard of respiratory impurity.)

"(3) That, given a sleeping-room of 4,000 cubic feet capacity, allowing 200 cubic feet of air-space with ¼ square foot air-inlet and ¼ square foot air-outlet for each person, the amount of CO_2 in the air at the end of eight hours would theoretically be 0.67 parts per 1,000 when 60 per cent. of the full complement are simultaneously accommodated, and 0.77 per 1,000 when 90 per cent. are sleeping. [The Chairman of the Chamber of Mines stated (see Appendix A) that during five-sevenths of each week not more than 66 per cent. of the full complement of boys would simultaneously occupy any room, and that during the remaining two-sevenths (Saturday and Sunday nights) the proportion of the complement would be about 90 per cent.

"(4) That if such rooms are, in addition, provided with a hooded stove, with a 6-inch flue, and, if around this flue, there is a second tube 12 inches in diameter, with a bell-shaped opening 8 feet from the ground, the amount of CO_2 in the air at the end of eight hours, assuming the fire was burning during that time, will be 0.64 per 1,000 where 66 per cent. of the boys are sleeping, and 0.74 per 1,000 where 90 per cent. are present.

"(5) That, under these conditions, the vitiation at its worst would be only slightly over De Chaumont's limit (0.6 per 1,000) and much under Haldane's limit (1.2 per 1,000), which latter is considered good enough for workers in English factories; moreover, it is four times less than what is possible in common lodging-houses which meet modern bye-law requirements, and five times less than that unfortunately permitted in many elementary school-rooms in winter.

"(6) That theoretically, therefore, the provision of air change is reasonably sufficient if 200 cubic feet of air-space, together with inlet and outlet area, and extraction by heat, be provided, as above indicated."

Majority Report.

25. There follow some recommendations as to details, which we shall have to refer to later, and which are of great importance. The calculations and other considerations upon which these conclusions and recommendations are based are set forth fully in Appendix A, and the Committee further recommends :—

"(11) That as our conclusions as to air delivery and air change are, to some extent, based upon theoretical considerations, which may, in some points, require the test of actual trial, it will be advisable to examine them in practical application, both in regard to the respiratory impurity which results and the necessity in cold weather for warming the incoming air."

26. The Commission considered that this last recommendation especially was a most reasonable and equitable one, and decided to put all the theoretical arguments to the test of actual experience. The carrying out of these experiments was, therefore, entrusted to a Committee of experts, originally formed by the Chamber of Mines with this object, whose convener was Mr. J. R. Williams, Consulting Chemist and Metallurgist to Messrs. H. Eckstein & Co. and to several other mines on the Rand, including the Rand Mines, Ltd. He superintended the sampling of the air of the various compounds, the analyses of which were carried out by Professor Aug. Prister, Messrs. B. Bay, Ph.D., M.A., and Alexander Heymann, M.Ch., M.Ph., M.A., with Mr. E. H. Croghan, and others, as samplers. Our Secretary, Dr. James Moir, a mathematical honours man, an Exhibition Scholar in Chemistry, and a Doctor of Science of Aberdeen University, an expert of the highest chemical qualifications, watched all the experiments on behalf of the Commission, checked all the analyses, and verified all the calculations.

27. The Commission is greatly indebted to all these gentlemen, three of whom are unconnected with the mining industry, for the great trouble they took in procuring personally and analysing no less than 101 samples of air in the compound huts, with 24 samples taken almost simultaneously of the air outside the huts. These samples were taken, some at 11 p.m., some at 1 a.m., and some at 3 a.m. Considering the trouble that was taken to procure thoroughly average samples, to prevent any possible error from the admission of gusts of fresh air when entering or leaving the huts by the erection of *storm-doors* (*i.e.*, porches with double doors), to ensure that the number of boys in a hut should be known during the whole night, and, finally, that our Secretary checked most of the samplings and all analyses and calculations, going over the latter two or three times, as he assured the Commission, the Commission considers that it is bound to accept the results of the Committee's investigations as being as correct and reliable as is humanly possible.

28. Usually the air was sampled from three huts simultaneously. In one there were about 66 per cent. of the full complement of boys (*i.e.*, at 200 cubic feet per head), in the second there were 90 per cent. of the same, and in the third there was the full complement of boys, viz., 100 per cent. Considerable difficulty was found in keeping the average percentage of boys in ; perhaps a room intended to contain 66 per cent. actually contained 72 per cent., because the boys like to sleep with their friends, but the exact number in the huts was always noted.

29. In addition to the results obtained by this Analytical Committee, Mr. J. R. Williams put in as evidence the results of a number of tests which had been made in July, 1904, for the information of the Rand Mines, Ltd. These are given in Appendix C., under the title of "Supplementary Tests." With regard to these, the rooms had 4,200 cubic feet of air-space, in which were put 21 boys, making up the 100 per cent., without counting police and the samplers, who were there at all hours of the night. (See Mr. J. R. Williams' evidence.) As will be seen in the tables (Appendix C. 3), during the first night samples were taken at 9, 11, 1, 3, and at 5 ; on the other nights the hours were 11 p.m., 1 a.m., and 3 a.m. In his evidence Mr. Williams stated, and he gave his reasons for his opinion, that "the figures given as to the amount of carbon dioxide are slightly higher than the amount the samples really contain, and I may say that all the figures err on the side of safety."

30. As regards the results of the Analytical Committee, Mr. Williams pointed out that in the first set of samples the high results obtained on the Village Deep were due to short circuiting. The hood over the stove-pipe was too far from the ground, and the anemometer showed "that the air was going directly from the louvre over the door to the hood over the stove-pipe." "On the next night the only alteration in the set of conditions was that the hood over the stove-pipe

Majority Report.

was lowered so as not to be more than 5 feet from the ground, which stopped the short circuiting." The subsequent analyses obtained in this hut conformed to the general results obtained in the others. "We also proved," says Mr. Williams, "that gratings instead of louvres on the roof are a distinct disadvantage, and may become very deleterious to ventilation for this reason, that the grating may act as an *intake*, thus only circulating the air in the upper part of the hut."

31. It should here be observed that eventually the experiments were conducted in two kinds of huts. One of these types was constructed in accordance with the recommendations of the Committee of the Medical Society, and these are called "the experimental type of hut." (See Appendix E.) The other kind of huts were selected ordinary huts of the Rand Mines type (see Appendix D.), and are hereinafter referred to as the "Rand Mines type." The essential difference between these two consists in the first type having large roof-ridge ventilators, with alternate windows and wire-gauze openings, whereas the roof ventilation of the second type consisted of smaller ridge ventilators, with louvres of the usual kind.

32. Experiments showed that the ventilation in the former type was frequently local and inefficient, the CO_2 rising in one case to 2.1 parts per 1,000, and the general average of 58 samples being .75. This was, in great measure, due to the excessive size of the wire-gauze area, the result of a misunderstanding in their construction, so that they frequently acted as inlets instead of outlets and caused an eddy in the upper part of the huts, without effecting much air change in the lower strata. The result of excessive outlet area is what has been termed "top-heaviness" of ventilation; that is, a reversal of the functions of the outlet area, which thus acts as inlet and causes downward draughts.

33. In the Rand Mines type of hut, where there are louvres and no gratings, this difficulty has been completely obviated; and, as Mr. Williams pointed out, in the construction of these huts, whether accidentally or intentionally, the outlet area does not materially differ from the intake area.

34. In consideration of this faulty construction of the experimental huts, and of the excellent results obtained in the Rand Mines type of hut, it was not considered necessary to test further the "experimental huts" or to consider the effects of structural alterations, as far as they were concerned.

35. The results of the analyses of the air taken in the Rand Mines type of hut came almost as a surprise to the Commission. The highest proportion of CO_2 found in any sample was .81 per 1,000, and the general average of 43 samples, with varying air-space, is only .55 per 1,000.

36. In the cases where the available air-space was calculated at 200 cubic feet per head, with a full complement of boys, 29 samples taken in this type of hut gave an average of .56 per 1,000 of carbon dioxide, etc. This includes the "Supplementary tests," but if only the results obtained by the Analytical Committee be considered, the average (from 15 samples) is .53 per 1,000, and on further analysing the figures, the average at 11 p.m. was .44, at 1 a.m., .57, and at 3 a.m., .59 parts per 1,000 of CO_2.

37. On the other hand, the average value of the CO_2 in the cases where 300 cubic feet per head was given was .54 (from 11 samples), which remained practically constant during the night. These figures show that the system of ventilation adopted in the Rand Mines type of hut is very perfect, and they go far to justify Dr. Pakes' statement, in reply to a question from the Chairman: "I think it might be possible, I won't even say probable, that only 100 cubic feet might be necessary."

38. The general average of the outside air samples was .355 parts per 1,000, or, rejecting two results where the sampling was known to be incorrect, .334 parts per 1,000 (from 22 samples).

39. The general impression produced by these results is that, in this type of hut, the amount of cubic space has very little effect upon the degree of vitiation reached. This is due to the fact that the air change is unusually large, and all the witnesses are agreed that this purification of the air was attained without draught or any unpleasantness whatever.

40. In Note B., attached to the table of average results of the analyses (see Appendix C. 1), the samplers and analysts state: "We are of opinion from careful inspection that the various rooms examined are built in such a way as to cause no inconvenience from draughts and other conditions to the occupants,

Majority Report.

and, after personal observations at practically all hours of the night, we have no hesitation in stating that, from a hygienic point of view, they are perfectly fit for habitation."

41. Mr. J. R. Williams, who spent several nights in these huts, in reply to a question as to the air currents, stated: "If you take the case of the Glen Deep, which has 200 cubic feet per head exactly in those particular rooms, I am certain that the most delicate candle in the world would burn without dropping any grease, and I would not call that a draughty room."

42. Our Secretary, Dr. James Moir, speaking from his personal experience, after spending whole nights in these rooms, says there was no draught, even when the number of air changes was greatly in excess of what is laid down as comfortable in the books.

43. The points upon which special stress was laid by the witnesses, and especially by Mr. J. R. Williams, in order to procure proper ventilation, were, first, that there should be two air-brick spaces on each side of the hut, as shown in the plans, under ordinary circumstances between 2 or 3 inches from the ground and measuring at least 12 inches by 15 inches. The provision of a wooden box, with the side well perforated, along the room, between opposite air-bricks and partitioned in the middle, would have a great tendency to decrease any draughts on cold and windy nights. Secondly, a closed stove in the centre of the room, with a 4-inch flue, and around this flue a second tube 12 inches in diameter, with a hood-shaped opening. This tube should be made telescopic, so that it can be raised or lowered If the hood be too high, say even 8 feet, there is a danger of short circuiting the ventilation; but if the hood be lowered to, say, 4 or 5 feet from the ground, Mr. Williams states that the hood will carry off 60 per cent. of the total air in the room in an hour, and that ninety per cent. of the remaining vitiated air will be carried off by the louvres in the roof, which should extend at least over half the length of the roof. The gratings on the roof were condemned, because, in the first place, they afford too large an outlet and consequent short circuiting and downward draught, and, secondly, "on a wet night the rain would come in and the boys would soon climb up and put a blanket over it; whereas the Kaffir would leave the louvre alone, as it would keep out the rain."

44. Another point connected with these huts is that, in certain compounds visited by the Commission, some of the huts were built back to back, probably with the object of economising space and brickwork. Several witnesses agreed with the Commission in condemning this arrangement, chiefly on account of the interference it occasions to through and through ventilation.

45. On the question of windows, the Commission heard evidence. As adjuncts to ventilation, they are open to objection, chiefly because of the facilities they afford to the Kaffir to interfere with them; but your Commissioners were keenly alive to the importance of light, from a hygienic point of view, and were familiar with the expert opinion that the window area should not be less than one-tenth of the floor space.

46. On the other hand, these huts are slept in by day as well as night, and if windows in the roof were permitted, it would be impossible for the day occupants to sleep on account of the sun; consequently, the Commission decided that ordinary windows should be placed in the side walls of the huts and as vertical lantern-lights between the roof louvres. These windows should be glazed, and without shutters. Moreover, it has been found advisable to protect these windows outside with a gauze grating to prevent the natives from passing in Kaffir beer and similar commodities to the boys in the huts. It is further recommended by the Committee of the Medical Society that no window shall be crossed by a bunk in such a way as to interfere with the access of light or air.

47. Several important recommendations were made regarding the position and structure of the bunks. In most compounds these are arranged in two tiers. Whilst approving of this arrangement, the Commission would not sanction any further extension than the two tiers, nor, so far as the Commission has ascertained, is there any intention or desire on the part of the mining authorities to put up more than two tiers in any hut. Of all the varieties of bunks which the members of the Commission saw, the form which met with their greatest approval was the fixed iron framework which supported movable boards, which could be removed frequently and thoroughly cleaned. This arrangement was found in several of the newer huts. The Medical Society further recommended (paragraph 9, see Appendix A.) that there be a clear space of at least one foot between the wall and the nearest edge of any bunk. We found the bunks so arranged in a few huts, but it was by no means general. The Kaffir has most gregarious

Majority Report.

tendencies, and all the witnesses interrogated on the subject agreed that this tendency showed itself strongly in the huts. No matter what size of room was given them, or how much air-space per head was allotted to them, they would congregate in one end or one corner of the room and sleep all huddled up together, just as they have been accustomed to do in their own kraals. The witnesses agreed that this was a custom most difficult to prevent or interfere with.

48. This tendency, so unhygienic and so calculated to militate against all the schemes devised for their benefit in the huts, was made a subject of special enquiry by Surgeon-General Edge, and the solution which seemed to offer the greatest chances of success, and which was adopted by the Commission, was that each bunk should be separated from its neighbours by a very small ridge, not sufficiently high to look like a barrier, but high enough to prevent a Kaffir willingly lying on it.

49. This difficulty is not met with among the Chinese, who are, generally speaking, much more hygienic in their habits. Mr. J. R. Williams' evidence upon this point was very interesting. He stated (see page 18) : " I would like to mention one point, viz., that I am delighted with the cleanliness of the Chinese, compared with the Kaffirs ; and I am confident in stating that it would be quite impossible to get 2,000 people of the labouring class from any town in Europe to occupy a compound and be more cleanly in their habits than the Chinese at the Glen Deep."

50. Consequently, it appears that, starting on good hygienic principles, it will be easier to maintain them in the Chinese compounds than in those provided for the Kaffirs. When the Commission visited the mines and inspected the compounds, they found that the old compounds inhabited by Kaffirs left very much to be desired, and several of them will require alterations, more or less extensive, to render them fit and proper habitations for the Kaffirs employed in the mines ; and yet it is a curious fact, and one to which reference will be made, that in some of these mines where the native compounds were the worst which the Commission saw, statistics showed that the sick rate and the death rate in these compounds were exceptionally low. In some of the newer compounds, such as that of the Glen Deep, the buildings themselves, the sanitary arrangements, the surface drainage of the large enclosures in which the huts stood, the bathing and cooking arrangements were as nearly as possible perfect, and impressed the Commission most favourably.

51. In most of these newer compounds the floors were concreted or otherwise rendered absolutely impervious, a point which the Commission considers of the greatest importance.

52. In calculating the cubic capacity of these huts, it was pointed out that most text books on hygiene suggest that nothing in height over 12 feet should be allowed to count for cubic space purposes. Dr. Charles Porter, however, pointed out that this refers to rooms in which people stand, sit, or recline near the floor-level. " In the compounds," he says, " there is a second tier of bunks at a height of at least 5 feet from the ground, and I, therefore, submit that the 12 feet mentioned ought to count from the level of the higher tier of bunks. I consider that the case is exactly analogous to that of a theatre," etc. (see Appendix F.)

53. The Commission, while recognising the force of Dr. Porter's contention considered that in view of the attainment of greater security a more restricted limit should be adopted, and decided that in huts with one tier of bunks, 12 feet in average height from the floor level should be allowed in computing the cubic space, but that in huts with two tiers of bunks, an average height not exceeding 14 feet should be allowed.

54. During the course of the evidence, many suggestions were made respecting matters closely affecting the hygienic protection of the natives working in the mines, such as the daily inspection of all the boys, the prompt separation and isolation of all cases of sickness, the provision of change houses at the shaft head, and so forth, points which were recommended some time ago by a Committee of Mine Doctors, and which have been adopted by many of the mines since, points which appeared to the Commission to be of great importance, but which did not come within the scope of the Commission's reference, and which, therefore, it is not necessary further to discuss here.

55. Two of the mine doctors, Dr. Louis G. Irvine and Dr. D. Macaulay, in their evidence before the Commission, approached the question from a different standpoint to that of all the other witnesses. They handed in as evidence a report on the causes of native mortality on the mines of the Witwatersrand,

Majority Report.

drawn up by a Committee of Mine Medical Officers, of which they were members, in June, 1903 (see Appendix G.1). These gentlemen have had considerable experience over an extended period, and therefore their evidence carries much weight with it.

56. They have extended that Report by a Supplementary Statement, which includes more recent data, and they handed it in as evidence. The conclusions drawn in this Supplementary Statement are in complete harmony with those of the former Report, but they go further and show more clearly the chief factors in the high mortality in 1902–3. The valuable tables which accompany the statement show the greatest differences in racial mortality (see Appendix G.2). These clearly prove that the highest death-rates occur amongst natives coming from tropical or sub-tropical districts, whose climates differ most from those of the Rand. The high mortality amongst Portuguese natives is ascribed partly to causes permanently operative, namely (1) difference in climate, (2) the great prevalence of malaria amongst the natives of these districts; and partly to causes temporary or more or less remediable, namely (1) the fact that the natives recruited after the war were for the most part raw boys, (2) the conditions of privation existing during that time, so that many of the recruits arrived weakly and scorbutic, (3) the rigorous winter seasons of 1902 and 1903, (4) the circumstances of under-ground work, and (5) the insufficient means formerly taken to guard against the adverse effects of all these conditions. In addition to these must be considered the pressure put on recruiting agents by the scarcity of native labour.

57. The great majority of deaths amongst Portuguese natives occurred amongst *new* arrivals from these districts, but it is noteworthy that a process of acclimatisation is effected apparently with fair rapidity, so that Portuguese natives who remain on the Rand and re-engage show a surprisingly low death rate.

58. On the other hand, natives drawn from territories whose climate approximates to that of the Rand, viz., Natal, Zululand, and Cape Colony, show a low death rate, which goes to prove that, among those inured to similar climatic conditions, the conditions prevailing on the Rand do not cause a high mortality.

This is emphasised by the recognised fact that gangs of boys leaving the mine are beyond comparison better in health and physique than those arriving on them. "The table (D. 1, see Appendix G. 2, page 85) prepared by the Witwatersrand Native Labour Association shows that among the East Coast natives allotted during the seven months from June 1st to December 31st, 1903, the mortality was 37 per 1,000, and 45.2 per cent. of these deaths occurred within one month after allotment to the mines, after one month's service the mortality steadily declined, although it remained considerable during the first three months, after which the decline is striking."

59. The incidence of disease among raw unacclimatised boys is further accentuated by Statement D. 2, which shows that on this mine, of 138 East Coast natives allotted by the Witwatersrand Native Labour Association direct from the recruiting areas, 33 were admitted to hospital in within 30 days, of which 2 died, and during the second period of 30 days 9 were admitted. On the other hand, of 112 East Coast natives locally engaged (*i.e.*, acclimatised) during the same time, only one was admitted during the first period of 30 days, and two during the second.

60. Statistics show, however, that the number of old hands seeking re-employment on the mines is steadily increasing. Statement D. 5 (page 87) "shows that from January to June, 1904, 58·9 per cent. of East Coast natives and 57.8 per cent. of Northern Transvaal natives were old mine boys," and this will of itself tend to diminish materially the death rate of the natives employed on the mines.

61. "These were the conditions," say Drs. Irvine and Macaulay, "which led us to recommend to the Chamber of Mines the desirability of making some provision to obviate the risk of suddenly exposing boys arriving from tropical districts to the dangers incident to sudden change of climate and sudden introduction to the conditions of mining work, and we suggested :—

"(1) That natives from tropical climates, and especially those arriving from new sources of supply to such countries, should, as far as possible, arrive here in the hot season, namely, from October to March.

"(2) The strictest supervision of recruits prior to entry into the Transvaal.

"(3) The provision of an adequate supply of clothing, and

Majority Report.

"(4) The institution of a detention compound at Johannesburg, where all weakly or impoverished natives should be detained, until in the judgment of the Medical Officer of the Witwatersrand Native Labour Association they were fit for allotment to the mines."

These recommendations have all now been put into operation.

62. In order to elucidate the comparative value of the various factors influencing the death rate, Drs. Irvine and Macaulay selected thirteen mines for detailed examination; six of these were chosen because they had for the official year 1903–1904 very high death rates varying from 70.7 to 91 per 1,000, three were taken as having death rates approximating to the average for the year, namely, from 51.3 to 56.5 per 1,000, the remaining four selected showed low death rates, varying from 19.6 to 35.6 per 1,000.

63. The results of this detailed examination are given in Drs. Irvine and Macaulay's supplementary statement, and it is only necessary here to refer to two of their conclusions—(1) the conditions of housing of the natives on these mines showed no direct relation to the death rate for the period in question. The two lowest on the list have compounds of the oldest type, which have not been altered. In fact these compounds were the worst which the Commission inspected. On the other hand those mines which have made the most improvements, in several instances figure high on the list. Secondly, this investigation clearly shows that there is a direct relation between the death rate and the percentage of raw recruits allotted. Broadly speaking the death rate varies *directly* as the percentage of recruits drawn direct from native territories, and inversely as the numbers locally engaged and composed of natives who are so far acclimatised.

64. Hence these witnesses point out that, however important the question of housing may be, it has not been a predominant factor in the causation of native mortality. On the other hand the question of acclimatisation is predominant, and they therefore urge that equal stress should be laid on the other measures which they have recommended. "If," they say, "the housing conditions in the Rand compounds are or can be made such, when judged by recognised standards, as to supply conditions adequate to health, it is unnecessary to lay additional stress on the one factor of cubic space, to the possible detriment of other measures which are, in our opinion, essential."

IN CONCLUSION,

THE COMMISSION RECOMMENDS:

1. That the standard of vitiation of the air in the compound huts as represented by the amount of CO_2 over and above that of the outside air do not exceed 0.6 per 1,000.

2. That the Rand Mines type of hut be the type of hut adopted in all new compounds (see Appendix D.).

3. That the method of ventilation described in this Report, with, *inter alia*, (1) Four air spaces in the brick work each at least 240 square inches in area, two to four inches from the ground, together with any suitable means of preventing direct currents between the opposite pairs of spaces; (2) Louvres in the roof as shown in the plans, extending at least to one-half of the length of the roof; be adopted.

4. That a closed stove occupy the centre of the hut, with a flue not less than four inches in diameter passing directly upwards through the roof, surrounded by a second flue 12 inches in diameter with a bell-mouth at the lower end. That this second flue be telescopic, so that the bell-shaped opening can be raised or lowered, but that it be not raised more than 5 feet from the ground.

Majority Report.

5. That the window space shall not be less than one-tenth of the floor space, the windows to be placed in the side walls of the huts, and as lantern lights between the louvred hutches ; no windows under any circumstances to be placed in the slope of the roof.

This recommendation differs slightly from that in regard to window space in the Interim Report, and this is chiefly due to the requirements of the Municipal regulations.

6. That the windows be glazed, and that they be not provided with shutters.

7. That the floors be absolutely impervious.

8. That the bunks be composed of fixed iron frames, with movable planks, which can be taken out and cleaned as often as is deemed necessary, and that a small ridge be fixed between contiguous bunks.

9. That the bunks be not placed against the walls, but that a space of 6 to 12 inches intervene between the bunks and any portion of the walls.

10. That no bunk be placed across a window, or in such a position as to interfere with the entrance of air or light.

11. That the huts may contain one or two tiers of bunks, but under no circumstances more than two tiers.

12. That in calculating the cubic air-space in huts with one tier of bunks, not more than 12 feet in average height from the floor shall be allowed, and in huts with two tiers of bunks 14 feet of average height shall be calculated.

* 13. The height of the walls and the inclination of the roof shall be such as to give an *average vertical height* from the ground to the roof of not less than 12 feet in single-tiered huts, and not less than 14 feet in huts with two tiers of bunks.

14. That not less than 200 cubic feet of air-space shall be allowed for each boy occupying the hut, when the full complement of boys is present.

15. That the shape of the huts be not necessarily square.

16. That the compound huts be inspected daily, and all sick boys be immediately removed in order to secure that the compound huts shall contain none but healthy boys.

ADAM JAMESON (*Chairman*).
KENDAL FRANKS.
J. DALLAS EDGE.
CHARLES LANE SANSOM.
JAMES MOIR (*Secretary*).

* NOTE.—Thus a hut with two tiers of bunks, measuring 24 feet by 25 feet and 14 feet allowed of average height from the floor, gives a cubic air-space of 8,400 feet ; and this hut will accommodate a full complement of 42 boys, although during five nights in the week the number of boys in the room will be about 28, and during the other two nights of the week about 37.

MINORITY REPORT

BY

Dr. GEORGE TURNER,

Medical Officer of Health for the Transvaal.

Pretoria, 4th January, 1905.

Minority Report.

I regret very much that I find it necessary to write a Minority Report. I agree practically with all that has been laid down in the General Report, and dissent only so far as the amount of cubic space is concerned.

It was considered advisable to come to an agreement on certain preliminary points, and as the conclusions arrived at are in some respects unusual, I will first comment on them.

The maximum amount of respiratory CO_2 has been laid down as 0·6 per 1,000 volumes of air, instead of 0·2. The higher figure was adopted because it was felt that, under practical conditions, the lower was not obtainable. With this I agree.

Yet if the figures of the analyses of air in the huts, made for the Commission, are inspected, it will be seen that on several occasions the lower limit was not reached.

It was originally arranged that the window space should be one-twenty-fifth of the floor area. This was decided upon because the double tier of bunks left too little wall space available for windows to permit of the regulation one-tenth ; and as the rooms are used by day as well as by night, such an amount of window area would make the rooms too light and too hot for day dormitories.

This, however, clashed with the Urban Bye-laws, and Dr. Porter, the Medical Officer of Johannesburg, suggested that the louvres should be extended and glazed sufficiently to meet the requirements of the Town Regulations as to window area.

Cubic Space.

This is really the matter upon which the Commission has been directed to report, and upon which I find myself at variance with the rest of my colleagues.

I contend that the *minimum* space allowed should not be less than 300 cubic feet, calculated upon the full complement of occupants.

On the other hand it was alleged that, as during five days of the week only 66 per cent. of the occupants were in the room—at one time—and during the remaining two days only 90 per cent., 200 cubic feet, also calculated on the full complement, would be ample.

It must be remembered that these rooms will be occupied continuously by day as well as by night, and under such conditions the Local Government Board, England, has prescribed a *minimum* of 400 cubic feet per head. This would require in the present instance from 267 to 360 feet, calculated on the full complement of occupants, or 293 feet on an average occupancy of 73·3 per cent.

It was proposed—and the proposal was adopted—that a series of experiments should be carried out to ascertain whether the air in the huts would, under ordinary working conditions, contain no more respiratory carbonic acid than would be considered allowable, viz., 0·6 volumes per 1,000.

Minority Report.

These experiments were carried out between the 29th August and the 16th September, 1904, and the results were laid before the Commission.

The results, apparently, have satisfied my colleagues that 200 cubic feet of space are all that is requisite. With that opinion I do not agree.

One of many of the reasons which do not allow me to concur in the general opinion is that I cannot consider the figures resulting from the analyses reliable. Let me say at once that I do not doubt the ability of the gentlemen who made the analyses to estimate closely the alkalinity of a solution of hydrate of baryta ; still less do I wish to cast any doubt upon their *bona fides*. More than these two qualifications, however, are requisite for the solution of the question in dispute.

To begin with, in two out of eight sets of analyses the dimensions of the rooms are not given. This has occasioned a considerable amount of difficulty in comparing the figures. In all cases the average number of persons present is stated, and in three the percentage of the full complement.

The experimental huts at the Village Deep, in the experiment of 2nd September, are said to have had a cubic capacity of 8,120 feet each, and that in the first hut 30 boys constituted 66 per cent. and in the second 40 were 90 per cent. of the full number.

If these statements are accurate, then the allowance of 200 cubic feet per head of the complement has not been provided. If 30 boys represent two-thirds, then the full number must be 45, and the cubic space per boy provided is only 180 feet. To make the statement correct, the cubic capacity of the hut should be 9,000, not 8,120 feet.

As regards the second hut, 40 are said to represent 90 per cent. of the occupants, therefore the full number would be 44.4 per cent., say 45.

If the size of the room is correctly given at 8,120 feet, then, allowing 200 feet per boy, the full complement would be 40–41 : 30 boys would represent 74 per cent. and 40 boys 98 per cent, not 66 and 90 per cent.

On the 8th September an experiment was made at the Village Deep in "C" room, as built by the Mines. The dimensions of the room are not given, but in the previous analyses the room built by the Mines at the Village Deep is said to have contained 8,120 cubic feet. I am informed that this figure is correct.

Now, if 34 persons represent 90 per cent. of the total, the total will be 37.7, say 38 persons, and the size of the room at 200 feet per head would be 7,600 feet.

If, on the other hand, the size be correctly given, the full number would be 40.6, say 41 persons, and 34 is nearly 83 per cent., not 90 per cent. of the total.

Besides, this does not agree with the statement made on the 2nd September, where 40 boys are represented as 90 per cent. of the full complement of a room of precisely similar size.

Again, on the 16th September, an experiment was made at the Village Deep. The analysis does not mention the size of the room, but in a previous experiment it is given at 8,120 feet. It is stated that 35 boys represented 90 per cent. of the full number, therefore the full complement would be 38.8 boys, and the size of the room 7,760–7,800.

If the cubic capacity is correctly given, the full complement would be 40–41 persons, and 35 boys would be 86 per cent.

It is stated that 30 boys constituted 66 per cent. of the full complement of the second hut, but no dimensions are given. If this statement be correct, the full complement would be 45 persons, and the size of the hut 9,000 cubic feet.

In making my calculations as to the number of times the air in these rooms was changed, I have supposed the statements as to percentage given in the analyses to be correct, and have estimated the cubic space per head accordingly.

The figures representing the rate of ventilation taken by the anemometer are of little use. The description of the places at which the observations were made are very confusing : air bricks are mentioned once, shutters once, ventilators four times. The word chimney is used on four occasions, and once the term outer flue, meaning the ventilating shaft enclosing the chimney. On two occasions no reference is made to the rapidity of the ventilation.

When observations with the anemometer were made, this was never done more than once, viz., at the commencement of the experiment, though the atmospheric conditions affecting ventilation varied considerably.

When the actual figures are analysed the results are extraordinary.

On one occasion—on the 29th August—the CO_2 in a sample taken inside the hut contained 0.07 volumes per 1,000 of CO_2 less than the outside air. Twice, on 16th September, the air in the room only contained 0.01 per 1,000 more CO_2

Minority Report.

than the outside air. Even when averages are made of the air inside and outside, on nine occasions the respiratory CO_2 did not exceed 0.2 per 1,000, the minimum being 0.04.

This naturally implies that the changes were very frequent.

There are other peculiarities. On the 6th September, in the first hut, the results show that the longer the hut was occupied the less respiratory CO_2 was found in the air.

On the 12th and 14th September the more numerous the occupants the less CO_2 was found ; the reverse was shown on 29th August and 6th September.

The ventilation in these huts, as measured by the number of complete changes in the hour, must depend upon the difference between the temperature inside and outside of them. The greater the difference the more active the ventilation. Yet on the 31st August, and the 6th and 14th September, the difference decreased and the ventilation increased. On the 12th September the difference inside and outside remained stationary, but the number of changes per hour decreased from 20 to 7.

In estimating the number of changes per hour from the respiratory CO_2 I have taken an average of the atmospheric CO_2 for a basis.

The results are incomprehensible. In most cases I have employed the usual formula, which gives a very approximate result, but in others I have worked out the figures hour by hour.

I find that on 2nd September, in the first room, the amounts of CO_2—inside and outside—would require 67 changes in the three-quarters of an hour, equivalent to 90 changes in the hour. During the second hour it fell to 11.

On the 6th September, in the first hut, the changes between 11 p.m. and 1 a.m. were 29, and between 1 a.m. and 3 a.m. they were 33.

On the 14th September, at the Glen Deep, between 1 a.m. and 3 a.m. in two huts they were 30 and 33 respectively.

On the 16th September, between 1 a.m. and 3 a.m., in the huts they were 22 and 24 per hour. Taken as a whole, the changes vary between 4 and 90 in an hour, and average 17.

As we were assured that there was no draught in the huts at any time, this is not conceivable. It can only be explained by a mistake having occurred somewhere. I do not suppose that the actual chemical analyses were incorrectly performed, probably the sampling was faulty.

I cannot understand why, when results of this nature were being obtained, more attention was not paid to the anemometric observations, and that additional samples were not taken.

But even supposing that it were incontestably shown that the respiratory CO_2 in the huts providing 200 cubic feet of space per occupant did not exceed 0.2 parts by volume per 1,000, I should none the less object to such a limited space, especially in rooms in which the men sleep in bunks one over the other, and when the rooms are occupied by night and day.

We have sufficient evidence that increased density of population, independently of the amount of room space, increases the general mortality.

It has been clearly proved that deaths from phthisis depend greatly on the number of persons living in a room. We know that in these compounds we have a high mortality—especially a high mortality from pulmonary diseases. We also know that a peculiarly virulent type of pneumonia is developed, which usually occasions a high case-mortality.

Quite recently it was seen that this variety of pneumonia spread from bed to bed, and very few patients recovered.

I do not consider 300 cubic feet by any means an ideal standard : it is far too little. That quantity I fixed upon because it is that usually adopted, and I felt that it would be practically impossible to obtain more.

I do not hold that, because the occupants are of a low class, careless and dirty, they require less space. On the contrary, the more this is the case the more necessary it is to ensure perfect ventilation.

The Medical Officers of the Mines have furnished statistics showing that the death rate amongst coloured miners has recently declined considerably. One of them stated that we might eventually reach a yearly average death rate of 40 in the thousand.

Minority Report.

From these statistics they argue that the high mortality was due :—

(*a*) To the poor condition in which the imported miners reached the mines.

(*b*) To the rigour of the last winter but one.

(*c*) To exposure to cold after coming up from underground.

(*d*) To insufficient nourishment.

The recent improvement they attribute to the mildness of last winter, a better food supply and the provision of change houses to protect the men when reaching the surface and they maintain that cubic space can have had little influence on the death rate.

In support of these contentions they show that the mortality is highest amongst new arrivals, and that it is controlled by the proportion of new comers amongst the workers. For instance, the newer and better compounds, which have a higher proportion of fresh, unacclimatised men, suffered more than several less sanitary compounds, in which the greater proportion of workmen had been long resident in Johannesburg.

With much of this I agree. The improvements mentioned are the practical outcome of the recommendations of my colleague Dr. Charles Lane Sansom, and I do not dispute their effect.

That new comers are more liable to sickness, and therefore furnish a higher death rate, than those inured to the work and conditions of life is a well-established fact, which I noticed years ago at Kimberley.

But these facts are not evidence that overcrowding has had little effect.

Probably no disease depends entirely on one factor. For instance, improper feeding is the chief cause of infantile diarrhœa, yet deaths from that disease, with few exceptions, occur only during hot weather. But that heat alone is not the cause is shewn by the fact that when there is no artificial feeding there is no infantile diarrhœa, even during hot summers.

It is therefore, to say the least, unwise to dismiss the effect of overcrowding as of minor importance, especially in view of the facts that the high death rate was largely due to pulmonary disease, especially pneumonia, and that at the height of the mortality, I am informed, the cubic space in the compounds did not average 150 feet per head.

Incidentally, I may remark that indiscriminate recruiting for the Mines is bad. Not only are men physically weak engaged, but men obviously suffering from leprosy are sometimes taken, and remain undetected in the compounds for a considerable time.

The mortality of the men employed on the Mines, taking their ages into consideration, should not exceed 20 in the 1,000 per annum, and we should not rest satisfied until this point has been reached. But I am convinced that this will not be arrived at under the system it is proposed to sanction.

GEORGE TURNER,
M.O.H., Transvaal.

INTERIM REPORT

OF THE

COLOURED LABOUR COMPOUND COMMISSION.

To His Excellency the Acting Lieutenant-Governor.

May it please your Excellency, we, the Members of the Commission appointed on the 28th July, 1904, to enquire into the accommodation and air-space required for Natives and Chinese in the Mine Compounds, have the honour to submit the following recommendations as an interim Report. **Interim Report.**

Owing to our not having yet had time to fully digest the scientific evidence which has been brought before us, we can only now recommend the type of hut which should be erected, leaving for a later report our recommendations as to the cubic space to be ultimately provided for each occupant.

We are of opinion that the "Rand Mines" type of hut, in accordance with the plans attached, should be adopted with the following modifications:—

(*a*) The area should be square and not less than 25 feet by 25 feet.

(*b*) The height of the walls should be not less than 8½ feet; and nothing above the average height of fourteen feet from the floor should be recognized in calculating the cubic capacity.

(*c*) The window-space should be not less than that of two stock sash-windows, each 2 feet 9 inches by 4 feet 1 inch, exclusive of frames, and each of twelve lights.

(*d*) There should be four air-inlets, each 12 inches by 20 inches, about six inches from the floor level, and situated as in the plans.

(*e*) The length of the louvre on the roof should be not less than half that of the side of the hut. The louvre should be five feet wide across the bottom, and the louvred space at least 1½ feet in height.

(*f*) A closed stove to be erected in the centre of the room, with a 4 inch flue leading through the roof, surrounded by a concentric tube, at least one foot in diameter, furnished with a bell-mouth, 4 feet in diameter, and 4½ feet from the floor.

(*g*) The floors must be impervious.

(*h*) No huts should be constructed back-to-back; between each row of huts there should be a space of at least twice the height of the huts.

We are of opinion that, for the present, such huts, if of 8,000 cubic feet capacity, should not contain more than 36 boys.

(Signed)

ADAM JAMESON (*Chairman*).
KENDAL FRANKS.
J. DALLAS EDGE.
CHARLES LANE SANSOM.
GEORGE TURNER.
JAMES MOIR (*Secretary*).

Pretoria, 24th October, 1904.

MINUTES OF PROCEEDINGS

OF THE

COLOURED LABOUR COMPOUND COMMISSION

APPOINTED TO ENQUIRE INTO THE

Cubic Amount of Air-space to be allocated to each Coloured Labourer in the Compounds of the Mines of the Witwatersrand Area

(GOVERNMENT NOTICE No. 909 OF 1904.)

FIRST SITTING.

Tuesday, 9th August, 1904.

PRESENT:

Dr. ADAM JAMESON, Commissioner of Lands, *Chairman.*
Surgeon-General J. DALLAS EDGE. | Dr. C. LANE SANSOM
Sir KENDAL FRANKS. | Dr. GEO. TURNER.
Dr. JAMES MOIR, *Secretary.*

Minutes of Proceedings.
9 Aug., 1904.

The Commission met in Room 27, New Government Buildings, Pretoria.

The Chairman read the Commission of His Excellency the Lieutenant-Governor of the Transvaal. He pointed out that such questions as ventilation and its effects on the efficiency of labourers could only be decided by scientific men, and that the constitution of the Commission was very satisfactory from this point of view.

The Chairman remarked that the Commission was aware that the Transvaal Medical Society had reported on the question before the Commission, and that it was necessary to have official cognizance of the actual accommodation at present available, or proposed, for coloured labourers.

RESOLVED, that witnesses be heard on behalf of the Medical Society and of the Chamber of Mines.

RESOLVED, that existing compounds of good and bad character be visited.

RESOLVED, that the Commission obtain independent analyses of the air in the newer type of compound huts.

RESOLVED, that the Secretary of the Commission be appointed as their analyst, and that the Chamber of Mines be asked to appoint one or more analysts to accompany him in sampling and analysis, these nominees to be approved of by the Commission.

The Commission discussed the question of what is the proper standard of respiratory impurity (carbon dioxide) to be adopted.

RESOLVED, to obtain full information about the structure of the newer types of hut.

The Commission deliberated.

Arrangements were made for visiting mine compounds on Friday, 12th August, and the Commission adjourned to that date.

Minutes of Proceedings.

12 Aug., 1904.

16 Aug., 1904.

FIRST VISIT TO EXISTING COMPOUNDS.

Friday, 12th August, 1904.

The Commission assembled at Park Station, Johannesburg.

(1) The Wemmer Mine was first visited, as being typical of the best class of compound. Hut No. 37, as measured by the Secretary, contained 7,400 cubic feet (neglecting the portion above 12 feet in height). The full complement of the mine is 1,250 boys, distributed over 37 such rooms, which works out at 220 cubic feet per head. It was stated, however, that, owing to the lack of labour, only 20 boys per room are housed, or one to every 370 cubic feet. At night there is no opening for the admission of air, and the louvre on the roof is only open to the extent of about 2 square feet. The rooms are partitioned by blankets in the day-time, and a large quantity of dirty clothing was hanging up to dry in the room; otherwise the rooms were very satisfactory.

(2) The New Goch Compound was next visited. The huts there were very small and dark, with no aperture in the (flat) roof, except what was due to decay. The smaller rooms contained about 1,300 cubic feet and the larger ones about 4,000. Apparently, six to ten boys were housed in the smaller ones. In both cases, the huts contained open stoves, and the atmosphere was choking owing to sulphur dioxide. Curiously enough, this mine has a low death rate.

(3) The Geldenhuis Main Reef Compound was next visited. The huts were even smaller and more objectionable than the previous ones. The air-space was estimated at about 80 cubic feet per head.

(4) The Simmer and Jack Compound was next visited. In this case, eave ventilation is given, and the cubic space was estimated at 160 cubic feet per head.

The Commission resolved to inspect the new Rand Mines type of hut at a later date, and adjourned to Tuesday, 16th August.

SECOND SITTING.

Tuesday, 16th August, 1904.

PRESENT:

Dr. A. Jameson, *Chairman.*

Surgeon-General Edge. | Dr. Sansom.
Sir Kendal Franks. | Dr. Turner.

Dr. Moir, *Secretary.*

The minutes of last meeting and the summary of the visit to the mine compounds were read and approved.

The Commission deliberated.

Resolved, that the medical witnesses should be examined on the question of a standard for carbon dioxide in compound dormitories.

The Secretary was directed to summon certain witnesses on behalf of the Commission, and to notify the newspapers that the sittings are open to the public.

The Secretary read some correspondence between himself and the Chamber of Mines and the Transvaal Medical Society, to the effect that these bodies wished to put forward a number of witnesses on their behalf. The Secretary was directed to make arrangements for hearing as many of these witnesses as desired to attend.

Dr. Irvine was called and examined. He explained that the attitude of the Chamber of Mines is purely an appeal to facts, and that the Chamber desired a postponement until the results of the tests which they proposed to carry out were available, and that the Chamber desired the Commission to appoint delegates to join their Ventilation Sub-Committee.

Resolved, to appoint the Secretary as delegate, with full powers of investigation.

Dr. Charles Porter was called and examined.

The Commission adjourned until the completion of the experimental investigation.

MINUTES OF MEETING OF SUB-COMMITTEE OF CHAMBER OF MINES.

Minutes of Proceedings.

17 Aug., 1904.

20 Sep., 1904.

Wednesday, 17th August, 1904.

PRESENT :

Mr. J. Harry Johns (*Chairman*), Messrs. Price and J. R. Williams, with Drs. Irvine, Porter, and Macaulay and Mr. Morris as advisers, with Dr. Moir as delegate from the Compound Commission. The meeting took place in Mr. Harry Johns' office.

The scheme for dormitories, proposed by the Transvaal Medical Society, was adopted, with some small alterations (see Appendix E).

The following Acting Committee of Samplers and Analysts was appointed :—

Convener :—J. R. Williams.

Samplers :—Drs. Bay and Moir, Messrs. Croghan, Crosse, and (alternatively) G. W. Williams.

Analysts :—Professor August Prister.
Dr. Bernhard Bay.
Dr. James Moir.
Mr. Alexander Heymann.

This Acting Committee met next day and drew up a programme of the observations and air-samples to be taken. Experiments commenced on the night of 29th August in huts erected according to the above scheme (Appendix E).

On the 6th September, the Ventilation Sub-Committee of the Chamber of Mines resolved to make observations in ordinary huts of the New Rand Mines type, and most of the subsequent work was done in these huts (Appendix D). The following programme was completed :—

28th August :—Inspection of Village Deep huts by Dr. Moir.
29th August :—Inspection of New Comet huts by Dr. Moir.
29th–30th August :—Sampling of air at Village Deep " Experimental " Huts.
31st August :—Sampling of air at New Comet " Experimental " Huts.
2nd September :—Sampling of air at Village Deep " Experimental " Huts.
6th September :—Sampling of air at Village Deep " Experimental " and " Rand Mines " Huts.
8th September :—Sampling of air at Village Deep " Rand Mines " Huts.
10th September :—Sampling of air at New Comet, Rand Mines type.
12th September :—Sampling of air at Village Deep " Experimental " and " Rand Mines " Huts.
14th September :—Inspection of and sampling of air at Glen Deep, Rand Mines type.
16th September :—Sampling of air at Village Deep, Rand Mines type.
17th–19th September :—Checking of all calculations and construction of table of daily averages.
18th September :—Final meeting of Chamber of Mines' Sub-Committee, at which Mr. J. R. Williams was appointed to lead evidence on the analytical results at the meeting of the Commission, now fixed for the 20th September.

THIRD SITTING.

Tuesday, 20th September, 1904.

PRESENT :

Dr. Adam Jameson, *Chairman*.
Surgeon-General Edge. | Dr. C. L. Sansom.
Sir Kendal Franks. | Dr. Turner.
Dr. J. Moir, *Secretary*.

The Commission met in Room 97 (Mines Department), Winchester House, Johannesburg, on Tuesday, 20th September, at 11 a.m.

The minutes, as circulated to members, were approved.

The Secretary read a *resumé* of the work accomplished in the interval, namely, the programme of sampling and air analysis carried out by the Analytical Committee of the Chamber of Mines, of which he (the Secretary) was a member.

Minutes of Proceedings.

23 Sep., 1904.

30 Sep., 1904.

The description of the structural arrangements of the two classes of hut which were tested was laid on the table, and also a table of average nightly results, constructed from the original data by the Secretary.

The Commission deliberated.

Mr. J. R. Williams was called and examined. He put in as evidence the original copies of the detailed analytical results, signed and forwarded by the analysts to the Ventilation Committee of the Chamber of Mines, together with certain comments by the samplers and by himself.

Mr. Alexander Heymann was called and examined, and put in a written statement of his views and those of foreign authorities on the reference of the Commission.

Dr. W. C. C. Pakes was called and examined.

Dr. C. Porter read a recent letter from Dr. J. Haldane on the general question.

The Commission resolved to inspect the compounds which had been experimented in, on the 23rd September, and adjourned its public sitting until Tuesday, 27th September.

SECOND VISIT TO COMPOUNDS.

Friday, 23rd September, 1904.

The Commission assembled at Park Station, Johannesburg, at 10.30 a.m. on Friday, 23rd September, and proceeded, under Mr. J. R. Williams' guidance, to the Village Deep Mine (Kaffir labour), where they inspected the two "Experimental Huts," as recommended by the Medical Society, and also a large number of ordinary unaltered huts of the new Rand Mines type. In the first type the construction of the roof-ridge ventilators, and in the second type that of the roof louvres, was noted. The closed stove and its appendages and the air-bricks, etc., were approved. The Secretary pointed out the three positions at which the air samples were taken almost simultaneously. The cubic space of these huts is about 8,100 cubic feet, and about 7,800 if only 12 feet from the floor be allowed.

After luncheon the Commission proceeded to the Glen Deep Mine, near Germiston, and inspected the entire Chinese accommodation, viz., dormitories, dining-room, wash-house, hospital, etc. The movable bunks and other modern improvements were noted, and the members of the Commission expressed themselves as gratified with the contrast between these huts and those they had formerly seen.

The Commission re-adjourned to Friday, 30th September.

FOURTH SITTING.

Friday, 30th September, 1904.

PRESENT:

The Chairman, all the Members, and the Secretary.

The Commission met in the Mines Department, Johannesburg, on Friday, 30th September, at 11 a.m.

The minutes, as circulated, of last meeting were approved.

Dr. L. G. Irvine and Dr. D. Macaulay were called and examined. They handed in a statement dealing with the causes of native mortality, which they had compiled in collaboration.

Mr. J. R. Williams was re-called to further elucidate the analytical results.

This completed the evidence.

The Commission deliberated.

RESOLVED, to fix a standard of CO_2 as respiratory impurity, either at ·5 or ·6 per 1,000 above the outside air.

RESOLVED, to recommend the Rand Mines type of hut for general adoption.

The Commission adjourned to a day to be fixed later.

Minutes of Proceedings.

24 Oct., 1904.

1 Dec., 1904.

FIFTH SITTING.

Monday, 24th October, 1904.

PRESENT:

Dr. A. JAMESON, *Chairman.*
Surgeon-General EDGE. | Dr. TURNER.
Dr. MOIR, *Secretary.*

The Commission met in Dr. Jameson's office, Pretoria, on Monday, 24th October, at 11 a.m.

The minutes of last meeting and summary of visit to the Village Deep and Glen Deep Compounds were read and approved.

The Chairman stated the object of the meeting, viz., the construction of an interim report, dealing with the type of compound hut to be recommended and other urgent matters, for the private information of His Excellency.

After deliberation, an interim report was drawn up and signed for presentation to His Excellency the Acting Lieutenant-Governor.

SIXTH SITTING

Thursday, 1st December, 1904.

Dr. A. JAMESON, *Chairman.*
Surgeon-General EDGE. | Dr. C. L. SANSOM.
Sir KENDAL FRANKS. | Dr. TURNER.
Dr. J. MOIR, *Secretary.*

The Commission assembled in Dr. Jameson's office, Pretoria, on Thursday, 1st December, at 11 a.m.

The draft of the final Report of the Commission was read, and, after some amendment, approved and signed by all the members, Dr. Turner doing so with reservation of the paragraph dealing with the recommendation as to cubic space.*

The Secretary was instructed to take the necessary steps for the revision of the Report for presentation to His Excellency.

* Dr. Turner has since submitted a Minority Report.

MINUTES OF EVIDENCE.

COLOURED LABOUR COMPOUND COMMISSION.

SECOND DAY'S SITTING.

Johannesburg, August 16th, 1904.

PRESENT:

Dr. JAMESON (*Chairman*), | Surgeon-General EDGE,
Sir KENDAL FRANKS, | Dr. TURNER.
Dr. SANSOM, |

Dr. MOIR, *Secretary*.

Dr. IRVINE.

Dr. Louis G. Irvine was called and examined. In answer to the Chairman, witness stated that he is a Master of Arts, Bachelor of Science, and Doctor of Medicine of Edinburgh University.

(*The Witness.*) I am not prepared personally to lead evidence at all this morning, and I should like to explain the reason why. The lines of evidence which I wish to lead eventually are two in number, viz., firstly, *the causes of native mortality on the Rand*, which has a very important bearing on the subject under your consideration, and the reason why I am not prepared to do so at once, is that the Commissioner for Native Affairs has recently asked the Transvaal Medical Society to appoint a Committee to report on that matter, and for that purpose we are collecting statistics from a great many different sources, namely, the Native Labour Association, the Commissioner for Native Affairs, etc., and that has not all come to hand yet. I should like you, therefore, to postpone hearing me on that particular line of evidence, for the reason that I wish the Commission not to take my personal opinion on the causes of native mortality, but to have the facts before them so that they can decide the matter for themselves. Then with regard to the second line of evidence, viz., *the recommendation of the Medical Society as regards cubic space*, Dr. Macaulay and myself—and I am speaking now for Dr. Macaulay—were told only a few days ago that the Medical Society wishes us to represent them before the Commission. When we were informed of that we went to the Chamber of Mines, whose representative we saw yesterday, and we asked the Chamber of Mines to at once constitute the structural conditions mentioned in the report of the Medical Society in at least two huts of two compounds, one Kaffir and one Chinese, and their Engineer undertook to do so at once. These alterations will be put in hand immediately, and thereafter, as soon as they are completed, we are to make a series of tests as to the condition of the atmosphere, and all the other points with regard to these compounds on which information is desired. The tests will be continued for any period you may determine, and I should say, the longer the better. The tests should be made every two hours each night, for say a fortnight, so that you would have actual data to go upon in basing your conclusions. The attitude of the Chamber of Mines is purely an appeal to facts. The Medical Society may be right in advancing this proposal to provide 200 cubic feet of air-space for each occupant, or it may be wrong, but in any event, the test by which they wish to be judged is that of fact. A sub-committee of the Chamber of Mines has been appointed, consisting of Mr. Harry Johns, Mr.

Minutes of Evidence.

Dr. *Irvine.*

16 Aug., 1904.

Price, the Consulting Engineer for H. Eckstein & Co., Mr. J. R. Williams, and Mr. Denny; and Dr. Macaulay and myself have agreed to act as advisors to that Committee with regard to the structural conditions, but could not be members of that Committee because we represented, not the Chamber of Mines, but the Medical Society.

(*Sir Kendal Franks.*) When you talk about structural conditions, do you mean those suggested in the report of the Medical Society?—Yes; I will give you a tabulated list of them. It was the desire of this Sub-Committee to invite the co-operation of your Commission in regulating these tests in any way you might desire. It was their feeling that they should subject the tests to every condition that the Commission might suggest. They propose that the Commission might possibly appoint a delegate, or delegates, to arrange the tests with them. That is the position of affairs, and that is why I think it would be extremely wise if you adjourned so as to allow us to have these tests carried out. The tests will, possibly, require three weeks. The Chamber of Mines has no idea of having this matter decided on anything but facts.

(*The Chairman.*) Then you propose to have these tests made in a compound hut, such as has been indicated in the report of the Medical Society?—Exactly. It was left to the Engineers to choose the compounds where the tests should be made, and they chose the (1) Village Deep, because it is a new compound which can be rapidly altered, and because it is near town and readily open to your inspection. The other one they chose was a Chinese compound, on the East Rand. We thought of having two houses in each of these two compounds altered in the exact way specified by the Medical Society, and, of course, with the number of boys regulated, etc.

(*The Chairman.*) You are then going to suggest to the Chamber of Mines the structure and the ventilation necessary?—We are going to do so. We drew up conditions yesterday, and these will be typed, and a copy will be given you.

(*Sir Kendal Franks.*) Did the Medical Society lay down the conditions of the building and how it should be arranged?—Yes; the structures are to be built according to the plan of the Medical Society.

(*The Chairman.*) Then, gentlemen, from what you have heard are you prepared to adjourn for three weeks after next Tuesday?

Agreed.

(*The Witness.*) Mr. J. R. Williams suggested that analyses should be made by three people, two of whom should be independent of the mining industry, as far as that is possible. The analysts suggested were Professor Prister and Dr. Bay, who are not directly connected with the mining industry, and Mr. Heymann, who is directly connected with the mining industry. If you have anyone else whom you would like to make analyses, or to check these tests, we should be only too glad.

(*The Chairman.*) The Commission has already appointed Dr. Moir for that purpose. Do the analysts intend to make their analyses conjointly?—The idea was, that the samples should be taken by Dr. Bay and perhaps Dr. Moir, and that the analyses might be carried out by different men from those who took the samples.

(*Surgeon-General Edge.*) Do you propose, Mr. Chairman, to ask that samples be taken from any of the compounds we have inspected already?

(*The Chairman.*) We can consider that.

(*Sir Kendal Franks.*) I think that will be hardly necessary, because, if you have certain conditions in the buildings with 200 cubic feet of air-space, that would be sufficient to experiment with.

(*Surgeon-General Edge.*) Do they propose altering all the compounds to this standard?—(*Dr. Irvine.*) They anticipate having to do so.

(*Dr. Turner.*) They have recently sent in a lot of plans, some of which I have here by me, but not a single one fulfils the conditions laid down by the Medical Society?—(*Dr. Irvine.*) That is very likely. Dr. Macaulay and I agreed that the only evidence we could lead before the Commission to-day is, that the representatives of the Chamber of Mines see that it is a matter of fact that we have to prove; and that they have agreed to give us the opportunity of a practical trial.

(*Dr. Turner.*) Even plans of new buildings do not comply with the stipulations of the Medical Society.

(*Dr. Macaulay.*) The mines are prepared to comply in the future.

(*Dr. Porter.*) The President of the Chamber of Mines stated quite definitely that he was willing to do anything in the way of mechanical ventilation, or of warming the incoming air, that the Medical Society suggested.

(*The Witness.*) They said in fact, that they were willing to abide by whatever conclusion the Medical Society came to.

(*Sir Kendal Franks.*) That means structural alterations and so forth ?—Yes; and our idea was, that the Commission should have an opportunity of seeing in concrete fact what the proposed conditions amount to, because hearing about 200, 300, or 400 cubic feet of air-space, and actually seeing them, are entirely different things.

(*Dr. Macaulay.*) They propose in these tests we are going to institute to establish exactly the conditions we have laid down.

Dr. Porter, M.O.H., Johannesburg.

Dr. Charles Porter, Medical Officer of Health for Johannesburg, was called and examined.

The witness submitted the following *precis* of evidence :—

16th August, 1904.

Commission on Air-Space in Compounds.

1. I am a Doctor of Medicine and Bachelor of Surgery, a Member of the Royal College of Surgeons, London ; I hold the Diploma of Public Health of Cambridge University, I am a barrister-at-law, a past Vice-President of the Society of Medical Officers of Health, and an examiner of the Sanitary Institute.

2. I have been exclusively engaged for nearly fifteen years in Public Health work, having held the following posts :—Assistant Medical Officer of Health for East Kent, Medical Officer of Health for the County Borough of Stockport, and County Medical Officer of Health for Shropshire. I have also been from time to time retained by various other sanitary authorities, including the London County Council and the Corporations of Stockport and Derby.

3. As a member of a Committee appointed by the Transvaal Medical Society, I have devoted considerable attention to the question of cubic space-allowance per head for Chinese compounds, and was one of those by whom the Medical Society's report was drafted.

4. I think it is right to state that I at once acquainted the Medical Officer of Health, Transvaal, with the formation and my membership of this Committee, and, as regards theoretical considerations and methods of calculation, I am indebted to him for several useful suggestions, and have endeavoured to meet his views as far as possible.

5. I believe I am well acquainted with the general conditions of mining compounds, and, in connection with this matter, have specially visited the Crown Deep and (on two occasions) the Van Ryn compounds.

6. On the occasion of my last visit to the Van Ryn compound, I was much impressed with the cleanliness and order of the rooms occupied by the Chinese, as compared with any Kaffir rooms I have seen anywhere. They were as neat and clean as a well-ordered barrack room, a point which, I think, has a bearing on ventilation.

7. I was present at the meeting of the Ventilation Committee of the Medical Society on the 10th June, when the President of the Chamber of Mines stated :—

(*a*) That the mining authorities were prepared to provide 200 cubic feet of air-space for each of the whole number of labourers present at any time ; that during five-sevenths of the week not more than two-thirds of the full complement would simultaneously occupy any room, and that during the remaining two-sevenths (Saturday and Sunday nights) the proportion accommodated would be about 90 per cent.

(*b*) That the mines would be prepared, if so advised by the Society, to provide means of mechanical ventilation and of warming the incoming air.

8. I adhere to the opinions expressed in the report of the Medical Society, for which I was largely responsible.

These opinions were as follows :—

(*a*) That cubic air-space allowance is, *per se*, no sufficient guarantee of adequate ventilation. The essential requirement is adequate *air-change.*

At the Brussels Congress of Hygiene in 1903, it was resolved in the Industrial Section that " It is not enough to merely prescribe air-space ; it is necessary also to prescribe a *sufficient renewal of air* in the rooms for each person employed."

(*b*) That the amount of carbon dioxide (CO_2) present in the air is the best objective criterion of the efficiency of air-change, the permissible limit of CO_2 being, according to de Chaumont, 0·6 parts per thousand volumes of air, and according to Haldane 1·2 parts per 1,000.

Precis of Evidence.

Dr. *Porter.*

16 Aug., 1904.

In cotton factories in England the CO_2 limit is ·9 parts per 1,000.

I wish to put it in formal evidence here that Dr. Whitelegge, H.M. Inspector of Factories in England, one of the foremost British hygienists, states officially at page v. of his report for the year 1903 that :—

"Arrangements were made for determination of CO_2 as a measure of the efficiency of ventilation in factories and workshops generally."

Further, Haldane's standard relates to factories, where the personal production alone of CO_2 per head varies from 1 cubic foot to 1·9 cubic feet per hour, according to the violence of the exercise, whereas in sleeping rooms the production per adult man is only ·72.

(*c*) That given a sleeping room of 4,000 cubic feet capacity allowing 200 cubic feet of air-space with a ¼ square foot air-inlet and ¼ square foot air-outlet for each person, the amount of CO_2 in the air at the end of 8 hours would theoretically be about 0·67 parts per 1,000 when 60 per cent. of the full complement are simultaneously accommodated, and about 0·77 per cent. when 90 per cent. are sleeping.

The air in this case is calculated to be entering at the rate of about 3·5 feet per second.

(*d*) That if such rooms are in addition provided with a hooded stove with a 6-inch flue, and if around the flue there is a second tube 12 inches in diameter with a bell-shaped opening 8 feet from the ground, the amount of CO_2 in the air at the end of 8 hours, assuming the fire to be burning during that time, will be 0.64 per 1,000, when 66 per cent. of the boys are sleeping, and 0·74 per 1,000 when 90 per cent. are present.

The air in this case enters at the rate of 3·64 cubic feet per second.

This open stove arrangement is liable to the objection that the room may be filled with smoke therefrom owing to gusts of wind.

I therefore consider that it would be better to have a closed stove with a 6-inch flue leading direct from it through the roof, and around this flue a second tube, 12 inches in diameter, with a bell-shaped opening 8 feet from the ground. This arrangement is similar to that devised by M. Flori, of Boulogne, and much used in the ironing rooms of laundries in the North of France.

(*e*) That under these conditions the respiratory impurity at its worst is only slightly over De Chaumont's limit (0·6 per 1,000), and much under Haldane's limit (1·2 per 1,000), which latter is considered good enough for workers in English factories ; moreover, it is four times less than what is possible in common lodging-houses which meet modern bye-laws requirements, and five times less than what is unfortunately permitted in many elementary schoolrooms in winter.

(*f*) That, theoretically, therefore, the provision of air-change is reasonably sufficient if 200 cubic feet of air-space, together with inlet and outlet area and extraction by heat, be provided as above indicated.

(*g*) That whilst the exact arrangement of the required inlet and outlet areas must be left to the Chamber's engineers, the Committee recommends that, so far as possible, there be a difference in height of 10 feet between them ; that there be two 6 inch by 9 inch air-bricks just above floor-level in both back and front walls of each room ; that there be a louvre above the door and along the whole length of the roof ridge.

(*h*) That there be opening windows of not less than 1–10th of the floor space, of which at least one-half shall be in the northern wall of the room, no windows to be crossed by a bunk in such a way as to interfere with the access of light or air. I highly approve of lantern roof-ridge ventilators as erected at the Langlaagte Deep.

(*i*) That the bunks be moveable, and that there be a clear space of at least one foot between the wall and the nearest edge of any bunk.

(*j*) That the floors be impervious.

(*k*) That as our conclusions as to air-delivery and air-change are, to some extent, based upon theoretical considerations, which may in some points require the test of actual trial, it will be advisable to examine them in practical application, both in regard to the respiratory impurity which results, and the necessity in cold weather for warming the incoming air.

Practical Trials.—I desire to press this point on the Commission very strongly indeed.

I have no "brief" for the mines, but I feel that the industry on which the Colony directly or indirectly depends, ought not to be hampered by restrictions that may be unnecessary.

Precis of Evidence.

Dr. *Porter.*

16 Aug., 1904.

In support of the view which I hold I will quote the latest report of Mr. H. M. Smith, H.M. Superintendent Inspector of Factories in England :—

> "It is clearly shown that by the use of suitable mechanical appliances it is not only possible but easy to secure in gassing-rooms an atmosphere conforming to a reasonable standard of CO_2."

(Roughly speaking, an ordinary gas jet produces as much CO_2 as three men, and there are hundreds of jets in a gassing-room.)

On the other hand, I have a profound respect for Dr. Turner's considered opinion on all Public Health matters, and, as he differs from us, I ask most strongly that the matter be settled by practical trial. A compound room should be arranged presenting the conditions suggested by the Medical Society, and a series of experiments made, open to the inspection of any one concerned.

Dr. Porter, Examined.

Minutes of Evidence.

Dr. *Porter.*

16 Aug., 1904.

(*Dr. Sansom.*) A report has been issued by the Transvaal Medical Society as to the amount of air-space per head to be provided in Chinese compounds ?—Yes.

I suppose that report will be handed in for the Commission to discuss in connection with all the compounds ?—Yes. The matter was specially dealt with by the Medical Society in regard to the Chinese compounds.

Was the Medical Society requested to draw up such a report by the Chamber of Mines ?—Yes, the matter was brought up by a letter from the President of the Chamber of Mines, and a Committee of the Medical Society was appointed.

Did the President of the Chamber of Mines attend a meeting of this Committee ?—Yes ; he attended before the Committee.

Did you go into the matter entirely by yourself ?—Of course the members of the Committee went into it. I thought it right to Dr. Turner to acquaint him at once with what was being done in the matter, and to let him have particulars of what was going on as the matter proceeded, and he was good enough to point out several methods of calculation, and so on, that assisted in bringing us more into agreement.

(*Sir Kendal Franks.*) Was it the Chamber of Mines that approached the Medical Society ?—Yes. The first I heard about it was in the course of a conversation with Dr. Irvine in the Municipal Buildings. He asked me something about cubic air-space, and I very briefly stated my views on the matter.

(*The Chairman.*) Do you propose to place the report of the Medical Society before the Commission as evidence ?—Yes ; as a matter of fact I believe you have it.

(*The Secretary.*) Do not these reports vary somewhat ?—I will hand you in one that is absolutely correct.

(*The Chairman.*) That report practically gives all the evidence which we may expect from the Medical Society ?—That is the evidence.

Will there be any modifications of this evidence ?—I don't think there will be anything very material. There is a suggestion in regard to one detail that I propose to make, and I should like to supplement some of the statements in the report by further evidence.

Then the evidence we receive from the Society will be supplementary to the report you are placing before us ?—No, sir, practically the report with a few supplementary remarks.

It is a theoretical report ?—Yes.

It is not based upon practical investigation ?—No, there has been no practical investigation to speak of.

(*Dr. Sansom.*) In view of these tests being made, I do not see that there is any good of our going into the details of this report, and arguing it. We can go into it afterwards if necessary when we have the results of the experiments. I was to have taken Dr. Porter over various points, but I do not think that would help us very much ?—I do not think so either. I think the whole thing comes down to facts.

(*Surgeon-General Edge.*) Would it not be as well to ask Dr. Porter whether he accepts our standards, or whether he has any amendments to them.

Minutes of Evidence.

Dr. *Porter.*

16 Aug., 1904.

(*The Chairman.*) We have already discussed the standard of impurity that should be allowed, and we should be very glad to hear your views upon that, namely, the amount of CO_2 that should be allowed, taking CO_2 as the standard of impurity?—Well, in our report we have taken ·6 per 1,000 volumes of air, but I should like to make one or two remarks about that. That standard was fixed by de Chaumont as the result of experiments in barrack-rooms forty years ago; and, subject, of course, to what General Edge may have to say about it, it appears to me to be obvious that the barrack-rooms then were not what they are now. De Chaumont laid down the standard of ·6 as the stage at which the air began to smell offensively. Professor Kenwood states that in recent experiments he has never noticed any offensive smell until the CO_2 gets to ·8, and he says he doubts whether the organic matter that is exhaled during respiration has the entirely injurious effect that is so usually attributed to it. He definitely states he does not find this offensive smell until it gets to ·8. I should like further to point out that in cotton factories in England the percentage of CO_2 that is permitted is 0·9 parts per 1,000.

(*Surgeon-General Edge.*) That is for the workrooms?—Yes, and therefore so much the more applicable to compounds, because in compound sleeping-rooms you have people at rest, and the adult man at rest is not believed to exhale more than ·72 cubic feet of CO_2 per hour, whereas when he is taking exercise or working, he may exhale anything from 1 cubic foot to 1·9 according to the violence of the exercise; and, if the standard of ·9 parts per 1,000 is good enough for a man who is exhaling 1 to 1·9 cubic feet per hour, it is surely good enough for a man exhaling only ·72.

(*The Chairman.*) In such a room is there no other means of producing CO_2, and is it not produced by combustion?—Yes, it is, but it seems to me that it all tends to the same conclusion.

Not exactly; I speak under correction?—Some materials will produce it. For instance, in the gassing-rooms of cotton factories in the north of England you will get a good deal of CO_2 produced from combustion.

Then that would not be exactly fair, because I understand that you simply take the amount of CO_2 as an indication of the amount of respiratory impurity, and therefore if there is another source of CO_2 you are not getting a true indication of the respiratory impurity?—That is so, but Dr. Whitelegge, H.M. Chief Inspector of Factories, who is one of the very first authorities on hygiene, considers, even with that additional source of CO_2, that the standard is sufficient. Now in the compounds, you will not have any additional source of CO_2 except the fire.

(*Dr. Turner.*) When you speak about ·6 of CO_2, do you mean total or respiratory?—Total.

I would point out to you that in these English workrooms there are other sources of CO_2?—In some of them.

In most of them. A great many varieties of goods produce CO_2?—I think a great many do not.

CO_2 from such sources does not prove the air is vitiated, because it is not the amount of CO_2 that is the trouble, but the CO_2 is only taken as an indication of something else?—Quite so.

A great many of the ordinary compound huts have a coal stove open at the top, and about two feet above that a hood placed to collect the fumes; but any draught blows the CO_2 from the stove into the room?—I have dealt with that in my report.

There is also another great risk. You may not only have CO_2 produced but also CO?—I have suggested that they should have the form of stove used in laundries in the North of France. It was invented by M. Flori, of Boulogne, and what the Medical Society has suggested is a very slight modification of his arrangement.

(*Dr. Irvine.*) It was precisely because of the risk of CO that we urged the adoption of closed stoves.

(*The Witness.*) What I do suggest as a modification of the recommendation of the Committee is this. (Here Dr. Porter made a rough sketch to illustrate his meaning, showing a closed stove, with a 6-inch flue, and around the flue a second tube, 12 inches in diameter, with a bell-shaped opening 8 feet from the ground.) We have calculated that in using this, the amount of CO_2 in the air at the end of 8 hours would be ·64 per 1,000 when 66 per cent. of the boys are sleeping, and ·74 per 1,000 when 90 per cent. are present.

(*The Chairman.*) This would not involve any great expenditure ?—No, sir.

(*Dr. Irvine.*) These are the conditions Dr. Macaulay and I insisted on.

(*The Witness.*) This kind of stove is commented upon very favourably in the report of Dr. Whitelegge.

(*The Chairman.*) Then with these stoves we need not take any other sources whatever of CO_2 into consideration ?—I think there will be no other material sources, sir.

(*Dr. Sansom.*) Then what standard are we to accept ?—I think the Medical Society is prepared to go as low as ·6, but at the same time I think that very low and unnecessarily strict. You know that Haldane fixes the standard at 1·2.

(*The Chairman.*) That seems very high ?—In 1902 Haldane recommended that the standard should be 1.0, and I have incorporated that in the Municipal bye-laws. With regard to weaving-sheds, where, as far as I know, there is no particular generation of CO_2, the Society of Medical Officers of Health have accepted .9 per 1,000.

(*Surgeon-General Edge.*) The Royal Tuberculosis Commission in January last recommended Haldane's standard being reduced, even below ·6 for dormitories ?—I was not aware of that.

(*Sir Kendal Franks.*) Of course the conditions out here are very different from the conditions at Home ?—I should like to point out that the conditions under which many of these compounds exist are semi-rural, if not rural ; and Haldane and others have shown that the normal amount of CO_2 in country air is ·3 apart from vegetation (and there is very little of that kind of thing about these compounds).

(*Dr. Turner.*) Haldane's average goes a little over ·3.

(*The Chairman.*) Do you think we would be safe to accept de Chaumont's original standard of ·6 ?—Well, ·6 is what the Medical Society has worked on in its report, but, personally, I think it unnecessarily low, and I am strengthened in that belief by what Professor Kenwood states, namely, that he did not notice this offensive smell until he got to ·8, whilst de Chaumont has not given any reason for fixing the standard at ·6, except the recognition of smell at that point. There is one other point I would like to make. On Sunday last I had an opportunity of going over the Van Ryn compounds. I believe we went without notice to anyone (except to secure permits when we got there), and the rooms occupied by the Chinese are far cleaner and in better order than in any Kaffir compounds I have seen on the Rand, and I have seen all the mines within the Municipal area.

(*Sir Kendal Franks.*) We want to be perfectly fair to all sides, so do you consider ·6 per 1,000 to be an unfair standard ?—I think it is an exceedingly strict limit, and I think it will be very hard for any one to adduce any good solid reason in support of it. Even the originator only stated that he noticed the offensive smell when ·6 of CO_2 was reached, whilst we have Professor Kenwood dealing recently with the ordinary conditions of life, and he says he does not smell the air until the CO_2 gets to ·8.

(*Dr. Turner.*) People's power of judging smells differ very much indeed ?—(*Dr. Porter.*) Dr. Irvine points out that that cuts both ways. I have had the privilege of being a pupil of Professor Kenwood and of knowing him very well indeed, and I think his sense of smell is as keen as his intellect, and you cannot say much more.

(*Sir Kendal Franks.*) What would you consider a fair limit to lay down as a standard of impurity in these compounds ?—I should think ·8 per 1,000 is a fair and sufficiently strict limit. On the other hand, I think I would be quite justified in asking for the limit that is recognised in factories in England, because I contend that what is good enough for our people in England is good enough for the Chinese. I feel that very strongly. I have spent a great deal of my time in inspecting factories and workshops in England, and I think that if a man like Dr. Whitelegge, who is one of the leading British hygienists, considers that ·9 per 1,000 is sufficient for thousands of workers committed to his official charge, then I am quite satisfied that it is sufficient for the Chinese. At the same time I think ·8 per 1,000 would be fair.

(*Dr. Sansom.*) Of course, if you make the standard ·9 per 1,000 it makes an enormous difference ?—Yes.

As it stands at present it means an enormous change in the air ?—That is so.

Minutes of Evidence.

Dr. *Porter.*

16 Aug. 1904.

If we raise our CO_2 standard the amount of air change we require is very much less ?—Yes.

(*Dr. Irvine.*) That is one reason why we wanted to introduce these structural alterations, because Dr. Turner's main objection, I fancy, was that these conditions would render life in these houses practically intolerable, on account of the frequency of air change.

(*Dr. Sansom.*) I think the frequency of air change works out at 12 times per hour ?—No, 9½ times—I am speaking of the Medical Society's report.

(*Dr. Turner.*) If you take the Medical Society's figures the change was in some instances 12.

(*The Chairman.*) You think the only evidence to be adduced as the reason why ·6 per 1,000 should be adopted is that of smell ?—Yes, sir, I have examined all the text-books on hygiene and I have not seen any other reason given ; if you read de Chaumont he gives us his reasons, " because the air begins to smell oppressive and offensive in barrack-rooms at ·6.

Is there no other evidence ?—Not to my knowledge. I should be glad to know it. I do not say there is no other reason, but I have been unable to find it.

(*Dr. Turner.*) We should take respiratory impurity as our standard and not the *total* CO_2, because some days we may have even less than ·3 per 1,000, and on other days considerably more, and when we make our experiments they should be made with the inside and outside air ?—I quite agree, sir.

The Chairman here quoted from Notter & Firth's " Hygiene," as follows (p. 207) :—

" On this basis (the high standard of Carnelley, Haldane, and Anderson) the hourly need of fresh air in dwellings would not exceed 1,900 cubic feet per head, and in schools be but 550 cubic feet. Experience, so far, has not justified the general acceptance of those low standard allowances of fresh air per hour."

(*The Witness.*) That is merely a pious expression of opinion, and he does not produce an atom of evidence to justify it. He says experience has proved it, but he gives nothing in support of the statement.

(*Dr. Turner.*) I rather fancy there was an experiment on a large scale in barracks.

(*Surgeon-General Edge.*) We have, of course, fought for years to get up the standard for barracks, and it is only recently that we got it fixed. A matter that has influenced me very much in sticking up for the ·6 standard, is the occupation of these miners. They are spending the whole of their days in a vitiated atmosphere down below, and they want a little bit better air when they come above. I urge that they require better air than soldiers. Their employment cannot be called a healthy one, in fact, judging from statistics, it appears to be very unhealthy.

(*The Chairman.*) Do the statistics show any great difference in the death rate between one compound and another ?

(*Dr. Irvine.*) Yes, they vary very greatly, and that is part of the question we are investigating.

(*The Chairman.*) Dr. Moir suggests that if ·9 per 1,000 is the standard for factories in England where the outside air is usually ·4, our standard should be ·8, since the outside air is ·3.

(*Sir Kendal Franks.*) To avoid confusion, we should stick to Dr. Turner's suggestion about respiratory impurity as distinguished from total amount of CO_2 in the air ?—That is so, sir. I may say that the Medical Society took ·6 as their basis, and if necessary are prepared to accept it, but speaking for myself (and I know one or two others who agree with me), I consider that ·6 per 1,000 is unnecessarily strict, and that the grounds on which it was fixed by De Chaumont do not now obtain. Unless, therefore, there is shown to be good reason for the adoption of ·6, apart from that of smell (which is inconclusive), I see no reason why ·8 should not be adopted. In any case, under our worst conditions we expect to get very little above ·6, and I do wish to accentuate this, that *what is good for our own people in England is good enough for these Chinese.* I mean that what is recognised to be good enough for factory-workers by an expert like Dr. Whitelegge (who was specially selected on account of his knowledge of hygiene for the post of Chief Inspector of Factories in England) is good enough for Chinese ; any health pronouncement he makes is entitled to the greatest respect and consideration ; and what he considers sufficient

there, ought to be good enough here. Personally, I must claim to speak with some authority on this subject, as I have lived in a manufacturing town for 10 years; and I do not see that there is any risk of a greater production of CO_2 here than in most rooms inhabited by human beings.

(*Dr. Turner.*) I don't think you quite see my point; you may have a room in a factory where a man is turning a crank and he is giving off more CO_2 than he would if at rest, and, therefore, you are obliged to accept a higher limit in a factory where a man is exerting himself, than you are for a room where a man is sleeping quietly, and where he ought to be building up his system. You cannot apply limits laid down for factories to dwelling-houses?—I should like to read to you again what the Superintendent of Factories in England says in a report which has just come to hand by this mail, *viz.*: "It is clearly shown that by the use of suitable mechanical appliances it is not only possible but easy to secure in gassing-rooms an atmosphere conforming to a reasonable standard of CO_2," and so in view of the experience that has been gained in England I do not see that there is or should be any insurmountable difficulty in supplying mechanically the necessary amount of air to allow 200 cubic feet of air-space to each native; moreover, I want to accentuate this that the Chairman of the Chamber of Mines made the statement definitely and specifically on behalf of the mines that he was prepared to do anything in the way of mechanical ventilation and of warming the incoming air that the Medical Society might think right. He could not have made the statement more explicitly, and he made it without the slightest reservation. The only persons connected with the mines I have spoken to on this subject are Mr. Harry Johns and Mr. Denny. I wanted to find out from them a method of calculating friction of air in tubes. It is a very difficult question, and these mining engineers have to do with it. Incidentally they told me, that it would be quite easy, and comparatively inexpensive, to provide, if necessary, mechanical means of injection of a supply of air and also of warming the air. In the Blue Book already referred to the Superintendent Inspector for Dangerous Trades makes the statement I have already read about gassing-rooms. An ordinary gas jet produces roughly as much CO_2 as three men, and in a gassing-room of a cotton-mill small gas-jets are there by hundreds, if not by thousands.

(*Dr. Turner.*) There it is distinctly stated that he limits that standard to a gassing-room?—Yes, but if it is possible by ventilation to remove the CO_2 it is also possible to remove other impurities.

But the CO_2 produced there is principally provided by the gas, and that is not a question of general ventilation at all.

(*Sir Kendal Franks.*) But surely it is as easy to remove CO_2, no matter what its source may be, and it ought to be easier still to do it in a room without any gas-jets at all.

(*Dr. Turner.*) No, sir. The number of times you have to change the air creates a fearful draught, and the people naturally object to it.

(*Sir Kendal Franks.*) There must be a draught in a gassing-room.

(*Dr. Turner.*) Oh, yes, you can ventilate any room with a hurricane through it, if the people can only stand it.

(*Dr. Sansom.*) That is the point of the whole thing. If the CO_2 were kept down to ·6 per 1,000, you must create a tiresome draught, but if it is ·8 or ·9 you possibly might be able to change the air without a draught. That is why I think it is necessary for us to say that ·6 is a very strict standard and that we might allow a little more. If we are to stick to ·6 then the whole question requires very careful consideration indeed.

(*Sir Kendal Franks.*) Does the ventilation of a gassing-room imply a hurricane going through the room?—No. I quite agree with what Dr. Sansom has said about the standard to be fixed, and again I record my opinion that ·8 is a reasonable one. I may say that under the conditions we have laid down, and which are to be subjected to practical tests, the air is calculated to be entering at the rate of 3·5 linear feet per second in one case, and 3·64 feet per second in the other. Now the agreeable rate for air to come in at varies from 2½ to 3 feet per second. When it is possible to warm the air, you can get it in at a very much faster rate (up to 4 or 5 feet per second) without injurious results.

(*The Chairman.*) Is it proposed to warm the air here?—Yes, if the opinion is expressed that it is desirable; the engineers have told me that it is a comparatively easy thing to warm the air. There is one other point I should like to refer to, and that is the question of adding moisture to the air coming in. Of

Minutes of Evidence.

Dr. *Porter.*

16 Aug. 1904.

course, if that is considered a necessity it can be easily done by putting tins on the stove, but I want to point out that one of the best practical authorities on ventilation, namely, Mr. Thomas, F.I.C., who has recently published a most excellent book on "The Ventilation of Churches and Public Buildings," says definitely, "no unpleasant feelings are experienced in air heated over hot water pipes which do not exceed 150 deg. F., and from professional experience I have no hesitation in stating that the addition of moisture need not be a matter of anxiety." He further states as a result of a great number of experiments in connection with large buildings that it is never necessary to warm the incoming air unless it is below 45 deg. F.

It is considerably below that here in winter?—Yes; it may be necessary, and probably will be necessary, to warm the air; and the Chamber of Mines, as I understand, quite anticipates that possibility.

(*Dr. Sansom.*) May I just ask a question about one point in the report? You assume that it will be necessary to change the air pretty rapidly?—Yes, it is calculated at 9½ times per hour with the air coming in at 3½ feet per second.

You do not propose that all the air coming in should be warmed, and you propose that a good deal should be natural ventilation?—Yes, that will come in in any case.

You say there will be a fairly constant difference of 10 deg. between the inside and the outside air. Do you think that that could be possibly kept up, because it makes a great difference in the calculation?—Of course it does. I think it is fair, and if Dr. Turner does not mind my stating it, and if I reproduce correctly my remembrance of what he said, I think he accepted that as perhaps open to further consideration, but on the whole a fair workable basis for calculation.

(*Dr. Turner.*) I am perfectly certain that during a great part of the year you won't get it. You did not get it on every night on which you made your preliminary experiments?—That was in some of the places; in others we got much more. At the Crown Deep, for instance, we got much more. At another we got about 10, and in another 5 only. This question depends on a rather intricate calculation, and I have not attempted it, but the exact amount of heat imparted to the air by the human body can be calculated out. The number of calories produced by the human body is known, and, knowing that, it is quite possible for an expert physicist to calculate what the addition of heat to the air will be. (*See Appendix* I.)

(*Dr. Sansom.*) The point is, whether that difference with this change of air you recommend is likely to be maintained?—I think it will be maintained. Of course if the Medical Committee finds that our theoretical views do not work out in practice, they will probably recommend certain definite mechanical means of ventilation, and these will be absolutely under the control of the people in charge of the compounds who can send in as much air as they like. We have recognised that there is a theoretical aspect to the conclusions we have come, and we have asked you to put our expressions of theoretical opinion to the test of actual practice. After these experiments have been made I presume I may have the privilege of being re-called if I so desire.

(*Dr. Turner.*) Exactly. I have a lot of questions I am going to ask you on these experiments.

(*The Chairman.*) We are very much obliged to you.

Dr. Macaulay.

Dr. *Macaulay.*

16 Aug. 1904.

Dr. Macaulay was called and examined.

(*The Chairman.*) What are your qualifications?—I am a Master of Arts and Bachelor of Medicine of Edinburgh University.

You have had a large experience of the working of these compounds, and we are anxious to know in what way you find you can control the natives in regard to their preventing ventilation by stopping up the holes with their clothes and blankets, etc. Do you find any difficulty in preventing that?—We do find a difficulty with the South African native in that respect, but I make it a point on my mines that the compound manager instructs the police both night and day to periodically visit the rooms and remove these obstructions.

Have you got any regulations as to where they place their clothing?—They seem to hang it up over their beds, thus making the air they breathe very impure indeed.

Do you do anything to prevent that?—We try to do it, and I might say that when we went last Sunday to the Chinese compound at Van Ryn, we found that the Chinese were very much more tidy in their habits, and there was none of this heterogeneous collection of clothes. The clothes were folded up and the rooms were quite clean and tidy.

Can you tell us whether in any of the compounds they are compelled to put their clothes in any place other than hanging round their beds. Is there any provision of lockers?—There is no provision of anything of that sort to my knowledge.

Is it not the case that they provide lockers in the Kimberley compounds?—I have never been there.

(*Surgeon-General Edge.*) I fancy the reason the clothes are under control at Kimberley is to have them searched in case any diamonds are concealed. I do not think it is on hygienic grounds?—I think that now that the mines issue proper clothing to the natives on their arrival here, the matter to which you refer will be very much more easily managed.

(*The Chairman.*) Do you not think it objectionable that they should have their clothing hanging round their beds?—I do not know how it can be obviated.

(*Sir Kendal Franks.*) In looking at these compounds we have been very much struck to see in almost every dormitory the way in which it was partitioned off by these blankets.

(*Dr. Irvine.*) The reason is that the night-shift boys who sleep in the huts in the day-time, cannot sleep in the light, and they purposely darken their bunks so that they may sleep in the dark.

(*The Witness.*) We have recommended, and the Chamber of Mines have practically agreed to, and the Government, I think, is insisting on, the provision of change-houses at the headgears so that the dirty clothes of the natives will not be carried to the dormitories.

(*Dr. Sansom.*) The difficulty is, that many of the natives will not leave their clothes in these change-houses, being afraid of having them stolen. They won't leave them, and I should be glad to hear how the difficulty can be met?—I think a little gentle compulsion would meet the difficulty. There is always a difficulty in training the native, but he is always amenable to discipline.

(*The Chairman.*) Do you think such a recommendation can be carried out?—I think so.

(*Sir Kendal Franks.*) In these proposed new dormitories do you think you would be able to prevent the natives or Chinese undoing all the good you do by blocking up the holes with their blankets?—That is a matter for the mine police.

You think it is quite possible?—I think so.

(*Dr. Irvine.*) The particular form of ventilation they object to is the eave-ventilation, coming from just over the top of the wall, because where bunks are arranged in two tiers, that comes disagreeably near the top bunk, but I do not think they would attempt to close louvres over the door, or roof ventilation.

(*Surgeon-General Edge.*) You will be responsible under these new rules for the ventilation being kept up?—The compound managers will.

But I suppose the mine medical officers will be responsible for seeing it carried out?—Yes.

(*Sir Kendal Franks.*) When all these things are done, it will be necessary to introduce legislation giving power to enforce these things?—Very possibly.

(*Dr. Porter.*) May I point out the procedure adopted under the Factories and Workshops Act in England?

(*The Chairman.*) We shall be much obliged.

(*Dr. Porter.*) An Inspector goes round and takes samples of the air from different parts of the room, and either on the spot, or subsequently at his convenience, he analyzes this air, and if it is found to exceed the legal limit of respiratory impurity proceedings are then taken. I may say as regards the mines that an arrangement has been arrived at whereby the Mining Inspectors attend to sanitary matters, with the Sanitary Inspector of the Municipality as *amicus curiæ*, and if the conditions are found to be unsatisfactory, action is to be instituted by the Mines Department, who have arranged as regards mines within the Municipality to call in the Medical Officer of Health of Johannesburg or one of his subordinates. That has been arranged with the complete concurrence of the Mines Department

Minutes of Evidence.

Dr. *Macaulay*

16 Aug., 1904.

and the Municipality. It is proposed to extend that to all the mines along the reef according to the memorandum drawn up by the Assistant Colonial Secretary. There is one other matter I should like to refer to, and that is the question of roof ventilation. I would like to inform the Commission, that I saw what struck me as being an exceedingly good form of combined window and ventilator at the Langlaagte Deep. It is what is called the lantern roof-ridge ventilator. It is like a long low small house on top of the roof, the sides of the house being windows which open. The alternate sections of the sides of those ventilators are made of wire-gauze of large mesh, the gauze being open, and the window space equal to not less than one-tenth of the floor space. Ventilation of that kind cannot be interfered with. I would like to suggest that form of ventilation for the consideration of the Commission. I believe there are some also on Dr. Macaulay's mines. I may say that we have them at the Smallpox Ward at Rietfontein Lazaretto, and it is most excellently ventilated.

(*The Chairman.*) Have you made any recommendation, or do you make any recommendation as to the material used for the bunks?—(*Dr. Macaulay.*) We have definitely recommended iron frames and movable wooden bunks.

You did not recommend the spring-mattresses?—We went into the question very carefully with our compound managers, when drawing up our report more than a year ago, and we discovered that the natives had a distinct objection to the spring bed. They prefer hard planks, and that is why we recommended movable wooden bunks.

Do you think it is as cleanly?—There is a plentiful supply of water in all the compounds, and they can be taken out and hosed.

You do not find any trouble from vermin?—We have not in the compounds where these have been put up.

The Commission thereafter adjourned for four weeks.

JAMES MOIR,
Secretary.

ADAM JAMESON,
Chairman.

COLOURED LABOUR COMPOUND COMMISSION.

THIRD DAY'S SITTING.

20 Sep. 1904.

Johannesburg, September 20th, 1904.

PRESENT:

Dr. Jameson (*Chairman*), Sir Kendal Franks, Dr. Sansom, Surgeon-General Edge, Dr. Turner.

Dr. Moir (*Secretary*).

The minutes of last meeting, as circulated to members, were approved.

The Secretary read the minutes of the meetings of the Chamber of Mines Ventilation Sub-Committee, which he attended on behalf of the Commission, and also a *resume* of the proceedings of the analytical committee appointed to carry out the practical experiments and analyses. Tables showing the average daily results of these analyses were circulated among the members.

A letter from Dr. Porter was submitted and taken as read. (See Appendix F.)

Some informal conversation took place before the public meeting of the Commission. The Chairman informed Surgeon-General Edge that the Commission was appointed by His Excellency the Lieutenant-Governor on account of a disagreement between the authorities: that Dr. Turner was of opinion that 200 cubic feet of air-space, as suggested by the Medical Society, was insufficient per person, and had so advised His Excellency; hence it was necessary to hold a Commission of enquiry to ascertain whether that was so or not.

The public sitting then commenced.

Mr. JOHN RICHARD WILLIAMS was called and examined.

Minutes of Evidence.

Mr. *J. R. Williams.*

20 Sep., 1904.

(*The Chairman.*) I understand you have been in charge of these experiments?—I was asked to superintend the necessary sampling and analyses of the air of the various compounds, and I have a statement here to put before you with the results of analyses of about 115 samples of air in the compounds with 24 samples taken almost simultaneously on the outside of the compounds.

The witness handed in the statement (see Appendix B.).

(*The Chairman.*) You are consulting chemist for Messrs. Eckstein and Co.?—I am consulting chemist and metallurgist to Messrs. H. Eckstein and Co., and also to several other mines on the Rand, including the Rand Mines, Limited.

(*Dr. Turner.*) Have you got the details of the analyses of which this table shows the average results?—I have brought one copy, which I have handed in, covering all the analyses and the conditions under which they were taken.

(*Dr. Turner.*) Are these samples all taken from the same hut?—I think in each case the huts are specified, because usually we were working on three huts, one having 66 per cent. of the complement, and the next 90 per cent., and the other 100 per cent., but we found a great deal of difficulty in keeping a fixed percentage of boys in. We would find a room intended to contain 66 per cent. with actually 72 per cent. because the boys like to sleep with their friends, but we noted the numbers in the huts exactly as the boys came out and in during the night.

(*Dr. Turner.*) But in this table there seems to have been only one hut taken?—No, you have three huts given as well as the outside air.

(*Dr. Turner.*) But how are we to know which of those samples belong to the different huts?—(The witness explained his statistics to Dr. Turner.)

(*Dr. Turner.*) It will be impossible, Mr. Chairman, to question Mr. Williams as to these details until we have had an opportunity of studying the individual figures. I understand that the first two portions of this table* were taken by the same men, whilst the third portion was taken previously?—The third portion, which refers to the Glen Deep, was taken before the Commission was appointed, and was only secured for the information of the Rand Mines, Limited, who wanted to ascertain what the condition of the ventilation of the huts really was, and it was added to this table by special request of some medical members of the Ventilation Sub-Committee of the Chamber of Mines.

Then this second figure of 0·8 in these supplementary figures is correct? Yes.

(*Dr. Sansom.*) Was the full complement of boys specially arranged?—I was requested each time to get the full 100 per cent. The rooms there had 4,200 cubic feet of air-space, in which we put 21 boys, making up the 100 per cent. without counting the police and the samplers who were there all hours of the night. In the first place I was practically in the compound the whole night.

So these boys were specially kept in for the whole time?—Yes; and I might say that it is very much easier to keep Kaffirs in the huts than the Chinese.

(*Dr. Turner.*) There are four samples given here. Can you tell me whether they are from four different huts?—There are four different nights given.

But were the samples taken from the same huts?—Yes, excepting the last case, in which you will see there were two huts.

Shall we have these detailed figures given us?—Certainly.

(*Dr. Sansom.*) We have got these four supplementary tests, and can you tell me whether exactly the same system was adopted in your own tests as was adopted in these two other tests?—Yes, with the exception that possibly we might have used more stringent methods of getting at the last trace of carbon dioxide, inasmuch as, after a large amount of experimental work, we found out a method by which we could possibly get the maximum amount of carbon dioxide. I think that if these analyses were taken fairly by any board of analysts in the world they would admit the fact that the figures given as to the amount of carbon dioxide are slightly higher than the amount the samples really contain. My reason for stating so is that we know that during titration there is a small vitiation of the sample. I may say that all the figures err on the side of safety.

The reason why I ask is because we have these three sets of results in front of us, and I wanted to know whether they might be taken as comparable?—Quite so.

* The Table referred to is that giving the average *daily* results (Appendix C.1).

Minutes of Evidence.

Mr. *J. R. Williams.*

20 Sep. 1904.

(*Dr. Turner.*) Can you give us any explanation of the fact that two samples of the supplementary tests are nearly double the average?—Well, it is rather unfortunate that during that night we took no outside samples, because, had we taken outside air samples the difference might be explained. Some time ago I was on another mine taking samples, and I found as high as .75 in the outside air. It was easily explainable, because there was a chlorination plant working next door, having two stacks, which would give off a large amount of carbon dioxide, and also a large amount of SO_2, which would react in the same manner as CO_2. These last three tests were put in by special request, but in their case samples of outside air were not taken.

I notice the outside air is very fairly constant, and only varies from ·3 to ·38?—We have had some cases in which the variations are considerably greater, but unfortunately not during the work of the Commission, although there is an abundance of authority in Europe to tell you that you will get up to 7 and 12 per 10,000 on a foggy night, which would very materially affect a sample of that kind. It is very unfortunate that these last samples only showed the purity of the air to a certain extent, because samples of the outside air were not taken.

(*Sir Kendal Franks.*) You are speaking of the supplementary tests given at the foot of this statement?—Yes.

(*Dr. Sansom.*) I believe that when series 1 and 2 were done you had special arrangements at the door-ways?—In all the samples excepting the supplementary tests a special storm-door was put on as requested, and while speaking of that I would like to draw the Commission's attention to the first set of samples where, instead of having ordinary ventilation, there was a louvre over the door with a hood over the stove-pipe which accounts for the very high results obtained on the first day. I was slightly at a loss to account for this, but on going to the same hut the following day when we were not sampling, I took an anemometer with me, and found that the air was going directly from the louvre to the hood over the stove-pipes in such a manner as to cause short-circuiting of the general ventilation, which is proved by the fact that two samples taken almost simultaneously in the same room varied from 0·97 to 2·14. On the next night, when sampling, the only alteration in the set of conditions was that the hood over the stove-pipe was lowered so as not to be more than five feet from the ground, which stopped the short-circuiting. We also proved that the gratings, instead of a louvre, over the roof are a distinct disadvantage, and became very deleterious to ventilation, for this reason, that the grating acted as an *intake*, thus only circulating the air in the upper part of the hut. I therefore consider that the first set of samples should have been left out of the list, because the very same room, with small modifications, taken again on the 12th September, gave excellent results. It was then suggested to me that it might be thought that the hood was causing too much ventilation at one point. In the last set of samples I went purposely to the compound in the morning and prevented any fires being lit, and the result, therefore, shows what could reasonably be expected in the summer when there are no fires in the huts. I would like, however, to point out from 24 years' experience of the Kaffir, that you would not find these conditions in the summer, because the Kaffir will then sleep in the yard, and the doors and windows would be left open.

(*Dr. Turner.*) I gather, then, from your remarks that this very high sample was due to the fact that there was a direct draught of air from the louvre right up to the hood?—That is so. It was an experimental hut, which had never before been tried in this country. It was recommended for the test, so we gave the result of the analyses from those particular huts.

And after that you modified the conditions by lowering the hood to within five feet of the ground?—Yes, we made the hood telescopic, and brought it down lower so as not to exceed five feet from the ground, placing it just midway between the two tiers of bunks.

And that condition was maintained after the first sampling right up to the end?—Yes.

So that when later on you got ·78, the same conditions prevailed as in the sample in which you got ·91 and ·56 of CO_2?—Yes, except that in the case of ·91, giving a difference between the outside air of ·58 it was blowing a perfect hurricane, and on that night I particularly raised a very strong objection to that grating being put in the place of a louvre, because it was not ordinary ventilation.

In the second set of samples we worked throughout with the louvre, but in some cases with, and in other cases without, the hood over the fire. I believe that hood over the fire to be a very valuable means of ventilation, but in the second lot of samples (selected huts of the Rand Mines type) the ordinary louvre was used in place of the grating. In some cases the fire had gone out, and in the last three taken at the Village Deep there were no fires burning at all, so as to get at a set of conditions which we could reasonably expect to get on a summer's night.

(*Dr. Sansom.*) Have you been taking temperatures for any length of time up here ?—I have them all recorded, but I could not possibly commit them to memory.

No, I do not expect that, but I think there is a difference here in degrees F. averaging eight and nine. You will notice you have ten, eleven, six, one, seven, nine, and so forth. Is that about what you would take to be the normal difference, *i.e.*, eight or nine ?—I should say that would depend entirely upon the amount of fire the boys have in their rooms. Supposing you have an outside temperature of 44°, and you go into two huts, finding one with a fire and another with two fires, it would make a serious difference in the temperature, but in an ordinary way the difference with a fire burning in the winter would be between nine and eleven degrees F. I am speaking now of my experience gained during the last few months, when I have devoted a large amount of time and work to Kaffir and Chinese compounds.

You say that on the 12th September there were no fires burning ?—There were no fires, but there was a strong wind. That night, I may say, we decided we ought to have the same room taken without any fires burning ; nevertheless, even during that night we found the hood over the stove proved a very good means of ventilation for the lower strata of the room. Unfortunately the velocity is not given in this table.

(*The Secretary.*) It was something like 400 feet per minute, I think.

(*Dr. Turner.*) At the bottom of the first series I notice you have " very bright fires, slight breeze " ?—Well, in that particular case you may have a very bright fire burning a certain part of the time, and then a poor fire, and finally the fire burnt out.

(*Dr. Sansom.*) In the one case you have " very bright fire, slight breeze," and in the other " fire poor ; finally out ; slight breeze," and yet both give a difference of ten ?—I think that may have been due to the fact that the boys had a very good fire before we started sampling. On one night Dr. Irvine and Dr. Macaulay went with me, and we found the boys had two fires burning, and it would take some time to get the air to cool down.

Do you think it would take a long time in these huts ?—I think so.

(*Dr. Sansom.*) You see here we have bright fires and warm weather with the difference of 10 degrees, whereas further down you have no fire with a fair breeze outside, and the difference is only six degrees ?—Of course a lot of this can be accounted for by the condition in which the native would like his room. In nearly all these modern compounds there are at least two windows about the same height as the ones in this room, and sometimes you will find the boys open both of these windows, and with a fire burning you would not have any great difference in the temperature of the room.

(*Dr. Turner.*) I thought all the windows were shut ?—I always gave instructions that they were never to interfere with the boys, and never to open or close the windows at our request. In some cases there is a fanlight above, and we never by my knowledge had one of these windows opened or closed. The experiments were done under normal conditions right through. For example, we made a point of getting 66 per cent. in the room, and we usually got more, but we never interfered with them.

(*The Chairman.*) You see the closing of the windows accounts for a great difference in the analyses. I see that in one case there was 88 per cent. of the number of boys in the building, and the average of CO_2 was ·54, which was one of the best analyses, but still one of the highest percentages while the fire was poor and the weather was cold. Was that due to the windows being open ?—I should say it might be due to the fact that it was a very cold night, which in the ordinary way assists ventilation. The boys would have the fires burning, and you would therefore get natural ventilation.

(*Dr. Turner.*) But you distinctly state that the fire was poor ?—Yes, but of course you take the average. You might have a very good fire at eleven o'clock,

Minutes of Evidence.

Mr. *J. R. Williams.*

20 Sep. 1904.

and a very poor fire at one o'clock in the morning, and you take the average. There might be a very good fire burning from six o'clock to midnight, and then a poor fire, and we took the average during the time we were sampling.

(*Sir Kendal Franks.*) You mean it may have been a good fire up to the time you were sampling?—Yes; after that the boys would go to sleep, and in the ordinary way no boy gets up to add more fuel to the fire once they are asleep.

(*The Chairman.*) You think then that that very good result was due to the fire burning on the whole more briskly?—Yes, and also due to the fact that louvres had been substituted for gratings on the roof, and the height of the hood had been modified in this particular case. I am referring to the Village Deep samples.

(*Dr. Turner.*) I presume we will have the figures in detail?—With pleasure. I should like to promise them for tomorrow afternoon, but I hardly think they will be completed until the following morning.

(*Surgeon-General Edge.*) At what level were the samples taken?

(*The Secretary.*) Just on a level with the upper tier of bunks. You might explain, Mr. Williams, where the samples were taken?—Certainly. If you can imagine this table before us as being a specimen of a hut, the bunks of the boys are placed along the head and foot of the table, with the stove in the centre of the table. The samples were taken about two feet away from the bunks, between the bunks and the stove. In the case of the Chinese, they usually turn their heads to the outside of the bunks, while the Kaffirs sleep towards the wall, with their feet to the outside. In any case, I do not think the samples were taken more than two feet away from the bunks. Had we wanted to take the extreme ends between the door and the windows, we could undoubtedly have got much better results—I should say, on an average, .15 per thousand of impurity.

(*The Chairman.*) Then how do you account for the samples taken from the experimental huts being so much worse?—Whilst I fully appreciate and would always adopt the hood over the fireplace, that hood should always be made telescopic, so as to ventilate the lower part of the room, and the top part will look after itself. In all these cases, the experimental hut was exactly the same as the ordinary hut, with the difference that the gratings and windows were built on top in place of the ordinary louvre. They were built of stone, with an impervious floor, and with exactly the same amount of floor ventilation. There is absolutely no difference. They are all built from the same plan by the same contractor and at the same time, excepting that this grating on the top was put into the experimental hut.

(*The Chairman.*) In which class of buildings was the grating?—The gratings were on the experimental huts.

And the louvres on the other?—Yes, sir.

And you prefer the louvres?—Certainly; if you had that grating, on a wet night the rain would come in and the boys would soon climb up and put a blanket over it, whereas the Kaffir would leave the louvre alone, as it would keep out the rain.

Then I understand they have gratings in the experimental huts and louvres in the ordinary huts?—That is so.

Then in regard to the inlet, was there any difference?—The inlet was precisely the same in all cases. We had a group of 40 or 50 huts, and we selected one or two for the experimental huts and made the alterations required. The rest of the samples were taken from huts left in the ordinary condition.

(*The Chairman.*) Then the only difference is that in the one case there was a louvre and in the other the grating?—Yes, and also the fact that in the earlier experiments the hood over the fire was too high up, thus causing short circuiting.

(*The Secretary.*) I believe there is a difference in the size of the eave opening?—As far as the Village Deep is concerned, none at all.

(*The Chairman.*) We want to be quite clear on this point with regard to the hood. Why the first analysis is so bad, you say, is because this hood was much higher than in the other cases?—Yes, sir. The air naturally came through the place of least resistance, and went straight to that hood.

And then you altered the hood in the later experiments?—Yes, the following morning I took an anemometer with me and got the hood made telescopic so that we could raise and lower it at will. We sampled three times after the alterations had been made with very satisfactory results. In the case of the Glen Deep there were no modifications in the huts at all.

COLOURED LABOUR COMPOUND COMMISSION.

CHARTS

TO

APPENDIX G.3

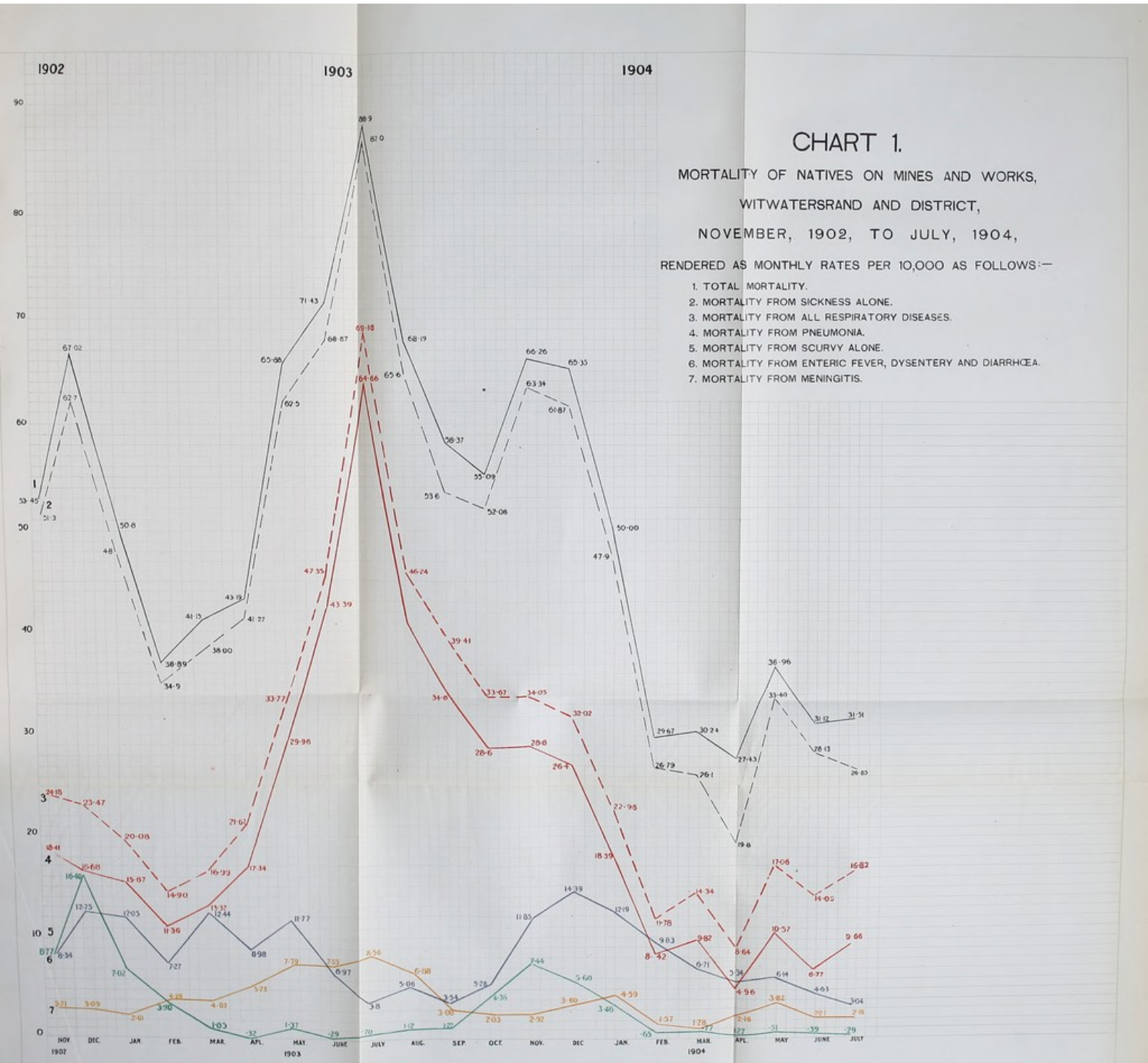
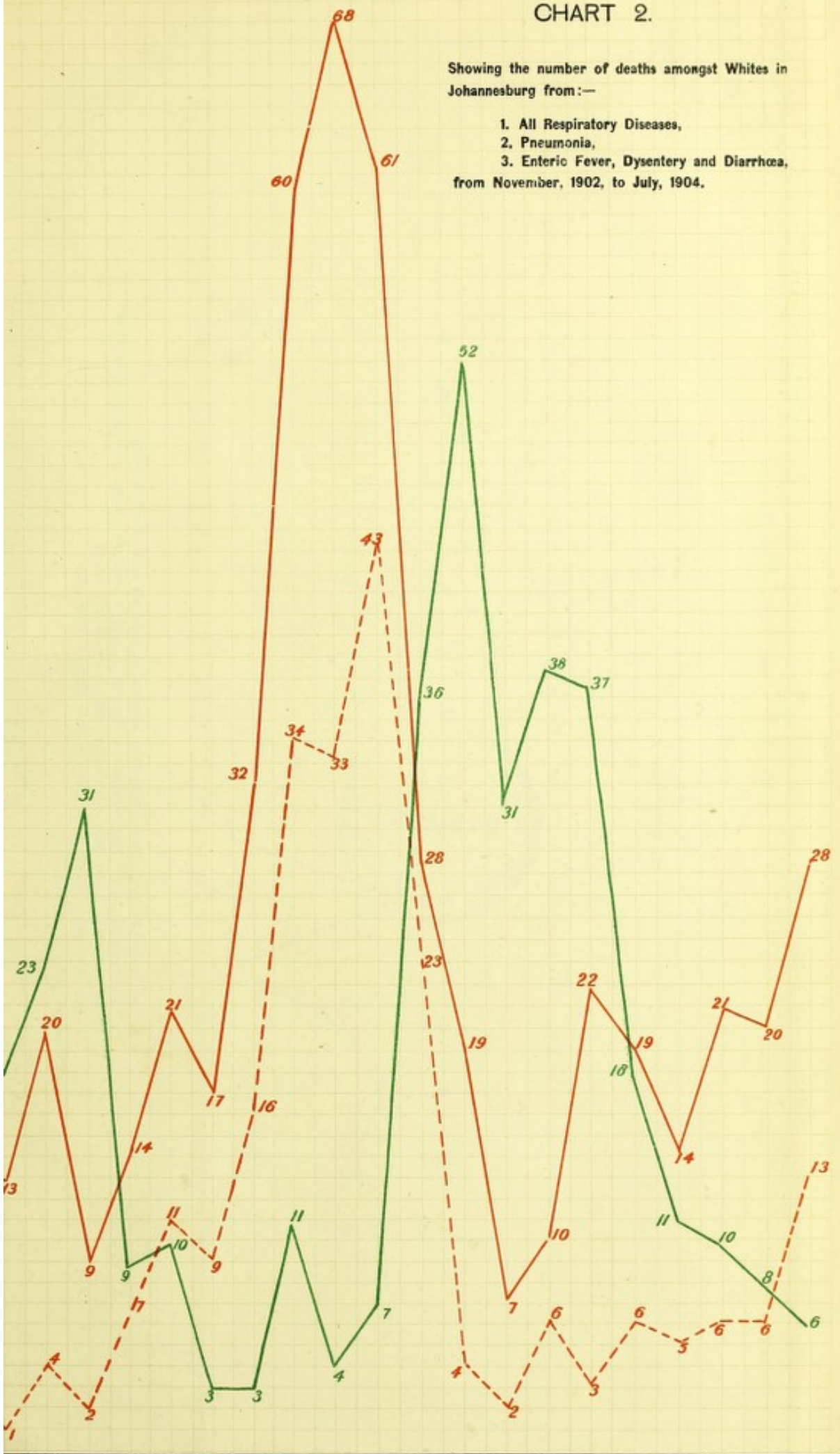

1902
1903
1904
CHART 1.
MORTALITY OF NATIVES ON MINES AND WORKS,
WITWATERSRAND AND DISTRICT,
NOVEMBER, 1902, TO JULY, 1904,
RENDERED AS MONTHLY RATES PER 10,000 AS FOLLOWS:—
1. TOTAL MORTALITY.
2. MORTALITY FROM SICKNESS ALONE.
3. MORTALITY FROM ALL RESPIRATORY DISEASES.
4. MORTALITY FROM PNEUMONIA.
5. MORTALITY FROM SCURVY ALONE.
6. MORTALITY FROM ENTERIC FEVER, DYSENTERY AND DIARRHŒA.
7. MORTALITY FROM MENINGITIS.
NOV. DEC. JAN. FEB. MAR. APL. MAY JUNE JULY AUG. SEP. OCT. NOV. DEC JAN. FEB. MAR. APL. MAY JUNE JULY
1902
1903
1904

CHART 2.

Showing the number of deaths amongst Whites in Johannesburg from:—

1. All Respiratory Diseases,
2. Pneumonia,
3. Enteric Fever, Dysentery and Diarrhœa,

from November, 1902, to July, 1904.



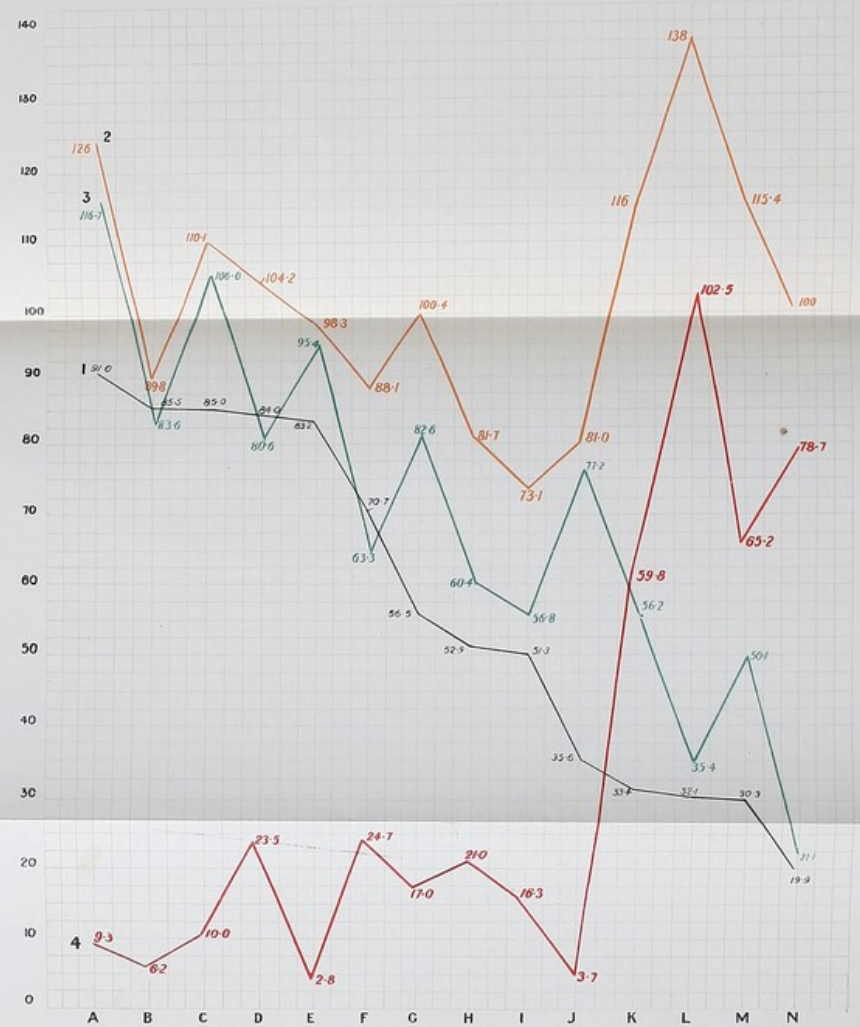
Dec. | Jan. Feb. Mar. Apr. May. June July Aug. Sep. Oct. Nov. Dec. | Jan. Feb. Mar. Apr. May June July

1903 | 1904

CHART 3.

Showing for Thirteen Selected Mines:—

1. The total death rate per 1,000 for year July, 1903, to June, 1904.
2. The percentage of the total complement replaced during that period.
3. The percentage of the total complement replaced by Natives recruited directly from Native Territories.
4. The percentage of the total complement replaced by voluntary boys locally engaged.



(*Dr. Turner.*) I understand they had closed fire-places in the *experimental huts*?—Yes, but in the Rand Mine huts they had a shallow iron vessel on a three-legged stool with an open fire in it, but in that case the hood was very much larger and was brought down lower. The closed fires only apply to the experimental huts, but I certainly would recommend that they should be adopted in all cases.

I have had some plans sent me where this hood must have been 8 feet from the ground?—In the first case they were over 8 feet from the ground.

And there was an open fire underneath?—Yes, in the Rand Mines type.

(*Dr. Sansom.*) Mr. Williams has just mentioned that the fact that the first set of samples showed a high percentage of carbon dioxide is rather curious. As a rule we have reckoned on a larger amount of cubic air-space per individual than 200 feet for ventilation purposes, and if 200 feet were the amount allowed our ordinary ideas about ventilation would probably have to change very much, as it would not be so easy to ventilate a place of 200 cubic feet by the accepted methods as a place of 300, 400 500, or 600 cubic feet?—That is so, in direct proportion.

I understand you have taken the direction of the air currents in this connection, and I would be very glad to know what results you have got?—If you take the case of the Glen Deep huts, which are 200 cubic feet exactly per head, in those particular rooms, I am certain that the most delicate candle in the world would burn without dropping any grease, and I would not call that a draughty room.

I was not talking about velocity but the direction of the air currents?—Well, as a rule, if you take that hood as being 4 to 5 feet from the ground there is 60 per cent. of the total air in the room changed once in an hour.

Can you give me any idea of the direction?—It is changed through the hood.

That is 60 per cent. through the hood per hour?—Yes, but only when the hood is 4 or 5 feet from the ground and it means that the lower strata would be changed at least twice as much as that, and that is where the boys are sleeping. With the small amount of examination I have made I should not like to be too absolute but I should say that at least 90 per cent. of the remainder goes through the louvre in the roof. I should say that the hood takes 60 per cent. of the volume of the room and the louvre in the roof 90 per cent. of the remainder of the air change. I may say that in one or two cases we found the air-bricks might become an outlet on one side in round figures of about 90 per cent. of the intake on the other, but that is easily got over by putting a box with a few holes drilled in it to distribute the air all over the room; still, I do not think the fact that they occasionally become an outlet on a windy night is at all serious.

(*Surgeon-General Edge.*) Is it the rule in the compounds that the boys must keep their own bunks?—I may state that when we were experimenting with 60 per cent. of the boys, the almost universal tendency was for them to huddle together. If you had a room big enough to hold 40 boys and only 20 occupying it you would find these 20 at one end of the room and the other end vacant. I should have stated that Dr. Porter very strongly advised Mr. Harry Johns some little time ago that this method of intake as to the distribution of air on the floor should be adopted, but, unfortunately, we did not get it in time to adopt it in any of the experimental huts. The provision of a wooden box over the air-bricks would have a great tendency to decrease any draughts on cold nights, and the cost would be so small that I am certain all the mines would put it in.

(*The Chairman.*) What is the distance of this air-brick ventilation from the ground?—I should say usually between 2 and 3 inches from the ground. The idea is that the compound is washed out every morning, and the bricks are placed there so that the water does not rise above the level of the air-bricks. Dr. Porter also made another very good suggestion, viz., that the outlet of the roof should not very much exceed the intake, and this also would have a great tendency to reduce any local currents or draughts. I may say, speaking of the ordinary huts or the standard huts of the Rand Mines, that that (whether accidentally or intentionally) has been carried out throughout.

(*Sir Kendal Franks.*) When we visit the compounds ourselves, which are the compounds you recommend us to inspect?—I should recommend you to take, in the first place, the Village Deep, which is very close to town, and is a typical compound which we are now using for our Kaffirs, and then I would recommend the nearest mine with Chinese—the Glen Deep. No modifications

Minutes of Evidence.

Mr. *J. R. Williams.*

20 Sep. 1904.

have been made upon these, and the huts are in the same condition as used for Kaffirs, with the one exception, that all the floors have been made impervious by bricks covered over with cement or concrete, and in some cases the floors are granolithic.

You say these are samples of rooms that have not been altered in any way?—The Village Deep has new rooms. During the time we were developing in the ordinary way, we built very temporary compounds, but my only reason for suggesting that compound is that that is occupied by Kaffirs, whereas the Glen Deep is occupied by Chinese. I would like to mention one point, viz., that I am delighted with the cleanliness of the Chinese compared with the Kaffirs, and I am confident in stating that it would be quite impossible to get 2,000 people of the labouring class from any town in Europe to occupy a compound and be more cleanly in their habits than the Chinamen at the Glen Deep. The Chinese will also do what you can never get a Kaffir to do, and that is, sleep with his head outwards instead of against the wall. Of course we cannot insist upon this being done even although we very much favour it, but the Chinese do it without any trouble.

(*Surgeon-General Edge.*) Do they also lie close to each other?—No, sir. The Chinaman rolls up his blanket inside a piece of grass matting or something of that sort and ties it up neatly at the end of his bunk so that no one will use his particular blanket during the day.

(*Sir Kendal Franks.*) These are the only compounds you think we should visit?—I should be very pleased if you should visit the whole lot as long as you do not take the very old out-crops.

It seems to me that we have taken most of the old outcrops already—? Well, if you visit the two mines I have mentioned you will get two typical mines.

What would be the best?—Amongst the best would be any of the newer companies such as the Simmer & Jack. The New Comet compounds are practically on a par with the compounds of the Rand Mines. We took a set of samples from there, and all these samples are fairly satisfactory. They are the ordinary type of hut, what we call the old Rand mines type.

(*The Chairman.*) We are very much obliged to you, Mr. Williams, for your evidence.

Statement.

Mr. *A. Heymann.*

20 Sep. 1904.

Mr. Alexander Heymann, M.A., M.Ph., M.Ch.

Alexander Heymann was called and examined.

(*The Chairman.*) What are your qualifications?—As I have to deal with figures I have made a written statement, which I will hand in and read to you.

I understand you are a chemist?—I am chief analytical chemist to Messrs. Eckstein & Co.

Have you been long in that position?—About two and a half years.

Are you to read this statement to us?—If you wish it I shall read the statement and then put it in as my evidence.

The witness handed in the following statement, which was read by the Secretary.

Johannesburg,
20th September, 1904

To the Commission on Air-Space in the Compounds of the Mines.

Statement by A. Heymann, M.A., M.Ch., et Ph.

Having been requested by the Chairman of the Commission to give evidence on the Regulations in force in Russia and Germany regarding air-space and ventilation in sleeping apartments, barracks, etc., and also any other information bearing on the question on which the Commission has to decide, I herewith beg to submit the following statement:—

My full name is Alexander Heymann. My degrees are Master of Arts, Magister of Chemistry, and Magister of Pharmacy, of the Imperial University of Moscow. Since taking my degrees in 1887 I have been employed in the capacity of analyst, technical and consulting chemist respectively, in chemical, pharmaceutical, analytical, and hygienic laboratories (Government as well as private ones) in various industries, such as at the petroleum wells in the Caucasus, at the Ural mineral mines, sugar, aniline, cement, and other factories, etc., mostly in Russia, and also for a short period in Germany and in London. My present position is chief analytical chemist at Messrs. H. Eckstein and Co.'s chemical and metallurgical laboratory.

Statement.

Mr. *A. Heymann.*

20 Sep., 1904.

The chief drawbacks of the Russian industries are three strict Government laws, the least breach of which is very severely dealt with. They relate to (1) strikes, (2) accidents, (3) hygienic conditions of the factories or mines. It is with the last I intend to deal, as it is the only one bearing on the subject before us. I have witnessed on several occasions the demolition of parts of a factory or the quarters of the workmen by order of the Government, simply on account of slight omissions or the non-fulfillment of the hygienic precautions prescribed by law. Thanks to this strictness, I have gained—in addition to my academic knowledge—some practical acquaintance with the subject, as well as having had, in my capacity as analytical chemist, to carry out various experiments and analyses. Any suggestions that I may make to the Commission will be derived and based on: (1st) My own academic and practical knowledge, and (2nd) on statements made by a few of the best authorities on the Continent on the subject, giving only the most recent in my possession. To this I will add some standards adopted by both the Russian and Prussian Governments.

The following air-space is theoretically adopted in Russia:—

For prisons, 350–425 cubic feet per head.
For barracks, 425–530 cubic feet per head.

In practice this is seldom, if ever, carried out. It is a well known fact that Russian prisons are considerably overcrowded. In consequence we cannot take this into consideration and must look for more substantial data.

The following table will show the quantity of fresh air necessary to be admitted per head per hour in order that the conditions should be hygienically perfect. As will be seen, I have chosen the statements of the best authorities on this subject in three different countries:—

Professor Skworzoff (Professor of Hygiene at the University of Charkow).
Professor Brusanin (Professor of Hygiene at the University of Moscow).
Professor Fisher, Berlin.
Professor Esmarch, University of Koenigsberg.
Professor Morin, France.

For prisons and barracks.—Total amount of air to be admitted per head per hour:—

Skworzoff and Brusanin (in 1900), 1,120 cubic feet.
Morin (in 1900), 1,060 cubic feet.
Fisher (in 1898), 880 cubic feet.
Esmarch (in 1898), 740-1,300 cubic feet.
Prussian Government, 920 cubic feet.

It would be hygienically permissible if even the lowest standard of 740 cubic feet of total air supply per hour were taken, but I would be even more liberal when dealing with other than white races, and would suggest that the average of the above six authorities be taken, viz., 1,000 cubic feet. If the Commission is satisfied with this standard, the next thing to settle would be the velocity of the entering air, or, rather, how many times during one hour would it be admissable to completely change the air? Here again different authorities give different figures. Esmarch states that the velocity of the entering air can be 6·5 feet per second; Skworzoff gives the figures at 7 feet per second. Some say four times an hour, others six times, or even more if the ventilation is properly arranged. In this instance I propose to be more liberal by not taking the figures 6 or even more, but would place it at 5 times. If the Commission is satisfied with this figure, then all that remains to be done to arrive at the necessary air-space would be to divide 1,000 by 5 = 200 cubic feet of air-space is necessary per head to allow the room to remain in a perfectly hygienic condition. This in my opinion would be a liberal allowance, the more so as I understand that the mines have already provided such a space, and state that at *no ove time* are there to be more than 90 per cent. of the full complement of boys present, thus practically not giving them 200, but 222 cubic feet of air. In order to substantiate this view of mine that 200 cubic feet would be ample, I bring forward other data based on calculation.

I need hardly explain to the Commission that the amount of carbonic acid present in the air is the chief and only guide to judge the purity of vitiation of air in inhabited rooms, and that all the following calculations rest upon the maximum quantity of CO_2 hygienically admissible in the air, so before proceeding the maximum of CO_2 to be allowed should first be settled. As we cannot ourselves fix such a standard by conducting experiments, which might take months or even years before definite conclusions could be ascertained, it is again necessary to consult those who have made this question a study of years.

In Pettenkofer's classical works 1 per 1,000 is mentioned as hygienically admissible. In later works, such as Professor Esmarch's, 0·7 per 1,000 is allowed in sick rooms, and 1 per 1,000 in rooms used for prolonged habitation, or from 2 to 3 per 1,000 for shorter periods.

Professor Brusanin gives 1·25—1·5 per 1,000.

Statement.

Mr. *A. Heymann.*

20 Sep., 1904.

I would suggest in this case as well that the highest figures be not taken, although quite safe since they are quoted by such authorities, and would suggest as a maximum 1·25 per 1,000 only be taken.

To arrive at the cubic air space take $A = \frac{D}{B - C}$

" A " being total amount of air to be allowed to enter room during one hour in order not to exceed the " B," which is the maximum amount of CO_2 to be present in the room. " C " being amount of CO_2 present in the outside atmosphere, and " D " the amount of CO_2 given off by an adult in one hour. Let " C " = 0·035 per cent., D = 0·0226 c.m. at 760°, which at the average local pressure —630 mms.—would be 0·02712, then $A = \left(\frac{D}{B - C}\right) = \left(\frac{0{\cdot}02712}{0{\cdot}00125 - 0{\cdot}00035}\right) = 30{\cdot}1$ cubic metres, or 1,065 cubic feet. Then $\frac{1065}{5} = 213$ cubic feet of air space. As at the utmost (twice a week only, I understand) only 90 per cent. of the full complement of boys are together, we would arrive at 101·70 cubic feet of air-space per head, which would be hygienically good for the men, therefore, from no matter what point of view, argument, or calculation, I am of opinion that my suggestion that 200 cubic feet per head is ample, can be safely adopted.

I have the honour to be,
Gentlemen,
Your obedient servant.

(Signed) A. HEYMANN.

Minutes of Evidence

Mr. *A. Heymann.*

20 Sep., 1904.

(*The Chairman.*) How do you account for these standards being so different from what is the generally recognised standard in England ?—May I ask what is the latest English standard ?

As far as we can ascertain it is 0·6.

(*Sir Kendal Franks.*) That is not the latest. They had a discussion at Oxford the other day.

(*Dr. Turner.*) But I did not say their standard was accepted.

(*Dr. Porter.*) The Society of Officers of Public Health accepted ·9 per 1000.

(*Dr. Turner.*) I think that was for factories.

(*The Witness.*) As far as CO_2 is concerned I believe some time ago we had a standard of ·7 in Russia, but the standard of 1900, as in my statement, is the latest. As a matter of fact the standard of the Prussian Government, which I give, is the old standard.

(*The Chairman.*) Then the standard has increased within the last 15 or 20 years ?—Yes, the standard which is thought to be hygienically fit has been raised (the amount of permissible vitiation).

(*Dr. Turner.*) Do you know what is the amount of cubic air-space at present allowed in German barracks ?—No, I have tried to obtain it, but I could not get it.

On what grounds was ·7 of vitiation allowed ? I notice that at one time vitiation of CO_2 was not to go beyond ·7 ?—Yes, but that was only adopted for sick rooms.

Supposing you take ·9, on what grounds do they say it is not to go beyond that ?—As a basis I should take the standard of Pettenkofer, and his reasons would be that beyond that limit it would be injurious to health.

He puts it forward as a theory, does he not ?—Pettenkofer laid that down as a standard.

But does he prove that by experiment ?—Yes.

Can you give us any reference to these experiments ?—I could not give you any reference at present, but I read his works some time ago, and he put 1 per 1,000 as a maximum that should not be exceeded, and if this maximum is exceeded, then the air should be considered as vitiated.

(*The Chairman.*) What does he base his standard upon, is it the condition of health ?—Yes, As a matter of fact I worked in a sugar factory in 1890 and 1891, and at that time 1 per 1,000 was adopted as the maximum amount of CO_2. The premises for the workmen exceeded that maximum, and they were ordered

to be demolished. The standard at that time, as I say, was 1 per 1,000. These standards which I give you now are the latest. I gave you 1·25 as the latest standard, but there are higher standards, as high as 1·5, but in 1890 the standard laid down by the Government was 1 per 1,000. Dr. Porter has just reminded me (and I can confirm it) that Pettenkofer states that at 1 per 1,000 the presence of CO_2 becomes perceptible by the smell.

(*The Chairman.*) Not until 1 per 1,000 ?—No, as soon as it reaches 1 per 1,000 you can begin to detect it; I understand that Dr. Thomas arrived also at the same result, viz., at 1 per 1,000 the air begins to smell foul.

(*The Chairman.*) That is the limit.

(*Dr. Porter.*) Yes. Dr. Thomas is Assistant Medical Officer of the London School Board, and his figures are based upon examination of the air of the London school classroom.

(*Dr. Turner.*) These are not sleeping rooms ?

(*Dr. Porter.*) No, sir; but they are very much worse because you have children together in these rooms in a way they are not in sleeping rooms.

(*The Chairman.*) Have you any other information to give us ?—I am one of the analysts for the Sub-Committee formed by the Chamber of Mines, and I can give evidence as to our experiments.

(*Dr. Sansom.*) I would like to ask you whether these average temperatures are normal and likely to be more or less maintained during the year ?—I would like to have before me a complete statement of our analyses.

This table which has been put before us shows the average and you will notice the column showing the average difference in temperature in degrees F. between the outside and the inside air ?—Yes.

Have you been making any experiments as to the difference of temperature between inside and outside air ?—Yes, but only as far as these analyses are concerned.

But independent of these analyses, since you have been in the country ?—We generally take the temperature almost daily, and my work depends very frequently on that.

I know there is a big difference in some of the figures. The samples on some occasions were taken on very cold nights, and naturally there would be a great difference between temperature inside and outside, but in no case has it come up to the supposition that was put before us originally, which was 15 degrees ?—I would not like to pass an opinion on that.

Is the question of the average amount of CO_2 in the outside air one which you have gone into before ?—Yes.

These averages strike one as being rather low. They show rather a high degree of purity, except in the case of the first two samples ?—I should say that the average of CO_2 in the outside air should be about .35.

Here is the New Comet which is further out in the country than the Village Deep, and yet there is a higher degree of CO_2 at the New Comet than at the Village Deep, which is nearer a large town ?—Yes, but this all depends on circumstances. There might be considerable vegetation surrounding the New Comet and not surrounding the Village Deep.

Here again the Village Deep shows ·32, and at the Glen Deep, which is out of the country, it gives ·38 ?—Do you want to arrive at the average which you should take for the outside air, or do you want to know why there should be a difference in these two figures.

The point I am getting at is this, that nearer a large city you would naturally expect rather a higher percentage of CO_2 vitiation in the atmosphere ?—Exactly.

Well that is not borne out of these figures ?—But that is not the only thing which would effect the amount of CO_2 in the air. Certainly when near a great city with a large number of chimneys the percentage of CO_2 would be much higher than if outside at some considerable distance from a city, but again if you take a country place with no chimneys, and yet with plenty of decaying vegetation, you might reach as high an average of CO_2 as ·5.

I think the conditions are very equal as far as the question of vegetation is concerned ?—Exactly, but there might be a slight difference, and this would counteract the vitiation of the area by the smoke from the chimneys of a large city.

(*The Chairman.*) Thank you, Mr. Heymann, we are very much obliged for your evidence.

Minutes of Evidence.

Mr. W. C. C. Pakes.

Mr. *W. C. C. Pakes.*

20 Sep., 1904.

Mr. Walter Charles Cross Pakes, Government Analyst and Bacteriologist, was called and examined.

(*The Chairman.*) Will you kindly state your qualifications?—I am a Licentiate of the Royal College of Physicians of London, and I hold the Diploma of Public Health of Cambridge, and am a Fellow of the Institute of Chemistry. I have held the posts of Demonstrator of Sanitary Science and Bacteriology in Guy's Hospital, Lecturer on Hygiene at the Bedford College for Women, Examiner in Hygiene for the R.C.S. and R.C.P. Conjoint Board, etc.

(*Dr. Turner.*) I only want Dr. Pakes' opinions generally on the question of the amount of cubic air-space per individual.

(*The Chairman.*) What are your opinions on this matter, Dr. Pakes?—I agree with the report handed in by the Medical Society. I sat on that Committee, and I do not consider that this new question of huts, properly treated, depends on a mere matter of cubic space, as is the case in common lodging-houses. I do not think the question of cubic air-space is what we have to consider. The point before us is really the vitiation of the atmosphere, and I think it might be possible, I won't even say probable, that only 100 cubic feet might be found all that is absolutely necessary. That will have to be determined by actual experiment.

What is the amount of vitiation which you advocate as the standard?—Well, sir, I have taught for some years in England, and in discussing the question of standards I have pointed out how De Chaumont's figure of ·6 per 1,000 was arrived at, and I have said that that was an impracticable limit, one never acted upon in England. I have always taught and recommended that a standard not exceeding ·9 should be adopted as a reasonable standard, and one that under proper circumstances should be obtainable. I know that Pettenkofer and others have accepted 1 per 1,000, but I know from experimental evidence given in England that ·9 is obtainable, and that is the standard I have invariably preached.

That is including the ordinary amount of CO_2 in the atmosphere?—Yes.

That would mean a limit of ·5 beyond the ordinary amount of CO_2 found in the air?—Yes.

(*Sir Kendal Franks.*) What do you mean by saying that ·6 is unobtainable?—In order to obtain .6 as a maximum amount of CO_2 present either in schools or in sick rooms, the necessary expenditure becomes so great that it is impracticable. Then, secondly, I am unaware that anyone has shown, either by experiment or by observation, that if the standard of ·9 or even Pettenkofer's standard of 1 is accepted, there is any injury to health. Why de Chaumont originally fixed on ·6 was that he could perceive an odour in the vitiated army barracks, but later authorities experimenting in more hygienically constructed premises have certainly failed to detect the presence of vitiation until the CO_2 has reached ·9 or 1 per 1,000.

What you would indicate is that de Chaumont smelt drainage and not ordinary CO_2 vitiation?—I think he probably smelt the clothes of the then dirty soldiers, because the bathing accommodation provided for them at that time was nothing like what it is now.

You do not think he smelt CO_2?—No, simply the exhalations accompanying the CO_2.

(*Dr. Turner.*) You say that ·2 of respiratory impurity having a maximum of ·6 combined with the CO_2 found in the air is not obtainable?—Pardon me, I am talking about England. I already stated to begin with, that this is really an entirely new problem.

(*The Chairman.*) Have you calculated the amount of cubic air-space that would be required under the conditions in which these compounds exist at the present time, allowing your standard of ·9?—I was a member of the Committee who sat for the Medical Society on this subject, and we went into the whole question, not from the point of view of cubic air-space, but of vitiation, and starting with vitiation we tried to apply our principles to these new buildings and formulated a scheme. We are prepared to abide by the actual experiments on that scheme, and that is entirely my position. If it cannot be obtained, and if our results are wrong experimentally, then we are wrong theoretically, and if they are right experimentally, then we claim we are right theoretically.

Your view is that in the event of vitiation being under ·9 per 1,000 with 200 feet cubic air-space per head, that 200 cubic feet should be accepted as a standard?—Certainly, if the vitiation does not exceed ·9 per 1,000.

(*Dr. Turner.*) I think we had better keep to respiratory impurity?—I mean .5 of respiratory impurity, because the CO_2 from burning candles would make a lot of difference.

(*The Chairman.*) It would be rather more than ·5 here?—I would allow up to .5 here as the limit of respiratory impurity.

There appears to be a difference between the outside atmosphere here and that of England?—Yes, but in the compounds built close to chimney stacks, you would naturally expect more vitiation of this kind upon occasions when the wind was blowing the smoke towards the compounds.

(*Dr. Sansom.*) I would like to ask you one more question. In testing the atmosphere bacteriologically, has any relation been discovered between the number of organisms present in the air and the amount of vitiation as represented by CO_2?—No, none whatever. The connection is not a direct one at all.

Of course we only look upon CO_2 as an indicator of the amount of vitiation from other sources, and the only thing we can test it by is CO_2?—Yes.

If we have ·9 of CO_2 that vitiation is not all respiratory vitiation?—That is so.

There is also a certain amount of exhalation from the body?—Yes.

Now has the number of organisms in the air any relation to the amount of CO_2?—No, it cannot have any, because the methods of production are totally different.

I am not stating that the organisms produce CO_2?—I know, but the amount of vitiation from the lungs is out of all proportion to the number of bacteria you find in a room because they are produced from different sources. In ordinary conditions the breath is sterile. You might have a room full of bacteria arising from dust.

That is the other point I wanted to get at?—Yes, but it has nothing to do with the vitiation of the atmosphere. The two cannot be connected.

Say that you have ·9 of CO_2 and a certain number of organisms in the air not given off by the lungs, would you expect, say *pneumococcus*, to show a greater development than in an atmosphere with ·6 of vitiation?—I do not think .9 is a dangerous atmosphere for anybody to be in, and I know of no evidence to show that people living in an atmosphere of ·9 are more susceptible to disease than in an atmosphere containing ·6 of vitiation.

(*Surgeon-General Edge.*) I think it is of greater importance that the Kaffirs should be restrained from huddling together, on account of our ideas as to the spread of tubercle.

(*The Chairman.*) Is the air expired by persons suffering from tubercle sterile?—The air that is simply exhaled by tubercle patients is also sterile, but directly the patient hawks, then the organisms are scattered; but the breath itself is sterile. In reply to General Edge, as to the Kaffirs huddling together, I believe it is very difficult to prevent them from doing so, and I would like to point out a precedent in England, where in the new naval barracks at Chatham, although the seamen have got a magnificent room, their hammocks are slung cheek by jowl. The medical authorities want to stop that, as they say it is very prejudicial, as, of course, the greater the proximity, the greater the danger of infectious disease, and the difference of perhaps a few inches in the distance between a healthy person and a tubercular patient may make a difference of months in the incubation period; still, I myself cannot perceive that the slight difference between 2 and 2½ feet would have any great bearing upon it. If you could put them 5 feet apart it might be different. I do not mean to say that it is not a factor, but I say it is not so important a factor.

I think what General Edge is referring to is that they sleep together?—Yes.

(*Dr. Turner.*) What floor space per head would you allow, the actual floor space of the room itself?—I think I should say about 10 feet high and 20 square feet floor space per head, but I would like to point out that with the double tier of bunks, you practically double the floor space for sleeping purposes. In common lodging-houses in England they are allowed a certain amount of floor space, but as regards sleeping accommodation if you have two tiers of bunks, as in these compounds, you double the floor space.

Minutes of Evidence.

Mr. *W. C. C. Fakes.*

29 Sep., 1904.

I cannot quite follow that, because you might have three or four tiers of bunks, and thus multiply the floor enormously ?—I do not say that for a moment, and I would not advocate the increasing of tiers to an unlimited extent, but this doubling of the bunks does give them greater space and gets over the difficulty of their being too close together.

It also means that you put a lot of men in a place smaller than the amount of floor space per man ?—Yes, but if the bunk is away from the wall there will never be a dead end.

But the ones I have seen have been close up against the wall ?—I am not quite sure, but I believe the engineers have accepted that alteration.

(*Surgeon-General Edge.*) Then are the labourers not also to be made to confine themselves to their own space, and not all huddle together at one end ?—As Mr. Williams has stated, the Chinese, at the present moment, are different from the Kaffirs in that respect.

If the same thing could be done with the Kaffirs it would improve their health ?—I understand that the new native quarters for the army at Pretoria have been made to the standard of 200 cubic feet.

There are no native quarters built yet. We have hospitals for them and temporary accommodation.

(*The Chairman.*) In some of these results there is considerable difference between those of the experimental huts and the selected huts of the Rand Mines type, and we are now informed that that is largely due to gratings having been used in the experimental huts and louvres in the Rand type huts. Did you advocate the gratings ?—No, sir, I advocated louvres.

The Medical Society recommended gratings ?—I am not quite sure about that I advocated louvres, but I have had nothing to do with this since the report went in.

You think louvres are the best ?—I thought so at the time, but that is a matter which I think can be proved or disproved by experiment, and this Mr. Williams has practically done. He says the currents are greater with the gratings than with the louvres.

What form of inlet do you recommend ?—I recommend the floor inlet and the board drilled with holes as suggested by Mr. Williams, which, I think, would meet the difficulty absolutely.

Do you recommend any louvres above the doors ?—It might or might not be necessary under certain circumstances. If a standard of impurity is laid down then the engineers must build their huts to keep it down to that standard. I do not wish to pretend to build a house. I have certain ideas, but it is for the engineers to carry out the details.

(*Sir Kendal Franks.*) To go back to the point which Dr. Sansom raised as to germs and ventilation, has the amount of CO_2 in the air any known influence whatever upon the development of germs ?—To the extent that it is present in the air, none whatever. If you grow certain organisms in pure CO_2 they do grow much better ; that is. in practically pure CO_2, but up to 10 or 15 parts per 1,000 I do not think CO_2 would have any influence whatever upon the growth of these organisms.

(*Dr. Sansom.*) That point has never been fully cleared up ?—No, not fully.

Supposing you took two cultures of *pneumococcus*, and you exposed one at an atmosphere of ·9 vitiation, and you exposed the other to an atmosphere of ·6 or ·4, or even pure air, will there be any difference in growth or activity of these organisms ?—I do not think an experiment like that has ever been tried, but concluding from the observations on bacteria in almost every conceivable surrounding, I should say it would have no influence whatever.

As a matter of experiment, it has not been done ?—Not that particular experiment.

Now can you give us any information as to the results of the exposure of germs to sunlight, and their growth when kept in darkness ?—That is a matter of experimental fact. Bacteria exposed to sunlight do die more quickly than those kept in the dark, and that is why the Medical Society advocate that every room should be lighted by windows.

(*The Chairman.*) Have you any other information to give us that we have not asked ?—I do not think so. I think I have covered the whole of the ground of the Medical Society's report.

(*Dr. Sansom.*) With regard to the question which I raised a moment ago, do you think it would be worth while having these experiments made ?—I do not think so.

(*The Chairman.*) Thank you very much.

Minutes of Evidence.

Dr. *Porter.*

20 Sep., 1904.

Dr. PORTER.

(*Dr. Porter.*) I have had a letter from Dr. Haldane in connection with this matter. I do not know whether you would care to hear it or not.

(*The Chairman.*) Certainly, we shall be glad to hear it.

(*Dr. Porter.*) Writing on the 4th August he says: "The problem of cubic air-space and ventilation for the mine compounds is, I think, very interesting, and the means suggested in the Medical Society's report ought to secure an air supply which will compare favourably with that of comfortable buildings in England and elsewhere. On the other hand the space per person is certainly small. There is scarcely enough data to show how far ventilation can overcome the danger of infection through close personal proximity, and if the health of the coolies remain good this really will be very important from the public health point of view. Personally, I am inclined to think what is of most importance is to avoid specific sources of infection by prompt removal to hospitals of all suspected cases, and, secondly, keeping the rooms thoroughly clean." You will observe that Dr. Haldane lays stress upon the prompt removal of suspected cases and keeping the place thoroughly clean as being of more importance than mere cubic air-space.

(*Dr. Pakes.*) This letter has reminded me that I was discussing this very question with several of the mine medical officers, and although I am not able to give any evidence on the point, except from hearsay, I understand the system of supervision of the sick, both natives and Chinese, is so well carried out that it is practically impossible for a boy to be sick for more than a few hours without being examined.

(*Dr. Turner.*) I have had a leper sent to the asylum who had been working on a mine for months and had even lost two fingers.

(*Dr. Pakes.*) I was not referring to leprosy.

(*Dr. Sansom.*) The point Dr. Pakes has raised is that if a boy says he is sick he is examined at once.

The Commission adjourned at 1.15 p.m. until Friday 30th inst., at 11 o'clock.

ADAM JAMESON,
Chairman.

JAMES MOIR,
Secretary.

COLOURED LABOUR COMPOUND COMMISSION.

FINAL PUBLIC MEETING.

Johannesburg, October 30th, 1904.

PRESENT:

Dr. JAMESON (*Chairman*),	Surgeon-General EDGE,
Sir KENDAL FRANKS,	Dr. TURNER,
Dr. SANSOM,	Dr. MOIR (*Secretary*).

Drs. *Irvine* and *Macaulay.*

30 Oct., 1904.

Dr. L. G. IRVINE and Dr. D. MACAULAY, Examined.

Dr. L. G. Irvine, M.A., M.D., B.Sc., Edinburgh, and Dr. D. Macaulay, M.A., M.B., C.M., Edinburgh. were called and examined.

(*The Chairman.*) You wish to give your evidence together?—We do.

We have received your report and I think the better plan would be for you to further elucidate that report?—(*Dr. Irvine*). I simply wanted to state that these reports have been typed rather hurriedly, and there are a number of errors. I have had these corrected and have a corrected copy here, which I would like to hand in to the Secretary, together with copies of the charts as the official copy. We wish to hand that in, as our evidence before the Commission.

Precis of Evidence.

Drs. *Irvine* and *Macaulay*.

30 Oct., 1904.

The corrected reports were as follows :—

PRECIS OF EVIDENCE

LED BY

Dr. L. G. Irvine and Dr. D. Macaulay.

1. We appear before the Commission as representing, together with others, the Transvaal Medical Society. We are Medical Officers of Mining Companies on the Rand, and have, for a considerable period, given special attention to the causes of native mortality on the mines.

We desire to lead joint evidence.

2. We beg to submit as evidence a report on the causes of native mortality on the mines of the Witwatersrand, drawn up by a Committee of Mine Medical Officers in June, 1903, of which Committee we were both members (see Appendix G. 1).

3. We have extended that report by a supplementary statement, which includes more recent data, and which we beg also to submit as evidence. The conclusions drawn in this supplementary statement are in complete harmony with those of the former report. We have included in that statement no reference to the question directly before the Commission, and have endeavoured to give therein only impartial data for its consideration.

4. Regarding the particular matter before the Commission, namely, the standard of cubic air-space to be allotted to coloured labourers on the mines, we would, in the first place, call attention to the concluding portion of the statement we have submitted which summarises :—

(1) The causes which, in our opinion, contributed to bring about the high mortality of 1902–3.

(2) The recommendations made by the Committee of Medical Officers to meet these conditions, which are given in detail in the report of June 6th, 1903.

(3) The steps which have been taken to carry out these recommendations on the part of the mining authorities ; and,

(4) The reasons which have contributed to bring about the lowered mortality of the first six months of 1904.

5. It will be seen that the high mortality amongst Portuguese natives is ascribed partly to causes permanently operative, namely, the difference in climate existing between the low-lying East Coast districts and the High Veld, and the great prevalence of malaria amongst the natives of these districts ; and partly to causes temporary or more or less remediable, namely, the fact that the natives recruited after the war were, for the most part, raw boys, the conditions of privation existing during that time amongst the natives of these territories resulting in the fact that many of the recruits arrived weakly and scorbutic, the extremely rigorous winter seasons of 1902 and 1903, the circumstances of underground work, and the insufficient means formerly taken to guard against the adverse effects of these conditions. In addition to these, the pressure put on recruiting agents by the scarcity of native labour should be considered.

6. It is to be noted that the great majority of deaths amongst Portuguese natives occurred amongst new arrivals from these districts, and that a process of acclimatisation is effected apparently with fair rapidity, so that Portuguese natives who remain on the Rand and re-engage show, so far as the figures at hand go, a surprisingly low death rate. In our opinion, it is impossible to reconcile this fact with the supposition that permanent conditions of bad housing have been the main causative factor in producing the high mortality of 1902 and 1903.

In this respect we would lay stress on the fact that the proportion of boys locally engaged or re-engaged is apparently increasing, and that, further, during the first six monthly period of 1904 the majority, even of the recruits arriving direct from Portuguese Territory, have been old mine boys, who are already partially inured.

7. In the same way natives from territories whose climate approximates to that of the Rand, viz., Natal, Zululand, and Cape Colony, show a low death rate, going to prove that, in those inured to similar climatic conditions, the conditions prevailing on the Rand do not cause a high mortality. The high rate of working efficiency amongst the natives on the mines and the recognised fact that gangs of boys leaving the mines are beyond comparison better in physique than those arriving on them, point to the same conclusion.

8. We would call special attention to the comparison of the recruiting figures for the thirteen selected mines embodied in our statement, as explaining in large measure the surprising variations in the comparative death rates of individual mines.

9. We would submit, therefore, that the question of housing has not been a predominant factor in the causation of native mortality, and that the standard of housing has recently been much improved.

Precis of Evidence.

Drs *Irvine* and *Macaulay*.

30 Oct., 1904.

On the other hand the question of acclimatisation is predominant. And, therefore, we would urge that equal stress should be laid on the other measures we have recommended—stricter selection of recruits, supervision of clothing, detention of weaklings, provision of change-houses, liberal diet, and adequate treatment of the sick—measures which involve considerable expense, and which the mining authorities are generally adopting.

10. The considerations we have urged point, in our opinion, to the strong presumption that the improvement in the native mortality which has characterised 1904 will be maintained, although seasonal variations and possible recurrences of privation in the recruiting areas may from time to time adversely affect the death rate.

11. We would submit that if the housing conditions in the Rand Compounds are or can be made such, when judged by recognised standards, as to supply conditions adequate for health, it is unnecessary to lay additional stress on the one factor of cubic space to the possible detriment of other measures which are, in our opinion, essential.

12. Finally, we would submit that the test observations, made at the request of the representatives of the Transvaal Medical Society by the Analysts of the Chamber of Mines and supervised on behalf of the Commission by Dr. Moir, show that these requirements are adequately met by the new "Rand Mines" type of hut. This hut provides impervious floors so as to secure ready disinfection, and provides also adequate means of warming, lighting, and ventilation. With a standard of 200 cubic feet per head, and with percentages of the complement present ranging from 67 per cent. to 102 per cent., the average of eight series of tests of these huts, which included the examination of 43 samples, showed no value higher than 0·6 parts of CO_2 per 1,000, a figure which satisfies the most exacting standards. At the same time the samplers agreed that the various huts examined were built in such a way as to cause no inconvenience from draughts or other conditions to the occupants, and, after personal observations at practically all hours of the night, had no hesitation in stating that, from a hygienic point of view, they are perfectly fit for habitation.

13. It must be borne in mind that these huts are inspected daily, all sick boys removed from them, the object being that the compound huts shall contain none but healthy boys. It is worthy of note, as showing the general efficiency of this system, that, although cases of plague, which in its pneumonic form is highly infectious, occurred during the recent outbreak in several of the native compounds on the Rand, no spread of the disease followed.

14. We conclude, therefore, that, with adequate supervision and given the type of hut mentioned, an allowance of 200 cubic feet per head of the total complement would be sufficient for purposes of health. For five nights of the week, roughly speaking, only two-thirds of the complement occupy huts; for the other two nights of the week, some 90 per cent.

L. G. IRVINE, M.A., M.D., B.Sc.
(Pub. H.), Edinburgh.

D. MACAULAY, M.A., M.B., C.M.
Edinburgh.

Supplementary Statement.

Drs. *Irvine* and *Macaulay.*

24 Sep., 1904.

SUPPLEMENTARY STATEMENT ON THE CAUSES OF NATIVE MORTALITY

ON THE

MINES OF THE WITWATERSRAND

BY

L. G. IRVINE, M.A., M.D., B.Sc, (Edinburgh),

AND

D. MACAULAY, M.A., M.B., C.M. (Edinburgh).

24th September, 1904.

I.

In June, 1903, a Committee of Mine Medical Officers presented to the Commissioner for Native Affairs a report on the causes of mortality amongst natives on the Mines on the Witwatersrand. The report showed that this mortality was due almost entirely to a few main diseases, namely :—

(*a*) Pneumonia, phthisis, and other respiratory diseases.
(*b*) Cerebro-spinal Meningitis.
(*c*) Enteric fever, dysentery, and other diarrhœal diseases.
(*d*) Scurvy.
(*e*) Malaria.

Other diseases than these it was not thought necessary to discuss, since all other diseases taken together have never since November, 1902, amounted to 8 per cent. of the total death rate, and since the attempt to press analysis further is rendered of small value by the considerable number of indefinitely classified diseases which this group contains. Fuller analysis would not reveal any other important contributors to the total mortality or any other factors which could be reasonably attributed to conditions of occupation (see Appendix G. 1 of this Report).

The general conclusions of this report were that the excessive mortality of 1902-1903 was due, in the main, to the following causes :—

(1) The poor condition of those natives who remained on the Rand during the war, many of whom were scorbutic, and all of whom had suffered from the hardships incident to it.
(2) The fact that a large proportion of the natives employed on the Rand were recruited from tropical districts, and that many of these arrived in a weakly condition, so that for both these reasons they were all ill-fitted to stand a sudden change in climatic conditions.
(3) The influence of these factors was accentuated by the nature of their occupation as mine labourers, the conditions under which they lived, and the fact that insufficient means were taken to protect them from the effects of climatic changes.

To meet these conditions the Committee of Medical Officers made certain recommendations, which are given in detail in their report, and which included the following :—

(1) Better supervision of the clothing of the natives on their being recruited and when at work.
(2) Provision of a detention compound for weaklings and for those temporarily unfit for work.
(3) Certain improvements in the condition of housing.
(4) A defined scale of diet.
(5) Recommendations regarding the administration of hospitals and the care of the sick.
(6) Provision of change-houses at the shaft heads.
(7) Enforcement of mine sanitation.

Supplementary Statement.

Drs. *Irvine* and *Macaulay*.

24 Sep., 1904.

Since the date of that report much fuller information has become available, but this only serves to strengthen its general conclusions and the importance of the recommendations made.

The statistics of mortality which were then available for six months only, are now open to examination for the period from November, 1902, to July, 1904. Tables of these are presented in Appendices A. 1, 2, 3, 4, and 5, and the main results are shown graphically in Chart 1.*

The tables presented show the mortality amongst native labourers on mines and works in the Witwatersrand, Vereeniging, and Heidelberg Districts; they are compiled from the data in possession of the Native Affairs Department. Tables A. 1 and A. 2 give the actual numbers of deaths from certain specified diseases, month by month, and Tables A. 3 and A. 4 give these numbers rendered as monthly rates per 10,000 natives employed. The monthly totals are also shown converted into rates per 1,000 per annum.

The chart shows very graphically the monthly variations in the death rate from each disease. The total mortality curve shows from November, 1902, to February, 1904, a marked symmetry. Two main seasonal rises are apparent:—

(1) A warm-season rise, culminating in November and December, due mainly to the increased incidence of the diarrhœal diseases and of scurvy.

(2) A cold-season rise, culminating in 1903, in July, and due to the increased prevalence of pneumonia and the other respiratory diseases, and of meningitis, whose incidence is closely related to that of pneumonia. So outstanding a feature is the line of pneumonia that for 1903 it practically dominates the whole curve.

From February, 1904, onward, the seasonal curve does not show the same marked symmetry, the cold-season rise being only just apparent. The reasons for this we shall try to explain later. As compared with the first six months of 1903, those of 1904 show in every case a lower value, this being strikingly evident during the months of 1903, but are in 1904 (taking the rates from sickness alone) better than the best months of 1903.

The comparison of the totals for the first six months of 1903 and 1904, respectively, shown in Appendix A. 5, brings this out very plainly. The mortality from pneumonia and meningitis in the latter period is less than half, from enteric it is less, from dysentery much less, from scurvy and malaria it is again less than half, and from other diseases less than a quarter. Almost all the main diseases, therefore, show a marked fall.

Compared with 1904, therefore, the mortality of 1903 was exceptionally high, and we believe that time will prove that the years of 1902 and 1903 were in this respect abnormal.

II.

In attempting to apportion the influence of the various elements which have contributed to the native mortality, and variation in which may be held to account for the improvement which it has recently shown, we must consider the following factors:—

1.—The Racial Distribution of the Labour Supply.

This is shown in Appendices B. 1 and 2, which give the number and source of the natives recruited by the Witwatersrand Native Labour Association during 1903 and 1904. It will be seen the main sources of supply are:—

	1903. *per cent.*	1904 (Jan.-June). *per cent.*
Portuguese Territory	52·9	30·04
Locally Engaged (including Natal and Zululand) ..	17·16	36·86
Transvaal (excluding those locally engaged) ..	13·79	15·005
Cape Colony	8·29	9·64
Bechuanaland	3·19	2·99
Basutoland	2·35	1·96
British Central Africa	1·10	1·16
	98·78	98·66

Those figures, which deal with new recruits only, do not, however, give the exact territorial distribution of the natives actually employed on the Rand, since natives from all sources who re-engage are included under the heading locally engaged.

* These Appendices are sub-heads of Appendix G. 2 of this Report.

Supplementary Statement.

Drs. *Irvine* and *Macaulay*.

24 Sep., 1904.

We, therefore, add a table which is based on the figures of the Native Affairs Department, and which shows the percentage distribution amongst the various territorial groups of the natives employed on the Rand for the year July, 1903, to June, 1904 :—

Comparison of Percentages of Territorial Distribution and of Mortality respectively.

	Percentage employed. *a.*	Percentage of Territorial Mortality to Total Mortality. *b.*	Ratio *C.* ÷ *a.*	Relation plus or minus of Mortality percentage to Employment percentage.
Portuguese Territory	67·26	81·13	1·21	+13·87
Transvaal	15·67	7·0	0·49	— 8·67
Cape Colony	7·41	2·05	0·28	— 5·36
Natal and Zululand	3·05	1·05	0·34	— 2·0
Basutoland	1·8	2·0	1·11	+ 0·2
British Central Africa	1·19	2·49	2·10	+ 1·30
British Bechuanaland	1·09	1·93	1·77	+ 0·84
Damaraland	0·94	1·21	1·28	+ 0·27
Swaziland	0·56	0·51	0·91	— 0·05
Rhodesia	0·53	0·35	0·66	— 0·18
Orange River Colony	0·31	0·09	0·29	— ·22
Others	0·18	0·19	1·06	+ ·01
	100·00	100·00		

When we next investigate the relative contribution of each of these territorial groups to the total mortality, we find considerable differences. In the above table the proportion which the deaths in each territorial group bear to the total mortality is compared with the percentage proportion of the total number of natives employed contributed by each of these groups. By this method it is shown that the Portuguese British Central African, Basuto, and Bechuanaland natives contribute more than their due percentage proportion of the mortality, while Transvaal, Zululand, Cape Colony, and Natal natives contribute less than their due proportion.

This comparison is brought out in a different way by taking, again from the figures of the Native Affairs Department, the annual death rates per 1,000 of each territorial group. These appear as follows :—

Territorial Death Rates rendered as per 1,000 *per annum for the Year July,* 1903, *to June,* 1904.

Portuguese Territory	66·8 per 1,000
Transvaal	24·7 ,,
Natal and Zululand	19·0 ,,
Cape Colony	15·3 ,,
Basutoland	61·5 per 1,000
British Central Africa	115·9 ,,
British Bechuanaland	98·4 ,,

Naturally such figures will vary much from period to period, according to the variations in the incidence of disease, but the first four, which represent the four largest territorial contributors to the labour supply, may probably be taken as affording an approximate index of the differences of racial mortality. The three latter figures, which are based on much smaller numbers, are thereby less reliable. The figures for Basutoland and Bechuanaland are probably unduly high, but the high figure for British Central Africa is a characteristic feature of all such determinations, and re-appears in a similar way in the Kimberley statistics. It certainly suggests that much reliance should not be placed on that district as a recruiting area for the future, particularly on account of the undue preponderance of sickness (chiefly malarial) amongst British Central African boys.

In all the territorial groups the main causes of death are the same, and of these respiratory diseases here, and even more strikingly at Kimberley, contribute the larger proportion, although individual variations in susceptibility to these occur. Not only do the Portuguese natives show the highest death rate of the four principal territorial groups, but they show also of these four the highest mortality from each of the principal diseases. With 67 per cent. of the total of employment, they contribute 79 per cent.

Supplementary Statement.

Drs. *Irvine* and *Macaulay.*

24 Sep., 1904.

of the deaths from respiratory diseases, 89·8 per cent. from meningitis, 80 per cent. from scurvy, and 85 per cent. from malaria. The prevalence of the two latter diseases amongst Portuguese boys on their arrival, has, undoubtedly, been a main cause of their relatively high mortality from pneumonia and from other diseases.

The broad result from this racial comparison is that natives drawn from tropical countries show a much higher death rate than those drawn from districts whose climate more nearly approximates to that of the Rand. British Central Africa and the Portuguese districts of Mozambique and Quilimane come easily first, Portuguese Territory south of Latitude 22 degrees comes next, while the Transvaal, Natal, and Zululand, and Cape Colony show much lower figures.

As we have said, we hesitate to accept the figures shown for Bechuanaland and Basutoland as safe indices of their relative racial mortality, although probably they may in the future appear permanently higher than the Transvaal, Natal, and Cape Colony. As accounting for the comparatively high death rate of Transvaal natives, it must be noted that by far the largest proportion, amounting in 1904 to 12·6 per cent. of the total recruits from all sources, came from the Northern Transvaal Districts, which are sub-tropical and malarial.

The term " race " in these comparisons is not to be taken in a strictly ethnological sense, but includes also the factor of territorial and climatic influence, since, as we shall demonstrate, even the Portuguese natives, when they have become acclimatised, may show quite a low mortality.

2. *The seasonal and climatic factor*, indeed, must be read in close association with the racial factor.

We have already drawn attention to the marked seasonal variations of the mortality curve in 1902 and 1903. It will be seen that it is natural pneumonia, and the respiratory diseases are most prevalent during the cold months of the year, during which extreme and rapid variations of temperature, conjoined with bitterly cold winds and frequent dust-storms, provide most direct and powerful causes of a high respiratory mortality. In the winter months the diurnal variations of temperature in the shade frequently, on the Rand, exceed 30 degrees Fah.

Further, the winter of 1903 was an extremely rigorous one, and the fact that the rise in mortality from respiratory diseases was then extremely high, whereas during the very mild winter season of 1904, through which we have just passed, it has been scarcely appreciable, points most strongly to the direct influence of seasonal conditions as an important factor in the death rate.

We would draw attention in this respect to the close similarity of the curve of mortality (for the same period) of the white population of the Johannesburg Municipality from pneumonia and respiratory diseases, which we owe to the courtesy of Dr. Porter (Sub-Appendix C., Chart 2).

Similarly the hot weather conditions are seen to predispose to the incidence of enteric fever and the diarrhœal diseases alike amongst whites and blacks.

When one comes to investigate in detail the incidence of mortality on natives from tropical countries in 1903, the further significant fact appears that this incidence falls with exceptional severity on new arrivals.

The table (D. 1), prepared by the Witwatersrand Native Labour Association, shows that among the East Coast natives allotted during the seven months from June 1st to December 31st, 1903, the mortality was 37 per 1,000. *Of the natives who died, 45·2 per cent.* (17 per 1,000) *died within one month after allotment to the mines.* After one month's service the mortality steadily declines, although it remains considerable during the first three months, after which the fall is striking.

Similar figures are shown for the natives from the Northern Transvaal, although the totals in this case are much smaller ; also, the returns relating to the British Central African natives show the same general results.

It is difficult to conceive an explanation of this fact on the supposition that permanent local conditions of bad housing and so forth were the main causes of the death rate in 1903.

The enormous susceptibility of new arrivals from tropical districts is a matter of every-day experience amongst those who have to do with the natives, and we attach one or two recent examples of this fact from our own experience, which show that even during the mild season of 1904 the same broad fact obtrudes itself.

Statement D. 2, for example, shows that between May 1st and July 31st, of 138 East Coast natives allotted by the Witwatersrand Native Labour Association direct from the recruiting areas, 33 were admitted to hospital in within 30 days, of whom two died, and during the second period of 30 days nine were admitted. On the other hand, of 112 East Coast natives locally engaged during the same time, only one was admitted during the first period of 30 days and two during the second. One of the latter died.

Statement D. 3 shows parallel of even more striking results in batches of Mozambique, Quilimane, East Coast, and British Central African natives.

Supplementary Statement.

Drs. *Irvine* and *Macaulay*.

24 Sep., 1904.

Very many of these cases of sickness are malarial in character, which predispose to acute disease, or there may be outbreaks of coryza and colds which may develop into true pneumonia or meningitis. Many of the natives, indeed, are found to be suffering from coryza and colds on their arrival.

Further, Dr. Brodie, Medical Officer to the Witwatersrand Native Labour Association, states that between the beginning of September, 1903, and the end of January, 1904, all the East Coast boys and most of the Northern Transvaal boys arrived in poor condition. In some gangs over 50 per cent. showed definite signs of scurvy. This experience may be regarded, to some extent, exceptional, owing to the fact that the mealie crop, on which the natives mainly depend for their food, was, that year, exceptionally poor. But the influence of this fact on the mortality for 1903 cannot be overlooked. During the first six months of 1904 the condition of East Coast and Northern Transvaal boys has been very much improved.

Although these are the months in which the natives arriving from these districts are always likely to arrive in the poorest condition than during the rest of the year, they are not the months when the climatic differences existing between their homes and the High Veld is most extreme. So far as the figures for 1903 go, they show that from October to April the curve of mortality for pneumonia is relatively low. It tends to rise in May to a maximum in July, and gradually falls again from July to October. The danger from pneumonia and meningitis to newcomers from tropical countries is much greater during the cold weather, even though the natives may arrive then in better condition. The risk is greatest, of course, in the case of boys arriving in poor condition, especially those suffering from scurvy, but it extends in some degree to all natives arriving in the cold months from tropical districts, many of whom, as we have said, are prone on arrival to be attacked by malaria.

We may expect, however, that as time goes on a greater number of the natives arriving from the East Coast and Northern Transvaal will be boys who have already worked on the Rand, and who will thereby be, to a greater or less extent, inured to the climatic conditions and the circumstances of mining life. The mines will come, we hope, to have a more or less permanent clientele amongst these natives. This is distinctly indicated in the Statement D. 5, which shows that from January to June, 1904, 58·9 per cent. of East Coast natives and 57·8 per cent. of Northern Transvaal natives were old mine boys.

Further, there is a considerable increase in the proportion of boys locally engaged. This is shown in Appendix B. 2, as compared with B. 1.

These were the conditions which led us to recommend to the Chamber of Mines the desirability of making some provision to obviate the risk of suddenly exposing boys arriving from tropical districts to the dangers incident to sudden changes of climate and sudden introduction to the conditions of mining work, and we suggested—

(1) That natives from tropical countries, and especially those arriving from new sources of supply in such countries, should, as far as possible, arrive here in the hot season, namely, from October to March.

(2) The stricter supervision of recruits prior to entry into the Transvaal.

(3) The provision of an adequate supply of clothing.

(4) The institution of a detention compound at Johannesburg, where all weakly or impoverished natives should be detained until, in the judgment of the Medical Officer of the Witwatersrand Native Labour Association, they were fit for allotment to the mines.

These recommendations have all now been put into operation. Statement E. 4 shows the working of the system of detention. It will be observed that in many cases whole batches were temporarily detained, and we believe that this measure will effect a considerable reduction in the amount of sickness amongst these natives when they are finally allotted to the mines.

Statement D. 6 shows the provision made for clothing.

3.—Nature of Work.

(3) As it is difficult to separate the racial from the climatic factor, so, in conjunction with both of these, we must take the *conditions of work*. Zulu, Basuto, and Cape Colony natives are mainly employed on surface work, although a certain proportion work underground. On the other hand, the East Coast and other natives form the larger proportion of underground workers, although many of these also work on the surface. This fact, no doubt, accentuates the influence of race and climatic conditions in heightening the mortality of the latter, for the risk of chill from exposure on emerging fatigued from the underground workings to the surface is, undoubtedly, a factor to be weighed. The underground temperature averages some 70 degrees Fah. throughout the year, and the sudden change to surface conditions, with perhaps an ice-cold wind blowing and a temperature below freezing point, forms a very obvious danger. But, on the other hand, surface boys frequently work in extremely exposed situations, and are often, with scanty clothing, subjected to the same severe surface conditions. It

Supplementary Statement.

Drs. *Irvine* and *Macaulay*.

24 Sep., 1904.

may be assumed that the absence of proper change-houses and the insufficient insistence on clothing helped, for the above reasons, to swell the mortality in 1902 and 1903, for, needless to say, the native himself is helplessly careless as regards both clothing and exposure. Dust and, in certain circumstances, the vitiation of the underground air by mine gases are also added to the risks of underground work, but they are, for the most part, operative only on those exposed to them over long periods.

The joint influence of season, race, and occupation is seen in the table of sickness statistics, compiled from the returns of the Mines Department (D. 7). These deal with all coloured labourers, and, therefore, differ in a slight degree from the returns given in Tables A. 1 and A. 2.

They show the effect of the seasonal factor in the number of cases of pneumonia, which for the second period of 1903 was more than double that for the first period of 1904. The mortality also, which was 26·3 per cent. of the cases for the former period, fell to 17·7 per cent. for the latter. The tables show also the further influence of occupational and in the part of racial conditions also in the fact that the proportion of cases of pneumonia amongst surface as compared with underground boys is as 1 to 4·3 and 1 to 5 in the respective periods, whereas the rates of the occupational distribution of surface to underground boys is, roughly, as 1 to 2. Further, the comparative case mortality from pneumonia amongst surface compared with underground boys is as 21·3 per cent. to 27·47 per cent. for the first period, and as 12·62 per cent. to 18·77 per cent. for the second.

In the case of meningitis the contrast is still more striking, the proportion of surface to underground cases being here only as 1 to 7 for each period. The case mortality of this disease is very high—from 70 to 75 per cent.

So far as bacteriological investigation has gone, the majority of these cases of meningitis are pneumococcal in origin, although a certain proportion are meningococcal.

Considerable variations are found in the mortality at the different mines, a point to which we shall return. It is, perhaps, worthy of note that the deep level mines showed, on the whole, for 1903–1904 a higher mortality than the outcrop mines, the latter having an advantage in rate of mortality of 9·4 per 1,000. Longer experience, however, is necessary to show whether this disproportion is a fixed factor and due to conditions of occupation which may or may not be remediable.

4.—Diet.

(4) During the time when no reliable statistics of native mortality were available the *diet* of the natives did not receive sufficient attention, and prior to 1903 the dangers of too exclusive a reliance on a staple diet of mealie meal, with a few accessories, was not sufficiently realised. Although the conditions of the war left on the hands of the mining companies a large number of natives who were already scorbutic, and the failure of the mealie crops over large parts of South Africa during 1902 and 1903 led to an impoverished and scorbutic condition amongst large numbers of the recruits, there is no doubt that the continuance of scurvy on the mines during these years was favoured by the nature of the diet provided.

But since that date the recommendations of the report of the Committee of Medical Officers regarding diet have been practically everywhere adopted, and the factor of diet need no longer be regarded as contributory to the death rate. Indeed, all observers agree that the condition of the natives leaving the Rand is immeasurably superior to that on their arrival, a fact which is ample proof that the prevailing conditions in this respect are quite satisfactory.

(5) *The care of the sick* is now also very greatly improved, and advance in this direction is being maintained. Since 1900, 38 native hospitals have been either newly built or enlarged and renovated. Twenty-six native hospitals are now under the direct supervision of white men, quite apart from the Compound Managers, who, on the small mines, exercise a general supervision, and special diet for the sick is now universal, and special provision for their clothing practically so. Daily medical inspection is now the rule on most mines, and we lay great stress on the strict segregation of sick boys.

(6) Before the adoption of the report of June, 1903, by the Chamber of Mines, the *standard of housing* of the natives was in need of improvement in several respects. The compound huts reproduced roughly the conditions of the native kraals. They were floored with earth, badly lighted, ill-ventilated, and heated by open coal braziers, with no provision for leading off the fumes.

From that date, however, great improvements have been effected in the housing of the natives. Since the resumption of work on the mines, 22 compounds have been built or substantially extended, partly for new companies and partly to replace old compounds which were regarded as obsolete. On 32 mines practically all the requirements of the Medical Officers' report regarding housing have been met, and in 21 others substantial improvements in housing have been made.

Supplementary Statement.

Drs. *Irvine* and *Macaulay*.

24 Sep., 1904.

The Rand Mines Group, for example (along with others), have in all their compounds introduced impervious floors, stoves with flues, suitable bunks, and provision for lighting and ventilation, and analysis of the air taken in typical rooms in several of their compounds show most satisfactory results.

III.

With a view to elucidating the comparative value of the various factors which we have discussed, we selected 13 mines for detailed examination. Six of these we took because they had, for the official year 1903–4, very high death rates, varying from 70·7 to 91 per 1,000. Three we took as having death rates approximating to the average for the year, namely, from 51·3 to 56·5 per 1,000. The remaining four selected showed low death rates, varying from 19·9 to 35·6 per 1,000.

(1) We found that in all these cases the diet supplied was substantially the same, so that this factor may be eliminated as a cause of the observed variations in the mortality.

(2) We then investigated the condition of the housing of the native workers on these mines, and we found that this bore no direct relation to the death rate. The two lowest on the list have compounds of the old type, which have not been altered. The huts have earth floors, no special provision for lighting or ventilation, no special bunks or stoves, and the cubic space allotted is no greater than on the others. On these two mines no change-houses are provided.

On the other hand, those mines which have made the most improvements, in several instances, figure high on the list. We do not say, of course, that these improvements are of no value, but they have been, for the most part, too recently introduced to enable one to judge as yet of their effect, and they clearly are not a main determining factor in explaining the variations in the death rate.

(3) We next examined the territorial distribution of the natives employed (Appendix F. 2), but we again found that this afforded no explanation of the variations. Mine "M," for example, has 96·5 per cent. of its complement composed of Portuguese natives and Mine "L" 89·4 per cent., as compared with 62·96 per cent. on the Mine "A" and 79·79 per cent. on the Mine "E."

(4) When, however, we went into the matter of recruiting, we found a clear clue. The mere replacement of boys does not itself explain the variations, since all the mines replaced from 73 per cent. to 138 per cent. of their complement during the year. Naturally, those mines which had fewest replacements have a relative advantage, but Mines "M" and "K," with a comparatively low death rate, have a replacement of 100 per cent. and 138 per cent., respectively, and the Mine "A," with the highest death rate, has a replacement of 126 per cent.

(5) We then in every case divided the recruits, on the one hand, into natives allotted by the Native Labour Association *who had been recruited direct from native territories*, and, on the other hand, into natives voluntarily engaging, who comprise natives whose term of service has expired, and who re-engage locally, and also a proportion of Transvaal, Natal, and Zululand natives. The results are shown in Appendix F. 3. Having done so, we calculated the respective numbers of these two classes of recruits as percentages of the average complement, and the resulting figures are very striking. They are shown in Tables E. 4 and E. 5. It is at once obvious that there is a direct relation between the death rate and the percentage of raw recruits allotted. Broadly speaking and allowing for minor variations, which in the complex conditions operative may not admit of obvious explanation, we may say that for the 13 mines subjected to investigation (to which, in the chart, we have added Mine "N") the death rate varied, directly as the percentage of recruits drawn direct from native territories, and inversely as the numbers locally engaged and composed of natives who are so far acclimatised. *This is the one relatively constant feature which appears as a result of this investigation*, and it is shown graphically in Chart 3.

(6) Nor does the explanation of this result lie in the supposition that the natives locally engaging were mainly Transvaal or Natal or Cape Colony boys; 2,694, out of the 4,811 local recruits, were Portuguese natives from south of Latitude 22 degrees, a percentage of 56. We found that it was impossible, without the exaction of enormous labour, to accurately allocate the deaths occurring among these two classes of recruits. But the high percentage of Portuguese natives occurring among the local recruits and the fact that Mine "M," with 92 per cent. of its local recruits and 96 per cent. of its total complement formed of Portuguese natives, still shows a mortality of under 20 per 1,000, proves that the Portuguese native, when acclimatised, has quite a low mortality. This result, taken in conjunction with the data given in Appendix E. 1, strongly supports the contention that a comparatively short period of inurement to local conditions of climate and work is sufficient to enormously lower the death rate of those natives, who are on first introduction most susceptible to disease.

IV.

Supplementary Statement.

Drs. *Irvine* and *Macaulay.*

24 Sep., 1904.

Finally, we may recapitulate in summary the conclusions to which we are led from consideration of the foregoing facts and figures the incidence of disease and mortality amongst the native workers on the mines of the Witwatersrand has been due to several factors, which we have briefly attempted to elucidate.

We believe, as we have said, that time will prove that the excessive mortality which occurred in 1902 and 1903 was quite abnormal.

The main causes of the high mortality which prevailed during these years were, in our opinion, the following :—

(1) The local legacy of the war in the shape of a large number of impoverished and ill-nourished natives, many of whom were scorbutic.

(2) The fact that the larger proportion of the recruits drawn to the Rand during those years came from tropical or sub-tropical districts whose climatic conditions differ very much from those of the Rand, and the further fact that, owing to the disturbance of the conditions of the industry caused by the war, a high proportion of these were raw recruits.

(3) That, owing to the conditions of privation existing in certain of the territories from which the greater numbers of the recruits were obtained, very many of the latter were weakly and already suffering from scurvy on their arrival, being thereby predisposed to any acute infection.

(4) That a large number of the natives were, and are, the subjects of chronic malaria, which is particularly apt to attack them when subjected to sudden changes of climate.

(5) That the scarcity of labour constituted a pressure on the recruiting agents to introduce natives who might otherwise have been rejected owing to their physical condition.

(6) That the seasonal conditions on the Rand were, during those years, extremely rigorous.

(7) That the special conditions of underground work aggravated the risks of the incidence of disease which the foregoing causes induced.

(8) That the form of diet, especially owing to the necessity of using imported maize, was unsuitable, and the diet insufficient in variety.

(9) That the conditions of housing, the supervision of clothing, and the care of the sick also required improvement.

At the same time, the conclusion to which the facts inevitably bring us to is that the most important factors in producing the mortality have been racial and climatic, and that the matter of housing, although of much importance, as we have insisted, has not been a *main* cause of the excessive mortality.

It will be seen that certain of these factors are permanent in operation and others are temporary or remediable, and, therefore, while we believe that the improvement in the death rate which has characterised the past six months will be maintained, we recognise that the mortality may be adversely affected from time to time by such conditions as the possible recurrence of scarcity in the native territories or rigorous seasons on the Rand. It is with this conviction that we have insisted that the main problem is one of acclimatisation, and that the Committee of Mine Medical Officers recommend that the incidence of disease should be met *at all points* with the object of protecting the native during that process. For this the Committee of Medical Officers recommended :—

(1) Strict supervision in recruiting.

(2) The adequate clothing of recruits on their introduction into the Transvaal.

(3) The provision of a detention compound, where weakly and impoverished natives should be kept back until fit for allotment to the mines.

(4) The adoption of a more varied scale of diet.

(5) The remodelling of the compound huts so as to provide conditions more conducive to health, by the introduction of impervious floors, to which we attach great importance, and by due provision for ventilation, lighting, and warming.

(6) Certain detailed recommendations regarding hospital construction and administration, and the daily inspection of the natives in the compound, so as to provide for the strict and immediate isolation of all the sick, so that there should be in the compound none but those who are fit for work.

(7) The provision of change-houses and of coffee and soup kitchens at the shaft-heads.

(8) The enforcement of adequate sanitation.

Since the date of the Medical Officers' report very substantial steps have been and are being taken to meet these requirements, which the Chamber of Mines have practically adopted *in toto*.

The first four are already fully complied with in every detail. The housing of the natives has been greatly improved, and on many mines fully complies with our recommendations. The care of the sick is now generally adequate, and in this respect it is satisfactory to note that when cases of plague recently appeared in the native

Supplementary Statement.

Drs. *Irvine* and *Macaulay.*

24 Sep., 1904.

compounds there was no spread of this disease. Of the principal companies, 30 have already erected change-houses, and in this respect the others might well follow suit. Mine sanitation is now under the care of the sanitary authorities.

We attribute the lower mortality which has fortunately characterised the first six months of 1904 and the improvement which is still maintained to the following causes :—

(1) The milder seasonal conditions which have prevailed.
(2) The better condition of the boys on arrival.
(3) The larger percentage of boys arriving from native territories who have already worked on the Rand, and the larger percentage of natives engaging or re-engaging locally, a feature, the importance of which, has been clearly demonstrated.
(4) The greater care in selection and detention of the recruits.
(5) The better all-round attention to the conditions under which the native lives and works carried on along the lines we have described. One marked result of this has been the practical disappearance of scurvy as an important factor in the mortality.

LOUIS G. IRVINE.

DONALD MACAULAY.

Minutes of Evidence.

Drs. *Irvine* and *Macaulay.*

24 Sep., 1904.

(*Dr. Turner.*) Have you obtained any records of the maximum and minimum temperatures during the years 1902 and 1903 ?—We tried to get them, but the Meteorological Department did not start them until June, 1903, so that we had no records before that date. We also found that, although it is a matter of common knowledge that the winter season of 1904 has been exceedingly mild, as compared with previous years, yet occasionally, we had a very low temperature at night, which kept up for a few hours and brought down the minimum average very much. Not having complete data, therefore, we did not submit these figures. There is one particular feature regarding the winter season of 1904 we should like to draw attention to, and that is the absence of those bitterly cold winds which we had in 1903, even though the temperature was low at nights this year.

As a matter of fact, I cannot get the temperatures for 1902 and 1903. I have got the average from 1893–4 up to last year, and the average for the year 1903–4 is very similar ?—Exactly ; that is what I say. We traced one particular month and found the averages did not vary very much. You see, if the temperature is very low for even half an hour that brings down the average. There is no comparison between the winters of 1903 and 1904. Although occassionally in 1904, there might have been a big drop in the temperature, making the average much the same as in 1903, yet it was unaccompanied by the same bitterly cold winds as in 1903.

There is one aspect of the question that has not been sufficiently dwelt upon yet. We have been going very much upon the amount of CO_2 in the atmosphere inside and outside the compounds, but what is your opinion as to the proximity of the people living in the compounds ?—Of course, that is an important element, but in the first place, it is, to a large extent, controlled by medical inspection, which removes daily any boy suffering from any infectious disease in the compounds, so that he is not there to act as a focus of infection, and, further, putting the bunks in two tiers, unquestionably greatly reduces the proximity, compared with having them all spread out on the floor.

Then you think that, practically, cubic space counts for nothing ?—I did not say so at all.

Then what is your idea ?—I say that the structural arrangements we suggest are sufficient.

(*The Chairman.*) That is the New Rand Mines type ?—Yes.

Not the model huts proposed ?—I think there are structural defects in the model huts which render them not so good as the type on the Glen Deep.

(*Dr. Turner.*) Then you think 200 as good as 300 cubic feet ?—I think 200 is sufficient for health purposes, with two tiers of bunks, and adequate daily inspection of the compounds.

(*The Chairman.*) Have you any further points you would like to bring forward with regard to the reports which have been circulated ?—(*Dr. Macaulay.*) I think everything we want to say is included in the reports. (*Dr. Irvine.*) We have also prepared a precis of the evidence interpreting the report.

(*The Chairman.*) Yes; we have got that. (*Dr. Irvine.*) Our idea was that the report should contain nothing controversial, but should simply give impartial data for the consideration of the question. We have put our interpretation of the report on this particular matter before you in the "Precis of Evidence."

(*Sir Kendal Franks.*) When you say 200 cubic feet is sufficient, do you consider 200 the minimum?—200 is certainly the minimum.

I mean is it the very least?—I think it is the least sufficient for purposes of health, yet I think it is sufficient. I would point out, with regard to the proximity question, also, that although sanitarians are rather averse to considering percentage of complement present, that really has a direct bearing upon the proximity question, on, at least, the five nights of the week when there is not the full complement present.

(*Dr. Sansom.*) That 200 you have reckoned on the total complement?—Yes.

Do you say that now, as a result of recent experiments?—No; I say that it is the only standard I should ever have accepted.

You mentioned 150 in the previous report?—Yes; but not as a standard. The reason of that was this. That report was drawn up at a time of emergency, and, considering the whole question, we were asked to provide measures to meet the death rate as quickly as possible, and we, therefore, recommended a very large programme.

We recommended a figure which I could not accept, and when Mr. Strange asked me if I would accept that as a standard, I said that I would not. (*Dr. Macaulay.*) It was a compromise in regard to the type of compound then in existence. We would never recommend that for new compounds.

(*Dr. Turner.*) Was 150 about the average?—(*Dr. Macaulay.*) Rather over the average. (*Dr. Irvine.*) I think, on the whole, it was. We found many of them lower.

(*The Chairman.*) When you recommend 200, that is for the full complement?—Yes; 100 per cent present.

And what when there is only 66 per cent. present?—Then they are getting 300 cubic feet per head.

Quite so; I understand.

(*Surgeon-General Edge.*) Have you any idea of what additional expense would be involved by the addition of another 100 cubic feet to the standard you have laid down?—That you would have to ask the engineers of the Chamber of Mines for.

(*Dr. Turner.*) You don't think this 150 cubic feet of air-space provided has anything to do with the heavy mortality?—We have shown in the report, I think, that it was not a main factor, because the mine with 19·9 death rate, although it had an equally low amount of cubic air-space and the old type of compound, it nevertheless, had the lowest death rate of all; which is simply due to the fact that it had a large percentage of acclimatised boys, so that, obviously the housing conditions were not sufficient to cause a high mortality.

(*Sir Kendal Franks.*) What mine was that?—(*Dr. Macaulay.*) It is marked "M" on the chart.

I think it was one that we saw?—Yes.

And one we considered about the worst?—Yes; about the worst. (*Dr. Irvine.*) We have been asked not to give the names of the different mines, but I can inform you in confidence.

(*The Chairman.*) You think the mortality is not due to the housing conditions?—I say, Sir, that the housing conditions do not form a main factor in the mortality. We have detailed the factors we believe to be important ones. You will find them stated in our report. There are a great many of them and we think the influences of these other factors are proved to be greater than the housing factor, from this analysis of the thirteen selected mines, which we have given. We went into the matter of housing, replacement of complement, clothing, etc., and we found that the one relatively constant factor determining the death rate was the relative percentage of new to old boys.

(*Dr. Turner.*) That I have no doubt about, because I have seen it in Kimberley, but still do you think that 150 cubic feet per head had any effect on those new boys?—It obviously had not sufficient effect in the case of the New Goch to cause a death rate of over 20.

But those boys had been through the mill and it was, more or less, a case of the survival of the fittest?—I should certainly say that I prefer 200 and the

Minutes of Evidence.

Drs. *Irvine* and *Macaulay.*

24 Sep., 1904.

housing conditions we have suggested. We would not have recommended the housing conditions to be changed, if we had not thought they were not below the standard of health.

(*Surgeon-General Edge.*) Do you think the outbreak of pneumonia at that time was at all effected by the boys crowding together ?—Take a mine like the Crown Reef. During June, 1903, which was the worst month for pneumonia, there were about 1,200 boys on the mine. I had in one month, eight deaths out of about twelve admissions into the hospital. I can give you the exact figures, but the percentage of mortality was enormously high, and the number of cases was not very great, so that does not point to an epidemic of pneumonia. In that compound there were 1,200 boys.

Were the cases close on each other in sequence ?—They came during the cold months of the year.

But did they come in a rush ?—They did not all come from one hut ; in fact, there were more surface than underground boys, the reason being that the surface works are very exposed, and boys were sometimes carried benumbed with cold from the dump and died within a few hours after being admitted to the hospital. It seems common-sense to me that these extreme seasonal conditions, making it impossible for certain boys to work in certain seasons, were more commonly the cause of pneumonia than overcrowding, although I do not deny that overcrowding may predispose to pneumonia.

(*Dr. Turner.*) You have given us these reports ?—Not for the last year throughout, but I can easily get you them.

(*Sir Kendal Franks.*) What month were you referring to ?—June 1903. (*Dr. Macaulay.*) I would like to say, as far as my own personal experience goes, that I have found that the isolation of the sick (which we consider a very important point) in such a compounded hospital as you saw in the Glen Deep, in every case has resulted in a very large diminution of the sickness rate. (*Dr. Irvine.*) Of course, you understand, Sir, our whole programme is proper isolation of all infectious cases.

(*Dr. Turner.*) Were you isolating them in 1903 ?—Oh, yes. (*Dr. Macaulay.*) Only since this report was adopted. There was no compounded mine hospital, as far as I know, prior to June 6th, 1903.

(*Surgeon-General Edge.*) What do you call a compounded hospital ?—Where the hospital is in an enclosure, separate and distinct from the compound, and they are kept prisoners there until they go back to work. (*Dr. Irvine.*) Ever since I came back from the war, the compound manager or hospital attendant, who is a most intelligent boy, goes round the compound every day and turns out all sick boys. This has been done since 1902. It is not a recent system with me. (*Dr. Macaulay.*) This was not adopted in June. The report was handed in in June, but it was not adopted until the end of August or beginning of September. (*Dr. Irvine.*) It was adopted on the 3rd September. (*Dr. Macaulay.*) And after that the hospitals had to be built.

(*Sir Kendal Franks.*) How many mines have adopted the recommendations you made at that time ?—This is included in our report.

Do you also state in your report how many have not adopted them ?—No ; only the positive fact of the number that have adopted them. (*Dr. Irvine.*) As far as the standard of housing is concerned, the majority of compounds with over 200 boys fulfil all the requirements.

(*Surgeon-General Edge.*) Under what law do they send in the specifications of huts to the Government to be passed ?—(*Dr. Macaulay.*) I am not aware whether it is in the mining regulations or not. (*Dr. Irvine.*) I have here a table including every mine on the Rand. The Native Affairs Department asked me to give them a schedule of headings for the inspection of all compounds on the Rand, and I think they are going to publish it. Every mine on the Rand is included in the returns, and you can find out from it the state of their compounds, diet, hospitals and everything.

(*The Chairman.*) Do you find you have any statutory authority for carrying out the recommendations which you have put forward ?—Well ; of course, the fact is, that the Chamber of Mines is technically, only an advisory body ; the directors of the companies are the executives, and what has happened is, that the Chamber of Mines have substantially adopted *in toto* our report, and they recommended all the companies to put these recommendations into effect, but the actual people responsible are the individual companies themselves.

(*Surgeon-General Edge.*) I presume if they decline to do it, there is no legal power to make them ?—

(*Dr. Sansom.*) No. The only possible way is for the Commissioner for Native Affairs, if he believes a compound is not as it should be, to remove the boys.

(*Surgeon-General Edge.*) Then why do they submit the plans for hospitals to the Government to be passed ?—(*Dr. Sansom.*) That is only for Chinese. Under the Chinese Ordinance they are bound to do so but not for natives.

(*The Chairman.*) You recommend the adoption of this New Rand Mines type of hut ?—Yes ; we recommend that type. There may be possibly small modifications, but that, broadly, is the type we recommend.

In looking over these plans we have never been quite clear in regard to the relation of the inlet to the outlet. We have never been clear as to whether the inlets are less than the outlets or greater ?—(*Dr. Irvine.*) Perhaps Mr. Williams might answer that. He has made detailed observations in all these huts. The reason why we based our recommendations on that type of hut was that it gives good air.

(*Surgeon-General Edge.*) Do you also approve of the back-to-back huts ?—I do not at all, Sir.

They have them also on the Glen Deep ?—I do not approve of them at all.

(*Sir Kendal Franks.*) We thought them very good.

(*Surgeon-General Edge.*) I thought so ?—The back-to-back hut may be rendered much less objectionable by not making the partition complete.

In those we saw the partition is not complete ?—That, of course, does not cause quite such a good draught as an ordinary hut with a window opposite the door, but it is certainly very much better than blocking the wall right up to the top. Still, I think in any new compounds that are being made, the back-to-back principle should be discouraged.

(*Sir Kendal Franks.*) Is there any objection to giving us the number of mines that have not adopted the recommendations ?—You can find that out from the returns of the Native Affairs Department.

I know ; but without making us count them ourselves, can you give us the proportion that have adopted them, the proportion that have not, and the proportion that have adopted them partially ?—You will find the details on page (17) of the supplementary statement. I went through the series of returns of the Native Affairs Department and I did it hurriedly, so I do not say that there may not be an error of one up or down in this return. I think there were 67 mines, each employing over 250 boys, and we found on these, since the resumption of work on the mines, that 22 compounds have been built or substantially extended, partly for new Companies, and partly to replace old compounds, which were regarded as obsolete.

Is that since the war ?—Well ; they were carrying it on during the war, since 1900. This is in our report. "On 32 mines, practically all the requirements of the Medical Officers' Report, regarding housing have been met, and in 21 others very substantial improvements in housing have been made." Supposing a compound put in impervious floors alone, I call that a substantial improvement, but I do not say that is adopting all the requirements, and, therefore, that list of 21 consists of mines which have adopted some of the requirements but not all.

And then the balance ?—The rest are practically unimproved.

(*Surgeon-General Edge.*) And your requirements include 150 cubic feet ?—They all have that, so I did not go into the question of cubic space. It was not measured.

The compounds we have seen are supposed to meet the requirements of 150 ?—Oh, yes.

(*The Chairman.*) Now what about this balance unimproved ; they number about 15, according to the figures you have given ?—A good many of them are mines with a very short life to run. Take the Bonanza, it has not got impervious floors, it has the ordinary earth floors ; it has got fixed bunks, but no means of lighting or ventilation. I call that unimproved, but nevertheless, the death rate was exceedingly small.

Do you account for that by the fact that the boys had been acclimatised ?—That does not come out so very strongly in the Bonanza, as there was less than 50 per cent. locally engaged. Take on the other hand, the Robinson Central Deep, with a small compound of the old type, which has engaged since the war

Minutes of Evidence.

Drs. *Irvine* and *Macaulay.*

24 Sep., 1904.

764 boys, and only 50 of these have been allotted by the Native Labour Association. All the rest have been locally engaged, and there has not been, during that time, a single case of death from sickness, while the compound huts are quite of the old type.

(*Dr. Turner.*) It is only just built ?—The new huts have only been built within the last few months.

(*Sir Kendal Franks.*) From this report, there are 14 mines that have not adopted any substantial improvements. Can you give an estimate of how many are short lived mines ?—I could not say. We only know individual cases. The Bonanza has only two years to run. (*Dr. Macaulay.*) And the one which I think you considered the worst, the Geldenhuis Main Reef, I am informed it only has a few months life.

(*The Chairman.*) In regard to those cases which have not followed your recommendations, although the death rate has not been any higher, but even less, has it been notified whether the sick rate is any higher ?—I think you may take the death rate as an index of the sick rate.

But in regard to minor ailments, has the vitality been lowered ?—On the Robinson Central Deep and the Bonanza, certainly not. The sickness rate is low. During the five months from January, I had not a single death from sickness on the Bonanza.

(*Dr. Macaulay.*) On the Rand Mines group, where the vitality of the labourers can be measured by their efficiency, they have an efficiency of about 95 per cent.

What is the efficiency on the others that have not followed out the recommendations in accordance with the Rand Mines type ?—We found it extremely difficult to get these from the Rand Mines. It is a very difficult figure to work out. Take the Crown Reef ; its sickness rate is not, as a rule, more than three or four per cent. of the complement, *i.e.*, not counting the boys who are not doing work because they don't want to, but taking simply sick boys. The sickness rate is not more than four per cent.

(*Dr. Turner.*) In your supplementary report, on page 5, there are some figures comparing the racial distribution of the native labour supply of 1903 and 1904. Have you left out any small groups ?—I think it is complete.

Why I am asking is because it does not add up anywhere near the 100 ?—Which table do you mean ?—

The one on page 5 ?—You will notice we state "the main sources."

That is what I wanted to know. It struck me some little fractional things had been left out ?—You will find them on the next page. You will also find full data of these in Appendices B. 1, and B. 2.

(*The Chairman.*) I think it is the desire of the Commission to convey our thanks for your very comprehensive report, which will greatly assist us in drawing up a report on this matter. I think we need not detain you any longer.

(*Sir Kendal Franks.*) I would just like to make a point clear. In the Precis of Evidence, on the fourth page, you state "with a standard of 200 cubic feet per head, that the percentage of the complement present ranged from 67 per cent. to 102 per cent." ?—That means there were more even than the full number corresponding to 200 cubic feet per head present.

When you were making that test you had more than the full complement ?—Yes : a boy extra or something of that sort.

Mr. J. R. Williams.

Mr. *J. R. Williams.*

20 Sep., 1904.

Mr. J. R. Williams was recalled and examined.

(*The Chairman.*) I think Dr. Turner has some points with regard to the analyses which he wishes you to clear up.

(*Dr. Turner.*) Would you look at the figures dated 17th September ?—Those of the 15 samples taken at the Village Deep.

Yes. Well, now I think at 11 p.m., respiratory impurity is represented at ·14, taking ·36 from ·50 ?—Unfortunately Dr. Moir has my original copy, but I will accept your figures.

Then at 1 a.m., it had risen to ·34 respiratory impurity ?—Yes.

And then at 3 a.m., it had fallen to ·13 ?—Yes.

Can you tell me what was the area of this opening through which 400 feet per minute were passing; was that one of 15 in. square?—

That is an intake, but, unfortunately, I have not the original copies of these analyses.

Do you happen to know the size of these intakes?—15 in. by 17 in., I think.

We measured them and made them 16 by 15?—It would be very simple for me to give you an actual copy of these. We have got them all on the plans.

Now as far as I can make out, during the next three hours they must have had some 2,340 cubic feet per head coming in there. That would reduce it down to ·34, and then to reduce it from ·34 to ·13 you must have had something near 5,000 cubic feet coming in?—Part of that would be accounted for by the various conditions of the fires.

But there are no fires?—But there are many other things. The boys may not have been smoking, or had no candles burning and so on. In nearly all cases you will observe that after one in the morning, the air in the compound was considerably purified, which was due, I think, to the reason that on the still nights when we were sampling, there was a gentle breeze which assisted ventilation, and also the fact that all the boys were asleep and not sitting round. I have seen as many as 10 boys sitting round the fire smoking.

They would not be doing that between one and three a.m.?—Up to 12, they would.

In this particular case they were constant?—Yes.

As far as I can make out, there must have been somehow or other, 5,000 feet of air per head coming into that room. There must have been an enormous number of changes of air during the hour?—The size of the room was 8,200.

Dr. Moir has suggested that, perhaps you took that particular measurement at the opening of the eaves or air-holes?—In all these cases, the anemometer was only used on the air bricks and also on the louvres over the door.

Yes; you have given 400 feet per minute, and the outside air was moving at 580. I am not cavilling at that, but it strikes me there must have been a tremendous amount of change going on in that room at that time?—Not so very great. The size of the room was 8,200 cubic feet.

Yes; with 35 boys in it?—Now, as, at least, 60 per cent. of the volume of the room per hour is going through the hood over the stove, it does not mean a very large amount to go over the louvres afterwards.

Still, the air must have mixed with it to have reduced the CO_2. If it was short circuited, as in the one instance, then it did not affect the CO_2?—What I mean to say is that after the figures you have given there is 48,000 feet accounted for going through the louvre, which is just on a level between the two bunks, and, therefore, not causing the boys any inconvenience at all.

I want you to come and look at my figures and see if they are correct. (Dr. Turner explained his calculations to Mr. Williams.) Referring to the amount of air-change mentioned by Dr. Turner, the witness said, judging from the general condition of the room and the absence of anything approaching to a draught, I should say it was quite impossible. That figure would mean a hurricane blowing.

That is why I cannot understand these figures.

(*The Chairman.*) There must be an error somewhere?—There can be no question at all about an error in the amount of CO_2 in the room. That is absolutely final. They were carefully checked, and at least three samples were taken with regard to the purity of the air. I would certainly vouch that there was no draught at all in these rooms.

(*Dr. Turner.*) How do you account for it?—I must say I would like to check those figures.

That is particularly why I asked you?—All right, I shall do so. The difference may, possibly, be accounted for by the condition of the outside air.

Then I am to disregard that figure altogether?—No, Sir; but I say the outside air only gives you a fair idea of the inside air. I have had the outside air as high as ·7.

Minutes of Evidence.

Mr *J. R. Williams.*

24 Sept., 1904.

I quite understand that, and, in fixing our standard, it must be a standard of respiratory impurity and not CO_2, otherwise you might be at a disadvantage as you might possibly have it up to 1·4 ?—What I want to point out to the Commission is, that in some cases we have had the air purer inside the compound than outside for a certain length of time. Take any mine where they have got chlorination works, and with certain winds blowing, you have Cl and SO_2, and, therefore, you cannot always take the difference between the outside and the inside air. I should say that to take the ordinary standard on the Rand, as ·34 to ·35 would be very much nearer for the outside air.

Then when the wind is blowing from these chimney-stacks towards the compounds that must affect the inside air which comes from the outside ?—The samplers take samples in rooms A., B. and C., and, at least 20 minutes after, they take the outside air, and in that 20 minutes, you may get local currents which would alter the outside air very considerably.

In no case here do I find a vitiation such as would be harmful to the inhabitants of the compound.

(*Surgeon-General Edge.*) It is the lowness of it. We are astonished at it being so good ?—Well ; they certainly are good.

(*Dr. Turner.*) This may not be the only occasion, because it is the only one I have worked out. That is the first one that struck me.

(*The Chairman.*) Would you look into these figures ?—I shall certainly do so.

There is one point I have never been clear about in connection with these plans. I am anxious to know the relation of the inlet to the outlet, and the relation of the outlet to the cubic capacity of the compound, and the relation of the inlet to the number of occupants ?—I can easily work these out for you. These plans were drawn up at the request of Dr. Turner the last time we went to the mine, and I only got them yesterday evening, so I have not had time yet to work them out. I should say, as near as possible, we aim at getting the outlet from 30 to 50 per cent. more than the intake, but as in all cases the intake of the air is practically a direct current, and in the other case, the air has practically to work its way slowly from the louvre. I think that will account for the engineers probably allowing more than the Medical Society would ask for an intake. I should say 50 per cent. is a very safe margin.

Then you think the outlets are 50 per cent. more than the intakes ?—Yes ; fully as much as that.

(*Sir Kendal Franks.*) I though you said you preferred having the outlet smaller than the inlet ?—No ; but I mentioned that in regard to the gratings, they were altogether out of proportion, and in my evidence I pointed out that the air was circulating in the upper part of the room. That, however, does not apply to the louvre. I think the outlet should certainly always be greater than the inlet.

(*The Chairman.*) Then there is not a chance of the outlet becoming an inlet ?—Not when you have a difference of 50 per cent. The law of gases, when heated, would certainly make them tend to rise. I think I mentioned a case where there was a velocity of 290 feet per minute going through an intake, which had become an outlet.

(*Dr. Sansom.*) The whole of that question has been recently dealt with in a book regarding ventilation of theatres, and I think the relation works out at 25 per cent. out-take more than the intake. We can get the book and see. The question of ventilation pressure is very well worked out there.

(*The Chairman.*) In drawing these plans, you have not provided for any uniform relation between the inlet and outlet ?—In this particular plan, you have got one of the open stoves in the old huts, and I would rather take one of the newer ones.

(*Dr. Turner.*) Which do you find works best ?—There is no question at all in my own mind that the closed stove is a safety valve, because with an open fire, the boys will take their fireplace from under the hood and put it in a corner of the room and sit round it. In the other case they cannot move it. At the same time, when taking samples at the Glen Deep, the hut was used just as it was. Of course, owing to the samplers being there, I presume the boys would not move the fireplace, as they might if they were not there.

(*The Chairman.*) Perhaps you will be able to let us have these relations definitely ?—Certainly.

(*Dr. Irvine.*) With regard to these analyses of samples, there were 21 analyses of samples taken on the night of the 14th September in three supplementary huts at the Gleen Deep. Now when we made up that summary at the end we suggested a classification of experimental huts, ordinary huts, and miscellaneous huts, which had not been supervised by Dr. Moir and were not, therefore, not official evidence. Now these series of analyses were really selected huts, and I would like to ask Mr. Williams to go over them. The confusion has arisen from our not having adopted a nomenclature from the start. There is another little alteration I would make in one of the tables. In considering chart (3), the 13 selected mines, you will notice that the black line means the level of the 100 per cent. replacement, but several of the mines did not replace their complements to the extent of 100 per cent., and, therefore, in order to give this chart its full value, the difference between these two black lines should be added together. Table F. 4, gives the percentage locally engaged and the percentage remaining on the mines.

(*Mr. Williams.*) Might I explain the question Dr. Irvine has raised as to the samples taken of the three experimental huts on the Glen Deep. They were experimental in as much as they were slightly modified, because we had altered the partitions between the two rooms and we had storm doors put in, but the term experimental was only used because they were slightly different to the huts used on the mines. I think I already drew your attention to that.

(*Dr. Irvine.*) My point is this. In your summary you reserve the term "experimental huts" for the Medical Society's huts solely and, therefore, confusion arises. They are not experimental huts in that sense. They are specially selected mine huts.

(*The Chairman.*) Before you go, Mr. Williams, have you put in these plans officially ?—I thought I should like to give you copies of the whole of them.

Are they put in officially ?—Yes, Sir.

The public sitting of the Commission thereafter concluded.

Appendix A.

APPENDIX A.

Report of the Committee of the Transvaal Medical Society appointed to consider the Question of the Amount of Air-space per head to be provided in Chinese Compounds.

The question upon which the advice of the Society has been invited by the President of the Chamber of Mines, in his letter of 31st May, 1904, is, in effect, whether it is necessary to insist on the provision of 300 cubic feet of space per head for each person it is proposed to house in the sleeping-rooms to be provided for the Chinese, in view of the climatic conditions in Johannesburg, and of the fact that these rooms are to be provided with chimney-stoves, inlet-holes, and louvres for ventilation.

At an interview with your Committee on the 10th June, the President of the Chamber further stated :—

1. That the mining authorities were prepared to provide 200 cubic feet of air-space for each of the whole number of Chinese employed on each mine.
2. That during five-sevenths of each week not more than 66 per cent. of the full complement would simultaneously occupy any room, and that during the remaining two-sevenths (Saturday and Sunday nights) the proportion accommodated would be about 90 per cent.
3. That the mines would be prepared, if so advised by the Society, to provide means of mechanical ventilation and of warming the incoming air.

Reference was also made in the President's letter to the intended provision of change-houses, wash-houses, dining-rooms, proper clothing, and medical care. These measures are highly necessary and commendable, and, since they are taken for granted, the Committee have not thought it necessary to further consider them in dealing with the special point of ventilation of the proposed sleeping-rooms.

On 4th June, several members of your Committee visited the Van Ryn Mine Compound, which is undergoing alterations for the reception of Chinese, and, on 5th June, inspected the Crown Deep Compound. The results of their observations are covered in the concluding recommendations.

Conclusions and Recommendations.

1. Cubic air-space allowance is, *per se*, no sufficient guarantee of adequate ventilation.

2. That the essential requirement is adequate air-change, and that the amount of carbon dioxide (CO_2) present in the air is the best objective criterion of its sufficiency, the permissible limit of CO_2 being, according to de Chaumont, 0·6 parts per 1,000 volumes of air, and, according to Haldane, 1·2 parts per 1,000.

3. That given a sleeping-room of 4,000 cubic feet capacity, allowing 200 cubic feet of air-space with ¾ square foot air-inlet and ¼ square foot air-outlet for each person, the amount of CO_2 in the air at the end of 8 hours would be 0·67 parts per 1,000 when 66 per cent. of full complement are simultaneously accommodated, and 0·77 per cent. when 90 per cent. are sleeping.

4. That if such rooms are, in addition, provided with a hooded stove with a 6-inch flue, and if around this flue there is a second tube 12 inches in diameter, with a bell-shaped opening 8 feet from the ground, the amount of CO_2 in the air at the end of 8 hours, assuming the fire to be burning during that time, will be 0·64 per 1,000 when 66 per cent. of the boys are sleeping, and 0·74 per 1,000 when 90 per cent. are present.

5. That under these conditions the respiratory impurity at its worst is only slightly over de Chaumont's limit (0·6 per 1,000) and much under Haldane's limit (1·2 per 1,000), which latter is considered good enough for workers in English factories ; moreover, it is four times less than what is possible in common lodging-houses which meet modern bye-law requirements, and five times less than that, unfortunately, permitted in many elementary schoolrooms in winter.

6. That theoretically, therefore, the provision of air-change is reasonably sufficient if 200 cubic feet of air-space, together with inlet and outlet area and extraction by heat, be provided as above indicated.

7. That while the exact arrangement of the required inlet and outlet areas must be left to the Chamber's Engineers, the Committee recommend that, so far as possible, there be a difference in height of 10 feet between them ; that there be two 6-inch by 9-inch air-bricks just above floor-level in both back and front walls of each room ; that there be a louvre above the door and along the whole length of the roof ridge.

8. That there be opening windows of not less than one-tenth of the floor-space, of which at least one-half shall be in the northern wall of the room ; no window to be crossed by a bunk in such a way as to interfere with the access of light and air.

9. That the bunks be movable, and that there be a clear space of at least 1 foot between the wall and the nearest edge of any bunk.

10. That the floors be impervious.

11. That as our conclusions as to air-delivery and air-change are, to some extent, based upon theoretical considerations, which may, in some points, require the test of actual trial, it will be advisable to examine them in practical application, both in regard to the respiratory impurity which results and the necessity in cold weather for warming the incoming air.

12. That, although not within the strict limits of our reference, we strongly recommend that all clothing and bedding be removed from the sleeping-rooms and exposed to the fresh air for at least one hour per day, weather permitting.

The calculations and other considerations on which our conclusions are based are fully set forth in the appendix hereto.

(Signed) FRANCIS NAPIER, *President.*
W. T. F. DAVIES,
KENDAL FRANKS,
R. P. MACKENZIE,
CHAS. PORTER,
W. C. C. PAKES,
Signatories.
H. TEMPLE MURSELL, *Hon. Secretary.*

June 22nd, 1904.

APPENDIX TO REPORT ON THE VENTILATION OF CHINESE COMPOUNDS.

The provision of a *certain cubic space per person* affords no reliable guarantee of reasonably sufficient ventilation, and as the result of a recent official enquiry by Dr. Haldane, he asserts that the most highly vitiated air was met with in rooms with an air-space of about 10,000 cubic feet per person, but in which the provision for air-change was quite insufficient.

What is required is *adequate air-change*, and the best objective criterion of its sufficiency is the proportion of CO_2 in the air.

Unrespired Air contains about 0·4 parts CO_2 per 1,000 volumes.

PERMISSIBLE LIMIT OF RESPIRATORY IMPURITY :—

(*a*) *de Chaumont's* :—

0·4 parts + 0·2 parts = 0·6 parts of CO_2 per 1,000 of air.

(*b*) *Haldane's* :—

1. 0·4 parts + 0·8 parts = 1·2 parts of CO_2 per 1,000 of air.
2. That not more than two volumes of oxygen should be required for oxidation per million volumes of air.
3. That micro-organisms should not exceed 560 per cubic foot.

The Common Lodging-house Bye-laws of London make it compulsory that every such house provide 450 cubic feet for every occupant when the room is used both night and day. There shall be a proper window space, which shall be opened for an hour in the forenoon and for an hour in the afternoon, and the room shall have a fireplace.

With windows and doors shut it may be assumed that the air in the room will be changed every *two* hours, *i.e.*, four times in eight hours. The total supply, therefore, will amount to $\frac{450 \times 5}{8}$ cubic feet per hour, namely, 281 cubic feet per hour per person.

Taking the CO_2 given off per hour as 0·72 cubic feet per adult male, the " respiratory impurity " at the end of eight hours will be 2·3 per 1,000, and the " total amount of CO_2 in the air " will be 2·7 per 1,000.

For elementary schools in England, the Education Department requires 10 square feet of floor-space and 120 cubic feet of air-space per head, without further stipulation as to ventilation. Many schoolrooms are without fireplace or special openings for ventilation, and, therefore, in cold weather, when the windows are shut, the air will probably not be changed oftener than once in two hours. Under these conditions, the limit of respiratory impurity is very rapidly reached, and, at the end of the first, second, and third hours respectively, the total amount of CO_2 present will be 2·6, 4·0, and 5·0 parts per 1,000, assuming that each child exhales 0·4 cubic feet of CO_2 per hour.

In the proposed compound rooms for the Chinese, if $\frac{1}{4}$ square foot of inlet (and the corresponding amount of outlet) is allowed per person occupying the room, we shall have the following approximate factors :—In a room for 20 Chinese there will be an inlet space of *five* square feet ; the height of the outlet (*i.e.*, the ridge ventilator)

Appendix A. above the inlet will be more than *ten* feet, and, with 20 boys in a room, the temperature of the room air will, within an hour, probably be 10° Fah. above that of the external air. Taking these facts, the velocity of the incoming air in feet per second will be—

$$V. = \sqrt{2\,g\,h}$$

or, $\sqrt{2\,g \times x\,(t_1 - t_2) \times a}$, feet per second.

Where

g : acceleration of gravity, taken as 32.
x : difference in height between inlet and outlet.
t_1 : temperature of air inside room.
t_2 : temperature of air outside room.
a : co-efficient of expansion of the air outside, assumed at 61° Fah. $= \frac{1}{491 + 29} = \frac{1}{520}$

This gives the following :—

$$: \sqrt{2 \times 32 \times 10 \times 10 \times \frac{1}{520}}$$

$$: \sqrt{\frac{6400}{520}}$$

$$: \sqrt{12{\cdot}30}$$

or, V. = 3·5 feet per second.

The inlet space being 5 square feet, $5 \times 3{\cdot}5$ cubic feet will be entering the room per second, a quantity equal to 17·5 cubic feet, or 63,000 cubic feet per hour.

Allowing a co-efficient of friction of one-third, this volume will be reduced to 42,000 cubic feet per hour, and, reducing this for height above sea-level, the amount will be 33,600 cubic feet per hour.

Starting with a cubic space of 4,000 cubic feet and 33,600 cubic feet entering in the hour, we get a total amount of CO2 at the end of the hour of 0.7 per 1,000 volumes of air.

After the first hour, the total amount of CO2 will average 0.8 per 1,000.

In addition to the natural ventilation, many of the rooms are to be provided with hooded stoves. These stoves will have a pipe of at least 6 inches diameter, and the difference in temperature between the air passing up the tube and the external air will be at least 50° F. The difference in height between the inlet and outlet will be about 9 feet (say 8 feet).

The velocity, therefore, will be :—

$$V. = \sqrt{2\,g\,x\,(t_1 - t_2)\,a}$$

$$: \sqrt{2g \times 8\,(50)\,\frac{1}{520}}$$

$$: \sqrt{2 \times 32 \times 8\,(50)\,\frac{1}{520}}$$

or, 7·0 feet per second.

The area of a 6-inch tube being 28·27 square inches, the quantity of air entering per second is 1·37 cubic feet or 4,932 feet per hour, or, allowing for friction (one-third), and difference of sea-level (one-fifth), 2,370 cubic feet per hour.

As this is ventilation practically on the ground level, it is not proposed to count this in the actual ventilation of the room, but it is mentioned to show that this will make the room comparable with sleeping accommodation of the Common Lodging-houses in England, which must be provided with a fireplace, which is sometimes used and sometimes not.

If, however, there is a second tube outside the flue with a diameter of 1 foot, with a bell-shaped opening 8 feet from the ground, there will be " mechanically assisted " ventilation which will give an additional supply.

The area of the outlet will be the difference between the area of tubes of 12 inches and 6 inches diameter, respectively, viz., about 0·52 square foot.* Air escaping per second is, therefore, $7 \times 0{\cdot}52 - 3{\cdot}64$ cubic feet per second, or 13,104 cubic feet per hour.

In this case loss by friction is taken as equal to 50 per cent., because the air is retarded not only by the inner surface of the outer tube, but by the outer surface of the inner tube or flue. Allowing as before for difference of sea-level, the air escaping will, therefore, be 3,931 cubic feet or, say, 4,000 cubic feet per hour.

We consider this 4,000 cubic feet per hour, which has been calculated on a theoretical formula, a very low figure, as Haldane has shown, experimentally, that a bright fire increased the ventilation of a room of 1,390 cubic feet as much as ten times, and, for this reason, we have thought it safe to tentatively disregard the effect of the amount of oxygen consumed and CO2 produced by the fire.

* (? 0·59).

When a fire is alight, there will, therefore, be 33,600 + 4,000 = 37,600 cubic feet entering per hour into each room of 4,000 feet capacity which is constructed to accommodate 20 Chinese, and which, in practice, will during five-sevenths of the week contain only 66 per cent. of that number and for two-sevenths of the week 90 per cent.

Calculated on these data, the amount of CO_2 per 1,000 volumes of air in the room at the end of eight hours is shown as follows :—

de Chaumont limit.	Haldane limit.	No Fire.		Fire Burning.		English Common Lodging-house.	Elementary School-rooms in cold weather.
		66 % boys.	90 % boys.	66 % boys.	90 % boys.		
0·6	1·2	0·67	0·77	0·64	0·74	3·3 (Average for 8 hrs. = 2·7.)	2·6 at end of 1 hour; 4·0 at end of 2 hours; 5·0 at end of 3 hours (Average for 3 hours 3 8)

The ventilation proposed for the Chinese Compound is, therefore, at its worst, more than four times as good as in English Common Lodging-houses, and five times better than in many elementary schoolrooms in winter.

In view, however, of the fact that these conclusions are based upon theoretical formula and data, which, in some instances, cannot be defined at present with accuracy, it will be advisable to test them in practical application, both in regard to the actual respiratory impurity which results and the necessity in cold weather for warming the incoming air.

For the purpose of the calculations as to air-delivery which this enquiry has involved, it has been necessary to assume some average difference of temperature inside and outside compound sleeping-rooms.

From consideration of the maximum and minimum night temperature for the summer and for the winter months, and of the results of hourly observations made on the night of the 13th–14th June inside and outside compound sleeping-rooms in which the proposed conditions for Chinese were constituted, it has been thought safe to accept 10° Fah. as a fair expression of this difference, except on very warm nights, when it is reasonable to suppose that the doors and windows of these rooms will be kept freely open.

Actual measurement was also made, by the courtesy of the Engineer of the Jumpers Deep, of the temperature of the hot air escaping through a 6-inch flue over a fire in a sleeping-room. At the rim of the hood of the chimney it was 260° Fah., whilst both at 8 feet from the floor and 8 feet from the top of the chimney it was 143° Fah., the actual measured amount of air escaping per hour being about 7,350 cubic feet.

It is, therefore, thought that it is reasonable to assume that if there were a second tube of 12 inches diameter surrounding the 6-inch flue, and provided with a bell-shaped opening 8 feet from the ground, the temperature of the air in this second tube would be 50° Fah. higher than the external air.

Appendix B.

APPENDIX B.

Original Certificates of Analysis, as forwarded to the Ventilation Sub-Committee of the Chamber of Mines by the Analytical Committee.

INDEX.

(1.)

Johannesburg, 2nd September, 1904.

J. Harry Johns, Esq.,
Chairman, Ventilation Sub-Committee,
Transvaal Chamber of Mines,
Johannesburg.

SIR,

Enclosed please find results of analyses of twenty-one samples of air taken at the two experimental huts of the Village Deep Compound during the night of the 29th August, 1904, together with our comments thereon.

As will be seen from the table, the samples were taken in triplicate and almost simultaneously, followed immediately by an outside air sample, and then by a similar triplicate sample in the second hut. This set of seven samples was repeated at 1 a.m. and 3 a.m., respectively.

Place "A" (in the last column of table) was on a level of upper left-hand tier of bunks, 1 foot from the edge and about 2 feet further in than the central line of the room.

Place "B" was the corresponding spot on the right side. Place "C" was half-way between the closed door and the stove.

Since the proportions of CO_2 in these simultaneous samples do not agree (and experimental error is excluded), we conclude that the CO_2 is very unevenly distributed in the room, and that, therefore, the ventilation is local, *i.e.*, the fresh air does not mix properly with the vitiated air. The weather during the whole night was unfavourable to ventilation, the air being close and warm.

Before conducting the analyses, the analysts decided that the most satisfactory check on the accuracy of the method and results would be obtained if they all worked in each others' presence, each undertaking independently a separate stage of the process, and each recalculating the figures of the others. This was done, and, in addition, every precaution was taken to make the apparatus reliable and to verify the strength of the solutions used.

We have the honour to be,
Sir,
Your obedient servants,

B. BAY, Ph.D., M.A.,
EDW. H. CROGHAN,
JAMES MOIR,
Samplers.

Prof. AUG. PRISTER,
B. BAY, Ph.D., M.A.
A. HEYMANN, M.Ch. & Ph., M.A.
JAMES MOIR, D.Sc. M.A., F.C.S.
Analysts.

TABLE OF RESULTS.—ACCOMPANYING REPORT, DATED 29TH AUGUST, 1904, OF AIR TAKEN AT VILLAGE DEEP COMPOUND.

Number of Sample.	Free Cubic Space (not Counting the Louvre).	Time of Sampling.	Average Number of Persons in Room.	Condition of Fire.	Number of Candles and Lamps.	Velocity of Air at Air-bricks.	Velocity of Air in Outer Flue.	Temperature.	Barometer Millimetres.	Temperature in Top Louvre.	Carbonic Acid in Parts per 1,000 Volumes.	Remarks.
1	7,660	11 p.m.	30	Very bright	1 candle, 1 lamp	110′ per minute at back 65′ at front 35′ at door (leakage).	460′ per minute	22° C.	626	16° C.	1·72	Outside Temperature 14° C. Sample in "A."
2	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	0·85	Sample in "B."
3	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	1·94	Sample in "C."
19	Outside	,,	—	—	—	—	—	14° C.	,,	—	0·28	20′ out.
4	7,970	11.15 p.m.	36	Glowing	1 candle	—	—	21° C.	,,	16° C.	0·99	Sample in "A."
5	,,	,,	,,	,,	,,	—	—	,,	,,	,,	0·62	Sample in "B."
6	,,	,,	,,	,,	,,	—	—	,,	,,	,,	0·63	Sample in "C."
7	7,660	1 a.m.	32	Smouldering	,,	—	—	18° C.	,,	18° C.	0·74	Sample in "A."
8	,,	,,	,,	,,	,,	—	—	,,	,,	,,	0·71	Sample in "B."
9	,,	,,	,,	,,	,,	—	—	,,	,,	,,	0·68	Sample in "C."
20	Outside	,,	—	—	—	—	—	14° C.	,,	—	0·55	20′ out (in lee of huts).
10	7,970	1.15 a.m.	35	Very bright	1 candle	—	—	22° C.	,,	16° C.	Sample broken	Sample in "A."
11	,,	,,	,,	,,	,,	—	—	,,	,,	,,	0·97	Sample in "B."
12	,,	,,	,,	,,	,,	—	—	,,	,,	,,	0·48	Sample in "C."
13	7,660	3 a.m.	30	Glowing	,,	—	—	18° C.	,,	—	2·14	Sample in "A."
14	,,	,,	,,	,,	,,	—	—	,,	,,	—	1·44	Sample in "B."
15	,,	,,	,,	,,	,,	—	—	,,	,,	—	0·97	Sample in "C."
21	Outside	—	—	—	—	—	—	13° C.	,,	—	0·62	20′ out (in lee of huts).
16	7,970	3.15 a.m.	30	Smouldering	1 candle	—	—	17° C.	,,	—	0·70	Sample in "A."
17	,,	,,	,,	,,	,,	—	—	,,	,,	—	1·11	Sample in "B."
18	,,	,,	,,	,,	,,	—	—	,,	,,	—	0·77	Sample in "C."

Appendix B.

(2.)

Johannesburg, 9th September, 1904.

J. Harry Johns, Esq.,

Chairman, Ventilation Sub-Committee,
Transvaal Chamber of Mines,
Johannesburg.

SIR,

Please find herewith results of analyses of nine samples of air taken at the New Comet Chinese Compound (Room 70) during the night of the 31st August, 1904, together with our comments thereon.

The samples were taken in duplicate and almost simultaneously, followed immediately by an outside air sample.

The analyses were conducted by all four analysts under the same conditions as the previous samples.

We have the honour to be,
Sir,
Your obedient servants,

B. BAY, Ph.D., M.A.,
EDW. H. CROGHAN.

Prof. AUG. PRISTER,
B. BAY, Ph.D., M.A.,
A. HEYMANN, M.Ch., M.Ph., M.A.,
JAMES MOIR, D.Sc., M.A., F.C.S.

RESULT OF ANALYSES.—NEW COMET CHINESE COMPOUND.

Number of Sample.	Time Taken.	Average Number of Persons in Room.	Number of Candles and Lamps.	Velocity of Air near Shutter.	Temperature.	Barometer Reading in Millimetres.	Carbonic acid in parts per 1,000 by Volume.	Place of Sampling
1	11 p.m.	16	2 candles	110 feet	18° C.	632	0·71	A.
2	,,	,,	,,	,,	,,	,,	0·76	B.
3	1 a.m.	,,	2 candles & 1 Lamp	..	14° C.	,,	0·70	A.
4	,,	,,	,,	..	,,	,,	0.78	B.
5	3 a.m.	15	1 candle & 1 Lamp	..	,,	,,	0·48	A.
6	,,	,,	,,	..	,,	,,	0·76	B.
			OUTSIDE SAMPLES.					
7	11 p.m.	..	..	..	14° C.	632	0·37	..
8	1 a.m.	..	..	..	12° C.	,,	0·34	..
9	3 a.m.	..	..	..	11° C.	,,	0·32	..

REMARKS.—The fire was out when samples 1–6 were taken. Cubic space of room was 4,255 cubic feet. Weather conditions: a fair breeze was blowing all through the night.

(3.) **Appendix B.**

Johannesburg, 9th September, 1904.

J. Harry Johns, Esq.,

Chairman, Ventilation Sub-Committee,
Transvaal Chamber of Mines,
Johannesburg.

SIR,

Herewith please find results of analyses of fifteen samples of air taken at the Village Deep two Experimental Huts on the night of the 2nd September, 1904.

The conditions of sampling and analyses were the same as those previously reported.

We have the honour to be,
Sir,
Your obedient Servants,

B. BAY, Ph.D., M.A.,
EDW. H. CROGHAN,
Samplers.

Prof. AUG. PRISTER,
B. BAY, Ph.D., M.A.,
A. HEYMANN, M.Ch., M.Ph., M.A.,
JAMES MOIR, D.Sc., M.A., etc.
Analysts.

Enclosure.

RESULTS OF ANALYSES.—VILLAGE DEEP EXPERIMENTAL HUTS.

66 PER CENT.* OF BOYS.

Number of Sample.	Time Taken.	Average Number of Persons in Room.	Condition of Fire.	Velocity of Air and Weather Conditions.	Temperature.	Barometric Pressure in Millimetres.	Carbonic acid in Parts per 1,000 by Volume.	Place of Sampling
1	11.30 p.m.	30	Glowing.	..	21° C.	626	0·44	A.
2	,,	,,	,,	..	,,	,,	0·43	B.
3	1 a.m.	,,	,,	..	20° C.	,,	0·36	A.
4	,,	,,	,,	..	,,	,,	0·38	B.
5	3 a.m.	,,	Smouldering	..	19° C.	,,	0·52	A.
6	,,	,,	,,	..	,,	,,	0·71	B.

90 PER CENT.* OF BOYS.

7	11 p.m.	40	Smouldering	..	19° C.	626	0·43	A.
8	,,	,,	,,	..	,,	,,	0·47	B.
9	1 a.m.	,,	,,	..	17° C.	,,	1·50	A.
10	,,	,,	,,	..	,,	,,	0·73	B.
11	3 a.m.	,,	,,	..	,,	,,	1·28	A.
12	,,	,,	,,	..	,,	,,	1·07	B.

OUTSIDE AIR.

13	11.45 p.m.	..	..	300′ per min. N.N.W.	18° C.	626	0·32	..
14	1 a.m.	..	..	255′ per min. variable N.N.W.	16° C.	,,	0·34	..
15	3 a.m.	..	..	Slight breeze	,,	,,	0·34	..

* These figures in this and the subsequent analyses are only approximate. 100% corresponds to about 41 boys, and the accurate percentages are given in Appendix C. 1.

Appendix B. **(4.)**

Johannesburg, 9th September, 1904.

J. Harry Johns, Esq.,

Chairman, Ventilation Sub-Committee,
Transvaal Chamber of Mines,
Johannesburg.

SIR,

Herewith please find results of analyses of 18 samples of air taken on the night of the 6th September, 1904, at the Village Deep Compound. The samples were taken in three different rooms, two experimental rooms and one as previously built of brick (Rand Mines type).

The conditions of sample-taking and analyses as before.

We have the honour to be,
Sir,
Your obedient servants,

Prof. AUG. PRISTER,
B. BAY, Ph.D., M.A.,
A. HEYMANN, M.Ch., M.Ph., M.A.,
JAMES MOIR, D.Sc., M.A., etc.
Analysts.

B. BAY, Ph.D., M.A.,
EDW. H. CROGHAN,
Samplers.

Enclosure.

RESULTS OF ANALYSES.—VILLAGE DEEP, LTD.—6th September, 1904.

EXPERIMENTAL HUTS.

Number of Sample.	Time Taken.	Average Number of Persons in Room.	Condition of Fire.	Velocity of Air and Weather Conditions.	Temperature.	Barometric Pressure in Millimetres.	Carbonic Acid in parts per 1,000 by Volume.	Place of Sampling
1	11 p.m.	33	Very bright	540′ in chimney 310′ in room at ventilator	17° C.	629	1·22	A.
2	,,	,,	,,	,,	,,	,,	0·82	B.
3	1 a.m.	,,	Bright	..	12° C.	,,	0·35	A.
4	,,	,,	,,	..	,,	,,	0·54	B.
5	3 a.m.	,,	Glowing	..	11° C.	,,	0·38	A.
6	,,	,,	,,	..	,,	,,	0·44	B.
7	11 p.m.	37	Glowing	400′ in chimney 370′ in room at ventilator	17° C.	629	0·45	A.
8	,,	,,	,,	,,	,,	,,	0·35	B.
9	1 a.m.	,,	Out	..	13° C.	,,	0·34	A.
10	,,	,,	,,	..	,,	,,	1·05	B.
11	3 a.m.	,,	Burning	..	14° C.	,,	0·34	A.
12	,,	,,	,,	..	,,	,,	0·70	B.

ROOM BUILT BY MINE.

13	11 p.m.	38	Bright	540′ per min. at the ventilator	13° C.	629	0·37	A.
14	1 a.m.	,,	Very bright	..	15° C.	,,	0·57	A.
15	3 a.m.	,,	Glowing	..	11° C.	,,	0·73	A.

OUTSIDE.

16	11 p.m.	..	..	700′	10° C.	629	0·34	..
17	1 a.m.	..	..	Fair breeze	9° C.	,,	0·32	..
18	3 a.m.	..	..	,,	,,	,,	0·31	..

(5.) **Appendix B.**

Johannesburg, 12th September, 1904.

J. Harry Johns, Esq.,

Chairman, Ventilation Sub-Committee,

Transvaal Chamber of Mines,

Johanensburg.

SIR,

Herewith please find results of analyses of samples of air taken on the night of the 8th September, 1904, at the Village Deep Compound "C" Room, as built by the Mine.

The taking of samples and analyses were carried out in a similar manner to those previously reported.

We have the honour to be,

Sir,

Your obedient servants,

Prof. AUG. PRISTER,
B. BAY, Ph.D., M.A.,
A. HEYMANN, M.Ch. & Ph., M.A.,
JAMES MOIR, D.Sc., etc.
Analysts.

B. BAY, Ph.D., M.A.
EDW. H. CROGHAN,
Samplers.

Number of Sample.	Time Taken.	Number of Persons Present in Room.	Condition of Fire.	Temperature in degrees C.	Barometric Pressure in Millimetres.	Carbonic acid in parts per 1,000 by Volume.	Place of Sampling	Remarks.
2	11 p.m.	34	Glowing	14	623	0·37	A.	
3	,,	,,	,,	,,	,,	0·64	B.	
4	1 a.m.	,,	,,	13	,,	0·57	A.	1 candle burning.
5	,,	,,	,,	,,	,,	0·48	B.	90 per cent. boys.
6	3 a.m.	,,	,,	,,	,,	0·50	A.	
7	,,	,,	,,	,,	,,	0·50	B.	
9	11 p.m.	..	..	10	,,	0·34	..	Outside samples.
10	1 a.m.	..	..	,,	,,	0·30	..	Strong wind blowing during the night.
11	3 a.m.	..	..	,,	,,	0·20	..	

Appendix B. **(6)**

Johannesburg, 16th September, 1904.

J. Harry Johns, Esq.,
Chairman, Ventilation Sub-Committee,
Transvaal Chamber of Mines,
Johannesburg.

SIR,

Herewith please find results of twenty-one analyses of samples of air taken on the night of the 12th September, 1904, at the Village Deep, Limited, in two experimental huts and one room as built by the mine.

The taking of samples and the analyses were carried out in a similar manner to those previously reported.

We have the honour to be,
Sir,
Your obedient servants,

B. BAY, Ph.D., M.A.,
EDW. H. CROGHAN,
Samplers.

Prof. AUG. PRISTER,
B. BAY, Ph.D., M.A.,
A. HEYMANN, M.A., M.Ch. & Ph.,
JAMES MOIR, D.Sc., etc.
Analysts.

EXPERIMENTAL HUT, WITH 66 PER CENT. OF BOYS.

Number of Sample.	Time Taken.	Number of Persons in Room.	Condition of Fire.	Number of Candles and Lamps.	Velocity of Air.	Temperature in degrees C.	Barometric pressure in m.ms.	Carbonic Acid in parts per 1000 by volume.	Place of Sampling
1	11 p.m.	36	Glowing	1 Lamp	104′ at ventilator 140′ in chimney	13	630	0·70	A.
2	,,	,,	,,	,,	,,	,,	,,	0·47	C.
3	1 a.m.	30	,,	,,	,,	12	,,	0·47	A.
4	,,	,,	,,	,,	,,	,,	,,	0·48	C.
5	3 a.m.	,,	,,	1 candle	,,	11	,,	0·79	A.
6	,,	,,	,,	,,	,,	,,	,,	0·61	C.

EXPERIMENTAL HUT, WITH 90 PER CENT. OF BOYS.

7	11 p.m.	35	Glowing	1 candle and 1 lamp	80′ at ventilator 290′ in chimney	13	630	0·43	A.
8	,,	,,	,,	,,	,,	,,	,,	0·50	C.
9	1 a.m.	32	Smouldering	1 lamp	,,	12	,,	0·71	A.
10	,,	,,	,,	,,	,,	,,	,,	0·68	C.
11	3 a.m	33	Out	1 candle	,,	11	,,	Sample broken.	A.
12	,,	,,	,,	,,	,,	,,	,,	0·47	C.

ROOM AS BUILT BY THE MINE.

13	11 p.m.	42	Glowing	1 lamp	125′ at ventilator 245′ in chimney	12	630	0·37	A.
14	,,	,,	,,	,,	,,	,,	,,	0·37	B.
15	1 a.m.	45	,,	,,	,,	13	,,	0·46	A.
16	,,	,,	,,	,,	,,	,,	,,	0·53	B.
17	3 a.m.	44	,,	1 candle	,,	10	,,	0·41	A.
18	,,	,,	,,	,,	,,	,,	,,	0·81	B.

OUTSIDE AIR. WEATHER: SLIGHT BREEZE.

19	11 p.m.	..	..	..	103′	8°	630	0·31	..
20	1 a.m.	..	..	..	120′	6°	,,	0·30	..
21	3 a.m.	..	..	..	120′	6°	,,	0·30	..

(7.) **Appendix B.**

Johannesburg, 16th September, 1904.

J. Harry Johns, Esq.,
Chairman, Ventilation Sub-Committee,
Transvaal Chamber of Mines,
Johannesburg.

SIR,

Herewith please find results of twenty-one analyses of samples of air taken on the night of the 14th September, 1904, in three Rand Mines huts at the Glen Deep, Limited.

The taking of samples and the analyses were carried out in a similar manner to those previously reported.

We have the honour to be
Sir,
Your obedient servants,

B. BAY, Ph.D., M.A.,
EDW. H. CROGHAN,
Samplers.

Prof. AUG. PRISTER,
B. BAY, Ph.D., M.A.,
A. HEYMANN, M.A., M.Ch. & Ph.,
JAMES MOIR, D.Sc., etc.,
Analysts.

---

66 PER CENT. OF BOYS.

No. of Sample.	Time Taken.	No. of Persons in Room.	Condition of Fire.	No. of Candles and Lamps.	Velocity of Air.	Temperature in degrees C.	Barometric pressure in mms.	Carbonic Acid in parts per 1,000 by volume.	Place of Sampling.
1	11 p.m.	30	Out	1 candle and 1 lamp	405′ at ventilator, 160′ in chimney	15	630	Sample broken	A.
2	,,	,,	,,	,,	,,	,,	,,	0·56	C.
3	1 a.m.	28	,,	,,	..	13	,,	0·61	A.
4	,,	,,	,,	,,	..	,,	,,	0·58	C.
5	3 a.m.	,,	,,	1 candle	..	,,	,,	0·71	A.
6	,,	,,	,,	,,	..	,,	,,	0·56	C.

90 PER CENT. OF BOYS.

7	11 p.m.	39	Glowing	1 candle and 1 lamp	360′ at ventilator, 370′ in chimney	18	630	0·53	A.
8	,,	,,	,,	,,	,,	,,	,,	0·57	C.
9	1 a.m.	,,	,,	1 candle	..	16	,,	0·71	A.
10	,,	,,	,,	,,	..	,,	,,	0·57	C.
11	3 a.m.	,,	,,	,,	..	15	,,	0·50	A.
12	,,	,,	,,	,,	..	,,	,,	Sample broken	C.

100 PER CENT. OF BOYS.

13	11 p.m.	43	Smouldering	1 candle	460′ at ventilator 260′ in chimney	17	630	0·55	A.
14	,,	,,	,,	,,	,,	,,	,,	0·55	C.
15	1 a.m.	,,	Out	1 candle and 1 lamp	..	15	,,	0·74	A.
16	,,	,,	,,	,,	..	,,	,,	0·55	C.
17	3 a.m.	,,	,,	,,	..	14	,,	0·44	A.
18	,,	,,	,,	,,	..	,,	,,	0·56	C.

OUTSIDE SAMPLES. FAIR BREEZE BLOWING.

19	11 p.m.	..	..	..	380′	13	630	0·36	..
20	1 a.m.	..	..	..	..	12	,,	0·41	..
21	3 a.m.	..	..	..	..	,,	,,	0·36	..

NOTE.—The cubic space of each room is 8,125 cubic feet.

Appendix B.

(8.)

Johannesburg, 17th September, 1904

J. Harry Johns, Esq.,

Chairman, Ventilation Sub-Committee,
Transvaal Chamber of Mines,
Johannesburg

SIR,

Herewith please find results of fifteen analyses of samples of air taken on the night of the 16th September, 1904, in two rooms as built by the mine, *with no fires*, at the compound of the Village Deep, Limited

The taking of the samples and the analyses were carried out in a similar manner to those previously reported.

We have the honour to be,

Sir,

Your obedient servants,

A. HEYMANN, M.A., M.Ch. & Ph.
Prof. AUG. PRISTER,

B. BAY, Ph.D., M.A.,
EDW. H. CROGHAN,
Samplers.

B. BAY, Ph.D., M.A.,
JAMES MOIR, D.Sc., etc.,
Analysts.

---

90 PER CENT. OF BOYS.

No. of Sample.	Time Taken.	No. of Persons in Room.	No. of Candles.	Velocity of Air.	Temperature in degrees. C.	Barometric pressure in millimetres.	Carbonic Acid in parts per 1000 by volume.	Place of Sampling
1	11 p.m.	35	2	400′ at ventilator, 240′ at chimney	14	631	0·57	A.
2	,,	,,	,,	,,	,,	,,	0·42	C.
3	1 a.m.	,,	1	..	13	,,	0·68	A.
4	,,	,,	,,	..	,,	,,	0·69	C.
5	3 a.m.	,,	,,	..	11	,,	0·64	A.
6	,,	,,	,,	..	,,	,,	0·40	C.

66 PER CENT. OF BOYS.

7	11 p.m.	30	1	420′ at ventilator, 380′ in chimney	13	631	0·52	A.
8	,,	,,	,,	,,	,,	,,	0·50	C.
9	1 a.m.	31	,,	..	12	,,	0·50	A.
10	,,	,,	,,	..	,,	,,	0·50	C.
11	3 a.m.	30	,,	..	10	,,	0·54	A.
12	,,	,,	,,	..	,,	,,	0·40	C.

OUTSIDE AIR.

13	11 p.m.	..	..	580′	11°	63	0·36	..
14	1 a.m.	..	..	..	9°	,,	0·34	..
15	3 a.m.	..	..	..	8°	,,	0·39	..

APPENDIX C.

C. 1.—TABLE SHOWING AVERAGE RESULTS OF ANALYSIS FOR EACH NIGHT.

(BY THE SECRETARY.)

I.—EXPERIMENTAL HUTS.

Date.	Mine.	Percentage complement at 200 c. ft. per head.	Average outside Temperature in degrees—F.	Average inside Temperature in degrees—F.	Difference in degrees—F.	Average CO_2 per thousand in hut.	Average CO_2 outside.	Difference.	No. of Samples Taken.	Remarks.
29-8-04	Village Dp. (K)*	78	57	67	10	1·24	0·48 (in lee of buildings)	0·76	8	Temperature in louvre, 61° F.; bright fire; weather calm and warm.
,,	,,	85	57	68	11	0·78	0·48 (in lee of buildings)	0·30	9	Temperature in louvre, 61° F.; bright fire; weather calm and warm; end room of line.
31-8-04	New Comet (C)	73	54	60	6	0·70	0·34	0·36	6	No fire; fair breeze outside.
2-9-04	Village Dp. (K)	74	62	68	6	0·47	0·33	0·14	6	Slight northern breeze.
,,	,,	95	62	63	1	0·91	0·33	0·58	6	Fires bright; weather warm.
6-9-04	,,	82	49	56	7	0·62	0·32	0·30	6	Fire very bright; cold weather.
,,	,,	88	49	58	9	0·54	0·32	0·22	6	Fire poor; cold weather.
12-9-04	,,	75	44	54	10	0·59	0·30	0·29	6	Very bright fire; slight breeze.
,,	,,	78	44	54	10	0·56	0·30	0·26	5	Fire poor, finally out; slight breeze.
II.—SELECTED HUTS OF RAND MINES TYPE.										
6-9-04	Village Dp. (K)	90	49	55	6	0·56	0·32	0·24	3	Fire bright; cold weather.
8-9-04	,,	80	50	56	6	0·51	0·31	0·20	6	Fire very bright; strong wind.
12-9-04	,,	102	44	53	9	0·49	0·30	0·19	6	Fire very bright; slight breeze.
14-9-04	Glen Deep (C)	67	54	57	3	0·60	0·38	0·22	5	Fire out; fair breeze.
,,	,,	92	54	61	7	0·58	0·38	0·20	5	Fire very bright.
,,	,,	100	54	60	6	0·57	0·38	0·19	6	Fire poor, finally out; fair breeze.
16-9-04	Village Dp. (K)	83	49	55	6	0·57	0·36	0·21	6	No fire; strong wind.
,,	,,	72	49	53	4	0·49	0·36	0·13	6	No fire; strong wind.
III.—SUPPLEMENTARY TESTS DONE BEFORE THE APPOINTMENT OF THE COMMISSION (See C. 3).										
7-7-04	Glen Deep (K)	100	..	54	..	0·41	..	..	5	Slight breeze after midnight.
11-7-04	,,	100	..	58	..	0·80	..	..	6	Slight breeze after midnight.
20-7-04	,,	100	..	58	..	0·54	..	..	3	Slight breeze after midnight (old room).
,,	,,	100	..	57	..	0·47	..	..	3	Slight breeze after midnight (new room).

* K = Kaffir. C = Chinese.

NOTE A.—The first set of samples taken at the Village Deep in the Experimental Compounds gave results so much higher in carbon dioxide than could have been expected from the general conditions of the rooms that I was at a loss at first to explain them; however, careful examination proved that the louvre over the door and the position of the hood over the stove-pipe acted in such a manner as to cause short circuiting of the general ventilation. This, I think, is proved by the fact that two samples taken almost simultaneously in the same room varied from 0·97 to 2·14. In the subsequent set of samples this hood was lowered, so as not to exceed 5 feet above the ground, and the samples taken afterwards in the same room were considerably improved.

I am also of opinion that the gratings suggested to take the place of the louvres over the roof are a distinct disadvantage, as I more than once observed that they acted as an intake, thus only circulating the air in the upper part of the hut.

It will be noticed that the huts as built by the mines, in all cases, with and without fires, gave very satisfactory results.

JOHN R. WILLIAMS.

NOTE B.—We are of opinion, from careful inspection, that the various rooms examined are built in such a way as to cause no inconvenience from draughts and other conditions to the occupants; and, after personal observations, at practically all hours of the night, we have no hesitation in stating that, from a hygienic point of view, they are perfectly fit for habitation.

JOHN R. WILLIAMS.
B. BAY, Ph.D., M.A.
EDW. H. CROGHAN.
JAMES MOIR, D.Sc., etc.

Appendix C.

C. 2.—CLASSIFICATION OF ANALYSES ACCORDING TO PLACE OF SAMPLING AND TIME OF NIGHT.

(BY THE SECRETARY.)

(*a*) "EXPERIMENTAL" HUTS (58 Samples in 20 Sets).

Hour.	Place A.	Place B.	Place C.	Outside.
11	1.72	0.85	1.94	0.28
1	0.74	0.71	0.68	0.55 (?)
3	2.14	1.44	0.97	0.62 (?)
11	0.99	0.62	0.63	0.28
1	..	0.97	0.48	0.55 (?)
3	0.70	1.11	0.77	0.62 (?)
11	0.71	0.76	..	0.37
1	0.70	0.78	..	0.34
3	0.48	0.76	..	0.32
11	0.44	0.43	..	0.32
1	0.36	0.38	..	0.34
3	0.52	0.71	..	0.34
11	0.42	0.47	..	0.32
1	1.50	0.73	..	0.34
3	1.28	1.07	..	0.34
11	1.22	0.82	..	0.34
1	0.35	0.54	..	0.32
3	0.38	0.44	..	0.31
11	0.45	0.35	..	0.34
1	0.34	1.05	..	0.32
3	0.34	0.70	..	0.31
11	0.70	..	0.47	0.31
1	0.47	..	0.48	0.30
3	0.79	..	0.61	0.30
11	0.43	..	0.50	0.31
1	0.71	..	0.68	0.30
3	..	..	0.47	0.30

AVERAGES IN "EXPERIMENTAL" HUTS.

Place.	Time.		
	11 p.m.	1 a.m.	3 a.m.
A.	0.79	0.65	0.82
B.	0.61	0.74	0.89
C.	0.88	0.58	0.71

Appendix C.

(*b*) "Rand Mines" Huts (43 Samples in 15 Sets).

Hour.	Place A.	Place B.	Place C.	Outside.
11	0.37	..	..	0.34
1	0.57	..	..	0.32
3	0.73	..	..	0.31
11	0.37	0.64	..	0.34
1	0.57	0.48	..	0.30
3	0.50	0.50	..	0.30
11	0.37	0.37	..	0.31
1	0.46	0.53	..	0.30
3	0.41	0.81	..	0.30
11	..	..	0.56	0.36
1	0.61	..	0.58	0.41
3	0.71	..	0.56	0.36
11	0.53	..	0.57	0.36
1	0.71	..	0.57	0.41
3	0.50	..	..	0.36
11	0.55	..	0.55	0.36
1	0.74	..	0.55	0.41
3	0.44	..	0.56	0.36
11	0.57	..	0.42	0.36
1	0.68	..	0.69	0.34
3	0.64	..	0.40	0.39
11	0.52	..	0.50	0.36
1	0.50	..	0.50	0.34
3	0.54	..	0.40	0.39

Averages in "Rand Mines" Huts.

Place.	Time.		
	11 p.m.	1 a.m.	3 a.m.
A.	0.47	0.60	0.56
B.	0.50	0.50	0.65
C.	0.52	0.58	0.48

Average of Outside Air (Omitting the Two Incorrect Samples).

At 11 p.m. = ·335 At 1 a.m. = ·336 At 3 a.m. = ·331

General Averages of "Rand Mines" Type Results.

At 11 p.m. .. .. .. 14 samples of average 0·49 per 1,000
At 1 a.m. .. .. .. 15 ,, ,, ,, 0·58 ,,
At 3 a.m. .. .. .. 14 ,, ,, ,, 0·55 ,,

Appendix C. C 3.—ORIGINALS OF TESTS DONE BEFORE THE APPOINTMENT OF THE COMMISSION.

COPY.]

H. ECKSTEIN & Co.,
P.O. Box 149.

Assay Offices and Laboratory,
Marshall Street West (Extreme End),
Johannesburg, 7th July, 1904.

CERTIFICATE OF ANALYSIS.

This is to certify that the following are the results of analyses of five samples of gases, marked No. 3,842, taken at 9 p.m., 11 p.m., and 1, 3, and 5 a.m. on the night of the 6th July, 1904, at the Glen Deep, Limited.

Conditions :—The samples were taken at the Compound while 21 Kaffirs were sleeping in the room.

We have analysed the five samples by three different methods in order to have a check, and the results obtained are as follows :—

Time.	Temperature in Degrees—C.	Carbon Dioxide.	Oxygen.
		Per cent.	Per cent.
9 p.m.	13·0	0·04	20·6
11 p.m.	13·0	0·04	20·6
1 a.m.	12·0	0·045	20·5–20·6
3 a.m.	11·5	0·045	20·5–20·6
5 a.m.	11·5	0·04	20·6

A. HEYMANN, M.Ch., M.Ph.,
B. BAY, Ph.D., M.A.,
Analytical Chemists.

To JOHN R. WILLIAMS, ESQ.,
Consulting Chemist & Metallurgist,
Johannesburg.

P.O. Box 3,697.

Johannesburg, 13th July, 1904.

Messrs. H. ECKSTEIN & Co.,
Johannesburg.

DEAR SIRS,

We beg to hand you herewith the results of analyses made of air taken in two different rooms of the Native Compound of the Glen Deep, Ltd., on the night of the 11th July, 1904.

The method adopted for the taking and analysing the samples was that of Pettenkofer's, viz. :—A "Winchester" bottle, well washed and dried, was filled by an air-pump and 30 c.c. of a solution of barium-hydrate of known strength introduced, the bottle being instantly well corked with an india-rubber stopper ; the whole of the bottles of samples being forwarded to the Laboratory on the morning of the 12th inst.

The temperature was taken at the moment of taking the samples.

The omission of the barometrical observation was made good by the information obtained from the Johannesburg Observatory, which notified that the pressure at 11–12 p.m. was 621·5 millimetres, on which pressure all the calculations are based.

The number of boys in each room when samples were taken was 21.

Appendix C.

ROOM ON RIGHT OF GATE.

Number of Sample.	Time.	Temperature in Degrees, C.	Volume.	Volume Reduced to Zero C. 760 m.m.	Total CO_2. c.c.	Volume CO_2. Percentage.
1	11 p.m.	17	2,740	2,060	2·317	0·112
3	1 a.m.	16	3,212	2,436	1·759	0·075
5	4 a.m.	12	2,932	2,258	1·693	0·075

ROOM ON LEFT OF GATE.

2	11 p.m.	15	2,747	2,077	1·825	0·087
4	1 a.m.	14	3,167	2,416	2·028	0·083
6	4 a.m.	12	2,682	2,065	1·962	0·095

NOTES ON THE ABOVE.

			Burning :	*Smoking :*
Sample No. 1 ..	Fire glowing ..	Smell : very little	2 candles ..	Some boys.
,, 3 ..	,, burning ..	,, hardly any ..	,, ..	One boy.
,, 5 ..	,, out	,, ,, ..	1 candle ..	None.
,, 2 ..	,, ,, ...	,, ,, ..	,, ..	,,
,, 4 ..	,, ,, ...	,, very little ..	,, ..	,,
,, 6 ..	,, ,, ...	,, hardly any ..	,, ..	,,

Conclusions :—Lane Notter and R. H. Firth, in their valuable book on "The Theory and Practice of Hygiene," give a classification of the air in closed rooms by considering only the percentage of carbonic acid existent in the air examined, as under :—

Air containing over 0·128 per cent. of CO_2 is "Bad;"

Air containing between 0·051 per cent. and 0·080 per cent. is "Fair;" and

Air containing between 0·035 per cent. and 0·051 per cent. is "Good."

From the foregoing analyses, we see that the air examined would be classed as "Fair." The big fire and the smoking in the room at the right of the gate evidently influenced the composition of the Sample No. 1.

It must be remembered that no barometrical observations were made when the samples were taken, and that all calculations were made on the reading recorded at the Observatory between 11 and 12 o'clock on the night of the 11th inst.

The samples were not taken by us, but we consider them as fair.

Yours faithfully,

PROF. AUG. PRISTER,
Technical Chemist.

B. BAY, Ph.D., M.A.

Appendix C. COPY.] Johannesburg, 20th July, 1904.

JOHN R. WILLIAMS, Esq.,
Consulting Chemist & Metallurgist,
Messrs. H. Eckstein & Co.,
Johannesburg.

DEAR SIR,

We beg to submit the following Report of Analyses of Air taken from two separate rooms in the Compound of the Glen Deep, Ltd., on Monday, the 18th July, 1904, between the hours of 10 p.m. and 4.30 a.m.

The first room, an old one, contained 21 boys.

The second room, newly built, contained 40 boys.

In both rooms the fires were out, hardly any smell was perceptible, the ventilators were open, and while the samples were being taken, one candle was burning and two whites and one native police boy were present.

The samples were collected at 10 p.m., 1 a.m., and 4 a.m.

FIRST ROOM.

Time.	Temperature in Degrees—C.	Barometer. m.ms.	Carbon Dioxide.
10 p.m.	16·5	623·0	0·056 per cent.
1 a.m.	14·5	623·0	0·059 ,,
4 a.m.	13·0	623·0	0·046 ,,

SECOND ROOM.

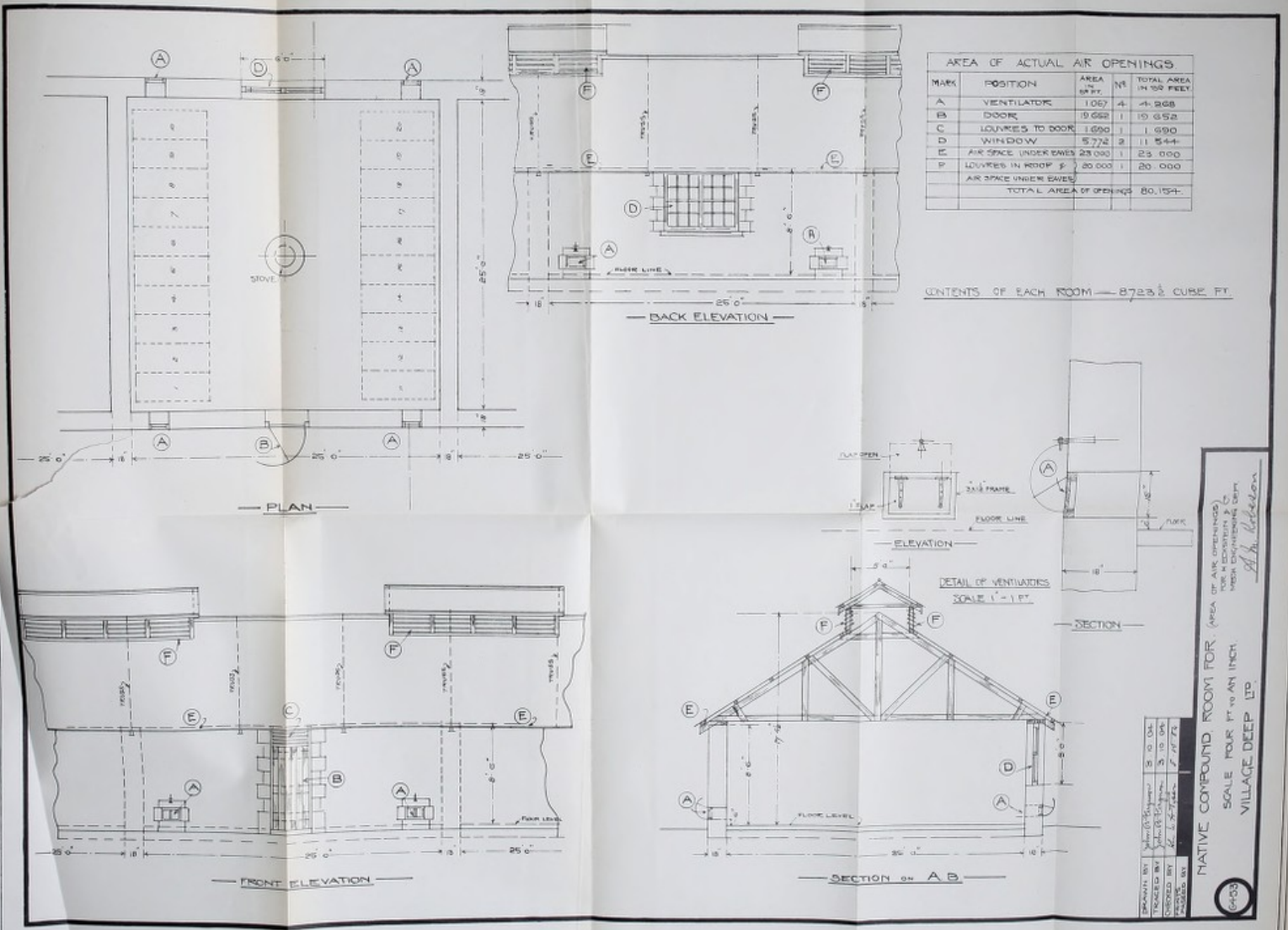
10 p.m.	14·5	623·0	0·038 per cent.
1 a.m.	11·5	623·0	0·054 ,,
4 a.m.	12·0	623·0	0·048 ,,

The night was fairly calm up to 1 a.m., when a slight breeze sprang up.

Yours faithfully,

B. BAY, Ph.D., M.A.
EDW. H. CROGHAN.

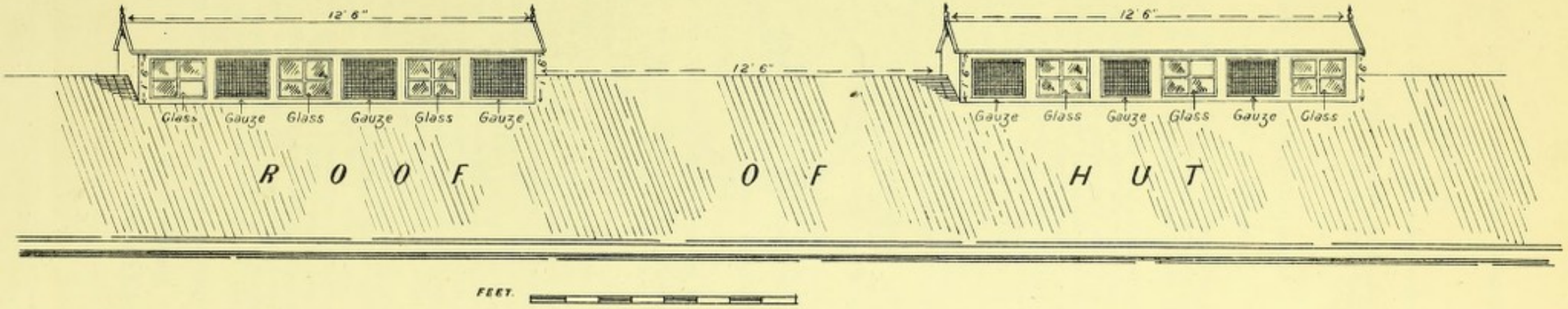
PLANS OF "RAND MINES" TYPE OF HUT SUBMITTED BY Mr J. R. WILLIAMS. · · · APPENDIX D.



APPENDIX E.

STRUCTURE OF "EXPERIMENTAL HUTS," PROPOSED BY THE TRANSVAAL MEDICAL SOCIETY.

These "Experimental Huts" are exactly the same as the "Rand Mines" type of hut, with the exception of the roof-ventilation, which consists, not of louvres, but of "lantern roof-ridge ventilators," as exhibited in the following rough sketch:—



The purpose of this form of ventilator is to combine outlet area with extra lighting area (of such a kind as not to admit the vertical sun).

It was expected that direct currents through the gauze to the further side would be prevented by having the alternation of gauze and glass different on the two sides of each hutch, *i.e.*, having glass *opposite* gauze (and *vice versâ*) along the hutches.

In practice, however, it was found that these direct currents occurred, and that the side of the hutch facing the wind acted as an inlet, and merely disturbed the "natural ventilation" of the hut. This was probably only due to the wire-gauze space being needlessly large.

APPENDIX F.

LETTER FROM DR. PORTER, M.O.H. FOR JOHANNESBURG.

Public Health Department,
Rooms 38 and 41, Municipal Buildings,
August 25th, 1904.

J. Moir, Esq., D.Sc.,

Secretary of Commission on Air-Space in Compounds.

DEAR SIR,—

STANDARDS OF VENTILATION.

I beg to draw your attention to Page 253 of the *British Medical Journal* of the 30th July, 1904 (No. 2,274), in which appears the report of a paper read by Dr. J. S. Haldane, F.R.S., at the recent Oxford Meeting of the British Medical Association on "Standards of Ventilation."

In this paper Dr. Haldane discussed the effects of breathing air containing (*a*) a high degree of carbonic acid gas; (*b*) a deficiency of oxygen; and (*c*) an increase in organic matter. He held that the real pathological effects of such conditions were slight, although much unpleasantness might be caused. The ill effects of atmospheric contamination were due in most cases, particularly in schools, to specific contamination, and even these conditions depended largely upon two factors, namely, temperature and air currents. *He then discussed the somewhat controversial question of standards of ventilation*, and *defended the standard of 12 parts CO2 per* 10,000 recently proposed by himself and Osburn as the best practicable and attainable standard under all conditions of labour and climate in factories and workshops.

Dr. Matthew Hay (Medical Officer of Health, Aberdeen, and Professor Public Health in University of Aberdeen) approved of the standards suggested by Dr. Haldane, as they were based on experimental work.

Dr. C. J. Thomas, B.Sc., D.P.H. (Assistant Medical Officer to London School Board), from investigations in schools, thought the pollution of air was due not to respiration but body pollution, and that bad smells did not arise until CO_2 had arisen above 10 parts per 10,000.

Dr. Symons, F.I.C., D.P.H. (Medical Officer of Health for Bath), thought there was some justification for the standard recommended by the Incorporated Society of Medical Officers of Health (9 parts per 10,000), as sanitation was advanced, not by experiment only, but by practical experience.

Dr. Groves (Medical Officer of Health for Isle of Wight and President of Medical Officers of Health Society) concurred.

2. HEIGHT AVAILABLE FOR RESPIRATORY PURPOSES IN COMPOUND ROOMS.

I omitted to refer to this in my evidence on the 16th inst., though I intended to do so. I understand that it has been suggested that nothing in height over 12 feet should be allowed to count for cubic space purposes.

I am, of course, fully aware that this is the view expressed in text books on hygiene, but I would point out that it refers to rooms in which people stand, sit, or recline near the floor level. In the compounds, however, there is a second tier of bunks at a height of at least 5 feet from the ground, and I therefore submit that the 12 feet mentioned ought to count from the level of the higher tier of bunks. I consider that the case is exactly analogous to that of a theatre, where, over the pit, there is the dress circle, over that the balcony, and over that the gallery. No one would think of contending, in regard to a theatre, that only a height of 12 feet from the pit floor should be counted for ventilation purposes; but one might assert with some reason that not more than a height of 12 feet *from the floor of the gallery* should count. For exactly this reason I submit that in compound sleeping-rooms the limit of height should be measured from the level of the higher tier of bunks.

I wish further to indicate another consideration which in my opinion militates against the limitation of 12 feet of the ventilating height of buildings, and this is the reason which has been recently adduced by Mr. J. W. Thomas, F.I.C., a well known authority on ventilation, and author of "Ventilation of Churches and Public Buildings." My point is, that the higher the building, within reason, the greater is its "ventilating pressure." By this I mean that the column of *outside* air (say at a temperature of 55° F.) at the floor level of the dwelling, will not only balance the air (say at 65° F.) *inside* at the floor level, but will raise it, and force it upwards with a pressure equal to 2 ozs. exerted upon every square foot of surface, this pressure obviously increasing with the height of the building.

I venture to ask that this communication may be officially noted by the Commission.

Yours faithfully,

(Signed) CHARLES PORTER.

Appendix G.

APPENDIX G.

PAPERS RELATING TO NATIVE MORTALITY.

G1.—ORIGINAL REPORT BY MINE MEDICAL OFFICERS ON THE MORTALITY AMONGST NATIVES EMPLOYED ON THE MINES OF THE WITWATERSRAND.

June 6, 1903.

To the Commissioner for Native Affairs, Transvaal.

Sir,—

In accordance with the verbal instructions which we received at a Conference held between the Commissioner for Native Affairs, representatives of the Transvaal Chamber of Mines and certain of the Medical Officers of the Mines, on February 13th, 1903, which instructions were subsequently further defined by the Commissioner for Native Affairs in a subsequent interview, we have since that date been occupied in the investigation of the incidence of disease and the causes of mortality amongst the natives employed on the mines of the Witwatersrand.

In this investigation we have been somewhat delayed by the lack of sufficient data, for although the Mortality Returns of the Native Affairs Department afforded us detailed information regarding the causes of death amongst natives from the beginning of November, 1902, we did not consider that any period of less than six months could give an adequate basis from which to draw reliable conclusions. This basis we now have, and, in addition to the mortality returns referred to, we have compiled monthly sickness reports for the various compounds with which we are personally connected.

For the information afforded by the mortality returns, and for other data relative to our investigation, we have to thank the Commissioner for Native Affairs, who, through his Department, has supplied us with much valuable material.

I.—Introductory Considerations.

The basis of our Report consists, therefore, in the Mortality Returns for the six months ending April 30th, 1903.

These we have summarised, and their results appear in the accompanying Table :—

TABLE SHEWING CAUSES OF DEATH OF NATIVES ON MINES OF WITWATERSRAND.

NOVEMBER, 1902 - APRIL, 1903.

Disease.	Nov., 1902.	Dec.	Jan., 1903.	Feb.	March.	April.	Totals.	Percentage of Total Mortality.	
(*a*) Pneumonia	86	81	78	64	76	108	493	32·0	
Phthisis	25	29	17	15	18	23	127	8·2	41·7
Other Respiratory Diseases	2	4	5	5	3	4	23	1·5	
(*b*) Meningitis	15	15	13	24	23	32	122	7·9	
(*c*) Enteric Fever	11	14	6	14	21	20	86	5·5	
Dysentery	25	36	33	15	44	33	186	12·0	20·5
Other Diarrhœal Diseases	3	12	21	12	6	3	57	3·0	
(*d*) Scurvy	41	80	35	22	6	2	186	12·0	
(*e*) Malaria	3	6	7	7	4	9	36	2·3	
(*f*) Other Diseases	29	28	24	19	16	23	139	9·0	
(*g*) Accidents	10	21	14	11	18	12	86	5·5	
Monthly Totals	250	326	253	208	235	269	1,541	Total of all Deaths	
Number of Natives employed for each Month	46,710	48,542	49,761	56,288	57,022	62,265	53,364	Average No. Natives employed per Month.	

Death Rate from all causes calculated as an Annual Death Rate .. .. 57·7 per 1,000.
Death Rate from sickness alone .. .. 54·5 per 1,000

Appendix G.

From this table it appears that the *Total Death Rate*, calculated on the basis of the average number of natives employed per month, would, when rendered as an *annual death rate*, be 57·7 per 1,000. Curiously enough, it appears that the death rate amongst the natives employed in the Kimberley compounds is practically identical, namely, 57·2 per 1,000 for the year 1902. We do not say that the mortality amongst the natives on the Rand cannot be reduced; we believe, and will try to show that it can, but it is certainly apparent that the natives on the Rand show a mortality no higher than that obtaining in other mining districts in South Africa. If deductions be made for accidents, leaving the death rates from sickness alone, the figures are in each case again identical, being 54·5 per 1,000 for the Rand, and 54·8 per 1,000 for the Kimberley compounds.

When we pass from the total death-rate to its individual components, we find that the diseases which mainly contribute to it are the following:—

1.—*Pneumonia, Phthisis, and Other Respiratory Diseases*, accounting for 41·7 per cent of all deaths. Of these, pneumonia alone is answerable for 32 per cent. of the total death rate, and is of all the individual diseases, by far the highest contributing factor;

2.—*Enteric Fever, Dysentery, and Other Diarrhœal Diseases*, which together cause 20·5 per cent. of the total deaths; of these, dysentery is the largest individual contributor (12 per cent.);

3.—*Scurvy*, which has during these six months accounted for a total of 12 per cent. of the deaths;

4.—*Meningitis (cerebro-spinal meningitis)* accounting for 7·9 per cent; and

5.—*Malaria*, which is answerable for 2·3 per cent.

All other diseases taken together only contribute a further 9 per cent; and of these, we have not thought it necessary to give more detailed information.

From information obtained, we find that amongst the natives employed on the C.S.A. Railways, the incidence of scurvy and pneumonia has also been very considerable; whilst, amongst the natives employed in the various Kimberley compounds, pneumonia is very prevalent and extremely fatal. The average daily population of the Kimberley compounds during 1902 was 8,681. There occurred in that period 1,186 cases of pneumonia, with 373 deaths, out of a total mortality of 497, forming a percentage of no less than 75 per cent. It is extremely interesting to note that cerebro-spinal meningitis, a disease which is prevalent on the Rand, and which competent observers believe is in its causation closely allied to pneumonia, is scarcely represented at all in the Kimberley death rate.

Scurvy has also been noticeable in the Kimberley compounds, but it has not there contributed in such a high degree to the mortality as it has on the Rand.

Now scurvy is a dietetic disease and, therefore, mortality from this cause should, in theory be entirely preventible. Indeed, the returns of the past six months show a steady decline in the death rate from this disease, owing to the attention of the mining companies having been directed to the necessity of improving the diet of the natives. During the month of April only two deaths occurred on the Rand from scurvy.

The mortality from pneumonia can certainly be reduced, but it cannot be altogether eliminated, for the natives are peculiarly susceptible to this disease, and the conditions of mining work favour its incidence. The same may be said of the allied disease of meningitis, and of the "diarrhœal diseases"—enteric fever, dysentery and diarrhœa.

We believe, however, that, should the recommendations which we shall advance later on be adopted, the mortality amongst mining natives could be reduced to 40 per 1,000, or even lower. To attain this result, several innovations are necessary, and it is especially important that those charged with the medical and general care of the compounds should try to gain the full confidence of the natives, who are particularly prone to conceal their diseases, until in many cases treatment is too late to be of any value.

The monthly "sickness reports" which we have personally compiled, go to confirm and extend the information outlined above, and they bring out the additional fact of the *decided preponderance of disease of all kinds* amongst underground as compared with surface workers.

We shall now proceed to consider in greater detail the individual diseases which we have found to be important factors in the native mortality.

II.—Pneumonia and the Respiratory Diseases.

Pneumonia, as we have seen, contributes to the total mortality the highest proportion of any individual disease, accounting for no less than 32 per cent. of all the deaths amongst the natives on the mines. Pneumonia is a "specific" disease; it is due, that is to say, to the attack of a definite micro-organism, the "pneumococcus," to which the South African natives seem to be peculiarly susceptible.

Appendix G.

Indeed, not only are the cases of pneumonia which occur amongst the natives on the Rand due to this specific agent, but there is reason to believe that many or most of the cases of cerebro-spinal meningitis which occur in the compounds arise from the same cause.

The suggestion that these two diseases, pneumonia and meningitis, are, on the Rand, produced by the same micro-organism, was first definitely formulated in a paper published by Drs. Brodie, Rogers and Hamilton, of Johannesburg, in 1898. They described cases of acute rhinitis (nasal catarrh) and meningitis, which bacteriological investigation showed to be pneumococcal in origin. There is no doubt that cases, similar to those which they described, still occur in all the districts of the Rand, and that they show an extremely high case-mortality. Indeed, so far as the returns under our consideration go, the disease is at present on the increase. It has been observed too, amongst white underground workers.

In our experience, meningitis mainly occurs amongst underground boys, a fact which suggests that the underground workings have become a habitat of the infective agent.

The precautions to be taken against the spread of meningitis, are practically those to be taken for the prevention of pneumonia, which we may now proceed to consider.

While the pneumococcus is the direct and active agent in the causation of pneumonia, there are also other definite causes which determine its attack. Of these, exposure to cold is the chief, and this cause is rendered all the more efficacious if the strength is otherwise reduced by insufficient food or excessive work, and by the fact that many of the natives come direct to the Rand, often scantily clad and in poor condition, from warmer districts, where extreme ranges of temperature do not occur. Underground workers are also very liable to contract a chill on coming out of the warm underground workings to the surface. Hence we find that the incidence of pneumonia is most marked during the cold months of the year, at which seasons precautions against it are especially necessary, particularly in regard to boys arriving during these months from warmer climates; such boys show an extreme liability to attack.

These precautions should consist—

1.—In the provision of a suitable dietary, the details of which we shall discuss later. We shall now refer merely to one particular matter in regard to diet, in reference to the prevention of pneumonia, namely, the *provision of a suitable soup-kitchen* at or near the entrance of the compounds, at which meat soup, together with some cheap form of biscuit (such as the army biscuit), should be served in the morning to each boy of the up-coming and down-going underground shifts, and to the surface boys. This system is already in vogue on several of the mines of the Rand, and has proved beneficial.

2.—During the cold season (from April to September) the recognised recruiting agency should be required to issue two blankets to each boy on starting for the Rand, who may not be possessed of them, and during the warm season, one blanket. *The possession of a blanket should be made compulsory on the part of the boys.* In the instance of one mine within our knowledge, there was a high incidence of and mortality from pneumonia, during the months of June and July of last year, particularly amongst a batch of newly-arrived and ill-clad East Coast boys, who nevertheless, refused to accept the offer of the company to supply them with blankets in advance. This is far from being an isolated experience.

For all surface boys, many of whom work in exposed situations, *e.g.*, on tailings heaps or slimes dumps, and who cannot, from the nature of their employment, wear blankets when at work, a woollen sweater and a pair of strong trousers should be provided. A large number of cases of pneumonia occurs amongst cyanide boys, and this provision would secure their being sufficiently clad.

The cost of the blankets and clothing might be deducted from the boy's pay in the course of the performance of his contract.

3.—Together with the soup-kitchen there should be *a change-house for the natives at the headgears*, with provision for them to leave their blankets there when going underground. The mere fact of having such a change-house would greatly reduce the risk of chill to the mine boys on coming to the surface.

4.—It is important that the boys should not be kept waiting for any long period in the cold, for the purpose of having their time tickets marked or of being paid. An excellent system of time-keeping, preventing any such exposure, is in vogue at the Treasury G. M. Co.

5.—We cannot approve of the present system of having earth floors merely in the compound huts. These cannot but form ready receptacles for infected sputum, and provide a dangerous means of perpetuating the incidence of pneumonia, meningitis and of other infective diseases. It is impossible to render the earth floors clean. We should, therefore, strongly recommend that *all future compound huts should be constructed with impervious floors.*

Bunks should be of movable wooden planks set in fixed iron frames; these bunks may be conveniently arranged in two tiers.

In all compound huts, stoves should be provided with iron flues to carry off the fumes, in place of the rough open coke stoves at present in general use. The fumes caused by the combustion of coke are, in the absence of ventilation, most dangerous, and, therefore, proper means for their escape should be provided. The inhalation of these fumes will certainly predispose to respiratory diseases.

Regarding the cubic space to be provided per head in the compound huts, we find that the full complement of boys does not at any one time (except on Saturday night and Sunday) occupy the huts. Consequently we are of opinion that, if impervious floors and stoves, with suitable chimneys are provided, an allowance of 150 cubic feet for each boy of the total complement of the hut would be sufficient for purposes of health.

With regard to other diseases of the respiratory group, *ordinary tubercular phthisis* is not uncommon in the compounds, and contributes its quota to the death rate. It is present, however, in the districts from which recruits for the mines are obtained, and we believe that most of the cases found on the Rand are imported. Provision should be made for the detection of this condition amongst recruits, and for the return of affected natives by the companies to the recruiting agencies within a specified time after their arrival.

So-called "*miners' phthisis*" is sometimes seen amongst the natives, in boys who have been engaged in underground work over considerable periods. The improvements in the conditions of mining, which are looked for as the result of the *Commission on Miners' Phthisis*, will no doubt go as far as possible towards avoiding risks from this source.

III.—Enteric Fever, Dysentery, and Diarrhœal Diseases.

Enteric fever does not show an excessive incidence in the compounds, and the natives seem to enjoy a relative immunity from this disease. The total contribution of enteric fever to the death rate is 5·5 per cent. Dysentery which also, like enteric, is due to an infective agent, is responsible for more than double this number of deaths.

Both diseases are more prevalent during the summer months, and amongst underground boys, due in the latter case, to the fœcal contamination of the workings and of the underground water. In this connection we may cite a small epidemic of enteric fever, affecting eleven white underground workers on one of the mines of the Rand a few months ago, which ceased at once when the underground water was made inaccessible to the men.

For any diminution of the incidence of this group of diseases, we must look, therefore in addition to the general question of a trustworthy water supply to the compounds), to improved underground sanitation. Towards this, we should urge the following recommendations:—

1.—In every mine, on each level, near the shaft, two sanitary buckets should be provided, one for white men, and one for natives. The automatic earth closet would be the best form of convenience. The buckets should be removed and replaced nightly. Use of these buckets should be made imperative on white men, and, so far as possible, each white man in charge of a gang of Kaffirs should be made responsible for their use of the buckets also.

2.—The gross habit of using disused workings in place of latrines should be absolutely forbidden, and its practice rendered penal.

3.—Underground water should not be used for drinking purposes.

In connection with underground sanitation, officials should be appointed, subordinate to the Medical Officers of Health for the Witwatersrand and the Municipality, whose duty it would be to periodically inspect the sanitary condition of the mines by personal visit. So far as we know, no such system exists at present, nor does such inspection appear to form part of the practice of the mining inspectors.

IV.—Scurvy.

We consider that too much stress has been laid by some on scurvy as a main cause of mortality amongst the natives, for, even if deaths from scurvy could be entirely eliminated, the death rate would still be high.

Appendix G.

At the same time, it is very evident that during the past six months scurvy has been an important cause of mortality and, coincidently, of course, of extensive sickness and consequent incapacity for work. Scurvy, however, is a preventible disease, and it is now declining, and we trust that for the future it will not bulk largely in the sickness or mortality returns.

In regard to causation, scurvy is a dietetic disease. It is due, that is, to *insufficient variety in the food*, and particularly to a deficiency of fresh meat and vegetables, and also to *indifferent quality of the food*, especially to decomposition changes. Tainted meat has been shown to be in itself a cause of scurvy, and in all districts where maize (mealies) form the staple food, disease, due to partial decomposition or disease of the maize, also frequently appears. In those parts of Europe, for example, where maize forms the staple food of the peasantry, a disease named "pellagra" is common; it is closely allied to scurvy and yields to the same treatment.

On the Rand also, we have traced a relation between outbreaks of scurvy on individual mines, and defective quality of the mealies supplied. On one mine in particular, where there was at the time no case of scurvy, there appeared during March of this year, 31 typical cases of the disease, and the mealies consumed during that month were found, on investigation, to be tainted and "musty." When other and sound mealie meal was substituted, the disease disappeared.

The disease which has been described as scurvy conforms, in the vast majority of cases, to the classical descriptions of that disease. One of its most obvious and common features consists in the swelling of the gums, which is often extreme, the gums bleed readily, and the breath is foul. This local condition, however, is merely indicative of the general tendency in scurvy to hæmorrhagic and serious effusions, which frequently take the form of infiltration of the muscles, especially of those of the legs. Hæmorrhage also may occur into the stomach or into the bowel, giving rise in the former case to vomiting of blood, and in the latter to symptoms simulating dysentery, and very fatal. We have observed not uncommonly also hæmorrhage into the joints, especially the knees. Thus there is in scurvy, a profound change in the blood, which is the chief pathological factor in the disease. Its result is seen in the effusions of blood in various parts, and in the exudations in the muscles and gums which we have mentioned, and in a condition of anæmia of all the tissues. Those affected by scurvy bear injuries very badly, and we have seen cases where injuries, in themselves relatively insignificant, have proved fatal owing to this cause, while the most trivial abrasions of the skin may give rise in scorbutic patients to severe ulceration.

Mild cases of scurvy are readily cured by the provision of a generous diet of meat and fresh vegetables; old-standing cases are much more intractable, but the case mortality is, under treatment, relatively low. The affection of the legs may give rise, especially if neglected, to a pseudo-paralytic condition, which has been ascribed to other diseases.

Cases which appear to conform more to the classical descriptions of "pellagra" are sometimes observed.

The question has also been raised whether some or many of the cases described as scurvy on the Rand, may not in reality be cases of *beri-beri*. There is, however, no evidence that this disease arises *de novo* on the Rand, and, although a few possible imported cases may be seen from time to time, we have no hesitation in saying, from a wide experience, that the vast majority of cases, described under the name "scurvy," are characteristic examples of this disease. Some of the members of our Committee have had previous experience of *beri-beri* in other parts of the world, but they have met with no cases of this disease upon the Rand.

We have taken some pains to find out whether scurvy is prevalent amongst boys arriving on the mines, and a certain proportion are so affected, but the majority of the cases have unquestionably contracted the disease upon the mines. The recent prevalence of the disease is partly the heritage of the war, due in part to the fact that the natives who remained on the Rand during the war were, for the most part, poorly fed, and to the further fact that a sufficient supply of South African mealies has not since been obtainable, owing to the disturbance of the normal South African output caused by the recent hostilities.

We regard scurvy, therefore, as a dietetic disease, and its prevention must be looked for in an adequate scale of diet for the natives. The question of the condition of the natives as regards manner of housing and over-crowding is, *so far as this disease is concerned*, of less importance.

V.—Diet of Natives.

We would, accordingly, offer the following suggestions regarding the diet of mining natives, and we would first lay down the principle, that the mining companies, which contract to feed and house the natives in their employment, should provide a diet sufficient to maintain them in a condition of working efficiency, *independently of any additions to their diet which the natives may make themselves*. The system of allowing

the natives to feed themselves adopted in Kimberley is by no means satisfactory, from the point of view of the prevention of scurvy, for in the Kimberley compounds, scurvy, although not a cause of great mortality, shows a considerable incidence, especially amongst boys who have been three months or more in the compounds.

The provision of an adequate diet is a matter of the simplest commercial economy, in that it not only reduces the incidence of disease in every form, and of scurvy and pneumonia in particular, but it secures the maximum output of efficient labour from those who are at work.

The source of the energy of human work lies solely in food, and to ignore this fact, by the supply of an insufficient diet, is a most short-sighted form of economy, for which the penalty is inevitably exacted in the form of bad labour, excessive sickness and an undue mortality.

We would, therefore, concentrate our attention on the question:—*What is a suitable dietary for the native workers?*

Mealies form the staple food of the natives of South Africa, to which various additions are made in the different districts. For this reason it is desirable to maintain mealies as the basis of any proposed dietary, especially as mealie meal is particularly rich in fat, is rich also in nitrogenous elements, and is highly nutritious, resembling oats in its nutritive value.

But while we agree that mealie meal should form the basis, the attempt to render it the only element of the diet will inevitably perpetuate the incidence of scurvy amongst the workers, as has been abundantly proved by the local experience of the past two years, and by the facts which we have cited, of the incidence of diseases allied to scurvy in other parts of the world, where maize forms the staple diet. If imperfectly cooked—and steam seems to be the best method of cooking—or, if at all decomposed or diseased, mealies, as we have seen, may give rise to serious disturbances of health.

Additions to this diet, therefore, become necessary, in order to provide that variety in the food, which is essential in order to provide the worker with a sufficiency of the necessary chemical components of an adequate dietary in proteids, carbo-hydrates, fats and salts. Before proceeding to discuss these necessary additions, we would call attention to certain facts regarding the available mealie supply. Hitherto the output of South African mealies has not been equal to the local demand, and, as a consequence, the difference has been made good by the importation of American and European mealies. Further, we have learned from inquiry that the mealie crop throughout South Africa has, this year, been a very poor one, owing to climatic influences, so that importation will still be necessary.

An extension of the mealie-growing area in South Africa is, therefore, necessary, if the local supply is in the future to be equal to the local demand. There is no reason, however, why, if this be done, South Africa should not be economically self-sufficient in this respect, except, of course, during bad years, for the factors adversely influencing surface crops in South Africa—drought, frosts, locusts, etc.—are, of course, many and variable.

We have had our attention drawn to the fact that American mealies have been, in some cases, shown to produce outbreaks of scurvy, which disappeared when a change was made to South African mealies. It seems an obvious inference, therefore, that steps should be taken to render the South African output sufficient for the needs of the country. Even so, however, the greatest care should be exercised to see that the mealies are sound. Only one crop of mealies is grown during the year. Green mealies can be obtained from December to May, and ripe mealies for grinding from April to December.

With regard to the additions to the mealie meal basis, rendered necessary by the considerations we have advanced, we may discuss the following:—

1. *Meat.*—We consider that 3 lbs., of meat per week should be supplied to each boy in the compounds throughout the year. Of this, 1 lb. should be issued to the boys in the compounds twice a week, while the additional 1 lb. should be used for the preparation of the soup which we have recommended should be supplied in the morning to all boys.

Fresh meat, should, where possible, be supplied, as it has a higher anti-scorbutic value. Tainted meat, so far from being a remedy against scurvy, is an active cause of that disease, and frozen meat is more liable to be tainted, or become so, than fresh meat. Where practicable, the meat should be slaughtered on the spot, so as to procure the additional advantage of obtaining the blood, which the natives readily consume.

A system of inspection of the meat issued by such butchers as may contract to supply the compounds should be instituted, and there should be stringent regulations and inspection of the meat and other food stuffs supplied by the occupiers of any eating-houses who may be allowed to cater for natives on or near the mines.

2. *Fresh Vegetables.*—Along with the 1 lb. of meat issued twice a week to each boy in the compounds, half a pound of fresh vegetables should be provided (also twice a week).

An additional 1 lb. of fresh vegetables per boy per week should be provided for the manufacture of the morning soup.

Appendix G.

Root crops can be obtained in the Transvaal in good quantity throughout the year, although larger quantities can be obtained during the summer than during the winter months.

Of these we may mention :—

Onions,	Pumpkins,
Potatoes,	Lettuce,
Sweet Potatoes,	Turnips, and
Cabbage,	Carrots.

During the summer months, marrows, yams, peas and beans can also be obtained, and an equivalent quantity of peas, beans and lentils might be used (say once a week) as a *substitute* for the mealie meal, and to relieve the monotony of the diet, but it must be noted that the anti-scorbutic value of the leguminosæ is not high. Should the local mealie crop fail in any year, it would be better to make good the deficiency by an additional supply of vegetables, than to do so by too exclusive a reliance on imported mealies. In the fruit season cheap peaches can also be readily obtained.

3. *Biscuit.*—The Army biscuit is cheap, palatable, and nutritious. Two should be issued per boy per day along with the soup, as previously recommended. The approximate weight of the biscuit is 2¾ ozs.
4. *Sugar* in some form is a necessary constituent of all diets. *Treacle* is, perhaps, the cheapest and most convenient form in which it can be obtained, and, in some of the compounds on the Rand, treacle is added to the mealie meal and cooked up with it ; it is appreciated by the natives. We should recommend its use in the quantity of 1 lb. per boy per week.
5. *Salt.*—½ oz. of common salt should be allowed per boy per day.

These, then, are the components which we recommend should form the routine diet of the natives. They may be tabulated thus :—

Mealie Meal.—The present ration is roughly 2 lbs. per day. We should recommend once a week, where practicable,the substitution of peasemeal, beans or lentils.

Meat.—2 lbs. per week, *plus* 1 lb. per week of soup meat, the soup to be issued daily.

Fresh Vegetables.—1 lb. per week, *plus* 1 lb. per week of soup vegetables, for use with the soup meat.

Biscuits.—2½ lbs. per week (at the rate of two army biscuits per day).

Treacle.—1 lb. per week.

Salt.—3½ ozs. per week.

Coffee might, during the summer months only, be substituted for the soup, but not during the winter months.

Kaffir Beer with the above diet would not be a *necessary* constituent of the dietary. It is, however, a useful addition, as it is a beverage to which the natives are accustomed, and it possesses an anti-scorbutic value. It is, however, rather costly. Should it be issued, it should be in the form and of the strength known to the Basutos as "leting."

A suggested schedule of meal-hours in the compounds form an addendum to this Report.

VI.—Malaria.

A certain proportion of the mortality is caused by malaria, but as these cases are practically all imported, and do not arise in any number *de novo* on the Rand, we need not discuss the incidence of this disease in detail. Malaria is particularly liable to break out amongst boys who have recently arrived from warmer climates, and who have previously contracted the disease there.

VII.—Miscellaneous Suggestions and Recommendations.

We offer, in conclusion, some general suggestions and recommendations which bear more or less directly upon the health of the natives :—

1.—In addition to the question of the routine supply of blankets to the natives by the official recruiting agencies, to which we have already referred, we would urge that the Government should seriously consider the advisability of directing that parties of natives, arriving during the cold season from warmer climates, should be retained in a central compound for a period of two weeks before being distributed to the mines. In this compound the natives would be well fed, and would be so far acclimatised before being subjected to the necessary exposures of mining work.

2.—The Medical Officers of the various mines should have the power to return to the Native Labour Association any boys arriving incapacitated for work by chronic disease or physical defect within a week of their arrival on the mine. A special certificate should be required in all such cases.

3.—All natives reporting sick should be compounded in a hospital enclosure *distinct from the general compound*. This enclosure should contain :—

i. A native hospital, with an allowance of, say 25 beds per 1,000 native employees, for acute cases. A good type of such a hospital is that recently erected by the Bonanza G. M. Co. In this, every boy on admission is bathed, sheds his rags and blankets, and is provided with hospital clothing and blankets, which are retained on his dismissal. The results of this system are extremely satisfactory.

ii A separate hut with impermeable floor and iron framed bunks for convalescent cases, or minor cases not requiring hospital treatment.

iii The usual conveniences, and a hut for the native attendant, with provision for hospital cooking.

4. *Diet for Natives in Hospital.*—Extra articles of diet should be allowed for natives in the compound hospitals, on order from the Medical Officers, *e.g.*, coffee, bread, flour, rice, and condensed milk.

5. *Disinfection.*—In the hospital enclosure provision should be made for the disinfection and washing of the clothing and blankets used by the patients.

In the case of all infective diseases, under which term we include pneumonia, meningitis, enteric fever, and dysentery, the following rules should be observed :—

i Should the patient have worn hospital clothing and blankets during his illness, these should be properly disinfected and washed before being again used.

ii The private clothing and blankets of the patient, if the case prove fatal, should be destroyed, and in the event of the patient's recovery, should be properly disinfected and washed, before the boy is allowed to return to the compound.

Until such time as the compound huts are constructed with impervious floors, it is impossible to find any simple method for their disinfection which would be at all satisfactory.

6. *Isolation of Dangerous Infective Diseases* (such as smallpox) is already provided for under the mining regulations. This provision should be scrupulously carried out.

7. We would strongly urge upon the Chamber of Mines to institute a *corps of hospital attendants*. Cape boys for this purpose are more cleanly, intelligent, and reliable than Kaffirs.

These boys, after six months' training by the medical officers of the mines, should be granted certificates, signed on behalf of the Chamber of Mines by one of the medical officers of the companies, and the possession of such a certificate should entitle the boy to a higher scale of pay, *e.g.*, £6 or £7 a month with quarters.

By these means an efficient corps of hospital attendants might gradually be created, who would prove of the utmost value. The system generally in vogue at present, of reliance on practically unskilled natives to look after the sick boys is unsatisfactory.

In larger compounds, where there are assistant compound managers, an alternative plan might be preferred, namely, to carefully select a number of retired N.C.O.'s or men of the Royal Army Medical Corps, some of whom are now in South Africa, and to appoint these men as assistant compound managers, with charge, under the medical officers of the compound hospitals, and with defined duties in the administration of the compounds also.

8. *Hospital Returns.*—We should recommend that, in order to secure a uniform system of returns of sickness from the compound hospitals, from which reliable statistics could be readily constructed, the following forms should be adopted.

i. Hospital Book, to be kept by the compound officials, and constituting a record of all admissions and discharges. The following items should be noted.

Date of admission.
Boy's number.
Boy's name.
Tribe to which the boy belongs
Department of the mine in which he is working.
Nature of disease or injury.
Treatment.
Date of discharge or death.
Total number of boys incapacitated by sickness or injury for each day.

If such a record were kept it would be a simple matter to construct the second form, namely :—

ii. Monthly Medical Report of Health of Natives, for which the Medical Officers of the Companies should be responsible. We append such a form :—

SUGGESTED FORM OF MONTHLY MEDICAL REPORT.

1. Number of cases incapacitated by sickness or accident on the last day of preceding month, *e.g.*, 15.
2. Number of cases admitted during current month, viz.:—

	Underground.	Surface.	Deaths. U.	Deaths. S.	Remarks.
a. Pneumonia	2	..	1	..	
Phthisis	..	..	..	..	
Other Respiratory Diseases	4	..	..	..	
b. Meningitis	..	..	..	..	
c. Enteric Fever	..	..	..	..	
Dysentery	..	..	..	..	
Other Diarrhœal Diseases	4	..	1	..	
d. Scurvy	3	..	..	..	
e. Malaria	3	1	..	..	
f. Other Diseases	21	6	..	..	
g. Accidents	8	3	..	..	
Total admissions, 55, viz.:	45	10	2	..	

3. No. of deaths—2.
4. No. of discharges—51.
5. No. remaining sick on last day of current month—17.
6. Average number of cases incapacitated per day—19·4.
7. Average No. of natives in Company's employment during the month—
   a. Underground—
   b. Surface—

9. The last matter to which we desire to draw attention is not directly concerned with the mortality of mining natives, but as its importance has been frequently impressed on us as Medical Officers of the mines, we have ventured to refer to it here.

We refer to *the absence of any system of insurance of the natives against accidents* arising out of their employment. Under present conditions, natives who have suffered permanent disablement, are either retained as pensioners by the companies, or are discharged to their homes, the matter of compensation being entirely at the discretion of the companies. We consider it very advisable that a regular system of insurance, with a recognised scale of compensation for defined degrees of disablement, should be instituted. At present the mining companies pay 2s. per month per boy to the Pass Office, and, if 1½d. or 2d. out of that 2s. were thereafter set aside as an insurance fund, it would amply meet all requirements, and would prove a great boon to a considerable number of disabled natives.

We are, Sir,

Your obedient servants,

L. G. IRVINE.
D. MACAULAY.
J. S. MORTON.
E. POLLAK.
A. WATT.
C. J. LYONS.

ADDENDUM.

SUGGESTED SCHEDULE OF MEAL HOURS IN COMPOUNDS.

	5 a.m.	12 noon.	5 to 6 p.m.
Underground *Day Shift	Mealie Meal and Treacle, *plus* Soup and Biscuits.	—	Mealie Meal and Treacle (Full Meal).
Underground †Night Shift and Surface Boys.	Soup and Biscuits.	Mealie Meal and Treacle (Full Meal.)	Mealie Meal and Treacle (Full Meal).

‡ On Wednesdays and Saturdays at 12 to 1, 1 lb. meat and ½ lb. vegetables to be issued to each boy.

* The day shift goes down at 6 a.m. and comes up from 4 to 5 p.m.
† The night shift goes down at 6 p.m. and comes up from 4 to 5 a.m.
‡ The Saturday day shift is from 6 a.m. to 1 p.m.: the Saturday night shift from 2 to 10 p.m.

MEMORANDUM

Appendix G.

BY THE EXECUTIVE COMMITTEE OF THE TRANSVAAL CHAMBER OF MINES ON THE SUBJECT OF A "REPORT TO THE COMMISSIONER FOR NATIVE AFFAIRS ON THE MORTALITY AMONGST NATIVES ON THE MINES OF THE WITWATERSRAND, COMPILED BY A COMMITTEE OF MEDICAL OFFICERS OF MINES."

The Executive of the Chamber has carefully considered the Report of the Committee of Mine Doctors, made to the Commissioner for Native Affairs, on the subject of mortality amongst Natives on the Mines of the Witwatersrand, and has discussed the various points raised and recommendations contained in the Report with the Commissioner for Native Affairs and members of the Committee of Mine Doctors.

1. The hygienic conditions prevailing amongst natives on the mines have occupied the attention for many months past of both the Government and the Boards of Directors of mining companies, and the Executive believes that the recommendations contained in the attached report of the Committee of Medical Officers have already been practically adopted. Precautionary measures have been taken against the exposure of natives to extremes of temperature, whether in respect of natives arriving from warm latitudes or natives that have been for some time working on the mines.

The attention of the Department of Native Affairs was drawn to the fact that the immediate vaccination of the more weakly of the newly-arrived natives at the Pass Office produced an injurious effect on their health, and the Commissioner for Native Affairs agreed to the postponement meantime of the vaccination of natives arriving in a more or less impoverished condition, stipulating, however, that the medical officers of the mines should receive instructions to vaccinate all such natives so soon as the state of their health would admit of the operation.

2. Special provision has been made by companies for the clothing of boys employed in cold weather on cyanide and other works, under conditions where blankets cannot be worn, and the Witwatersrand Native Labour Association has made satisfactory arrangements regarding clothing of new arrivals whilst on their journey to the mines.

3. The recommendation contained in the Report with respect to change-houses have been carried out wherever practicable.

4. *Sanitation and Water Supply.*—Provision has been made under Article 146, Section XV. of the new Mines and Works Regulations with regard to sanitation, and a circular has been issued drawing the attention of managers to the danger arising from the insanitary condition of old and disused workings, and advising them to take steps for the cleansing and disinfecting of such places. The Executive Committee understands that arrangements have been made in most cases for a pure water supply underground.

5. *Open Stoves.*—Companies have been recommended to adopt a new stove of cylindrical shape, perforated with large holes, with a cast iron plate on the top, and with an iron chimney to carry off the fumes. This pattern of stove has been in use on the East Rand Proprietary Mines for some time past. It is hoped that the introduction of these stoves will conduce to an improved ventilation.

6. *Diet.*—The Executive Committee cordially approves of the suggested alterations contained in the Report of the Mine Doctors, and would strongly recommend the companies, should the natives be found amenable, to adopt the schedule appended to the Committee of Doctors' Report in all cases. The Executive also considers that it would be well to divide the supply of food into two meals daily. It may be remarked, in connection with diet, that the death rate from scurvy has now been very considerably reduced.

7. *Housing of Natives.*—It is well known that the natives prefer a crowded room, and, however much air space is provided, insist upon huddling together. The Executive Committee recommends provision being made in compounds for 150 cubic feet of air space per man calculated on the basis of the number of natives on the companies' registers.

The adoption of cement or asphalte floors would be found very expensive for the older companies, but the recommendation might be adopted in the case of new compounds. Floors of brick or some hard substance that can easily be flushed out, are recommended in the case of companies whose compounds are already erected, and it is understood this provision meets with the approval of the Committee of Medical Officers.

8. *Hospitals.*—The attention of mine managers is directed to the proposals contained in the report of the medical officers with regard to hospitals.

The Executive Committee of the Chamber also recommends that natives of a superior class should be introduced from Basutoland and the Transkei as hospital attendants, and distributed amongst the mining groups. The Commissioner for Native Affairs has kindly offered to assist us in obtaining this class of attendant, and doubtless the mining companies will be glad to avail themselves of the offer. It is considered they would be more suitable than members of the Army Medical Corps, as suggested in the alternative proposal of the Committee of Mine Doctors.

Appendix G.

9. *Accident Assurance.*—This matter is under the consideration of the Chamber of Mines and the Native Affairs Department.

10. The Executive acknowledges the reasonable spirit in which the report of the Committee of Medical Officers is framed, and observes with great satisfaction that, as stated by the Doctors themselves, all the improvements suggested by them are already in use on some or other mine on the Rand.

In conclusion, the Executive Committee of the Chamber desires to express its sense of the courtesy and consideration shown by the Commissioner for Native Affairs throughout the conferences and correspondence on this important subject.

TRANSVAAL CHAMBER OF MINES,

JOHANNESBURG, 3rd September, 1903.

Appendix G2.

G 2.—TABLE OF APPENDICES TO SUPPLEMENTARY REPORT OF DRS. IRVINE AND MACAULAY.

A.—Analysis of Native Mortality on Mines and Works in Witwatersrand and District.

A. 1.—Actual number of deaths from specified diseases per month of 1903.

A. 2.—Actual number of deaths from specified diseases per month of 1904.

A. 3.—Deaths for 1903 from specified diseases shown as rates per 10,000 per month.

A. 4.—Deaths for 1904 from specified diseases shown as rates per 10,000 per month.

A. 5.—Death rates per 10,000 from specified diseases in six-monthly periods.

A. 6.—Deaths from specified diseases in six-monthly periods, shown as percentages of total deaths.

B. 1.—Numbers and source of natives recruited by the W.N.L.A. during 1903.

B. 2.—Number of natives recruited from January to June, 1904.

C.—Return of deaths amongst white population of Johannesburg Municipality for period November, 1902, to July, 1904.

D. 1.—Statistics showing period of service prior to death amongst East Coast and northern Transvaal Natives from June 1st, to December 31st, 1903.

D. 2.—C.R. Hospital Statistics.

D. 3.—G.D. Hospital Statistics.

D. 4.—Statistics of Detention Compound.

D. 5.—Proportion of old mine boys in gangs from East Coast and Pietersburg, January to June, 1904.

D. 6.—Provision for clothing.

D. 7.—Return of coloured labour. Statistics of sickness.

E.—Comparison of thirteen selected mines.

E. 1.—Average complement of natives grouped territorially.

E. 2.—Percentage territorial distribution of average complement.

E. 3.—Analysis of recruiting figures.

E. 4.—Comparison of death rates, total percentage replacement, percentage replacement direct from native territories, and percentage replacement by local engagement.

E. 5.—Data of foregoing table.

E. 6.—Comparative number of East Coast boys recruited direct from native territories and East Coast boys engaged locally.

E. 7.—Monthly death rates rendered as per 1,000 per annum for thirteen mines.

Also, three Supplementary Charts.

APPENDIX G.2.

A.—ANALYSIS OF NATIVE MORTALITY ON MINES AND WORKS IN WITWATERSRAND AND DISTRICT (see Chart 1).

A. 1.—Actual Number of Deaths from Specified Diseases per Month for 1903.

Disease.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Totals.	Percentages.	
(*a*) Pneumonia	78	64	76	108	196	298	456	295	254	217	217	198	2.457	50·83	
Phthisis..	17	15	18	23	13	25	22	19	25	24	27	33	261	5·40	58·34
Other Respiratory Diseases	5	5	3	4	12	3	10	15	10	14	12	9	102	2·11	
(*b*) Meningitis	13	24	23	32	51	52	60	49	22	22	22	27	397	8·21	8·21
(*c*) Enteric	6	14	21	20	10	11	3	7	1	2	13	28	136	2·81	
Dysentery	33	15	44	33	51	21	16	11	16	27	49	55	371	7·67	14·03
Other Diarrhœal Diseases	21	12	6	3	16	16	8	18	9	11	27	25	172	3·55	
(*d*) Scurvy	35	22	6	2	9	2	5	8	9	33	56	42	229	4·73	4·73
(*e*) Malaria	7	7	4	9	14	17	8	7	4	6	13	8	104	2·15	
(*f*) Other Diseases ..	24	19	16	23	37	29	26	38	43	38	38	39	370	7·65	
(*g*) Accidents	14	11	18	12	22	18	13	18	35	23	22	26	232	4·80	
(*h*) Unclassified	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
(*i*) Plague	..	..	..	..	..	..	..	..	..	..	2	..	2	·041	
Monthly Totals .	253	208	235	269	431	492	627	485	428	417	498	490	4,833	..	
No. of Boys employed ..	49,761	56,288	57,022	62,265	65,371	68,819	70,474	71,121	73,282	75,671	75,169	74,938	Av. 66,682	..	
Monthly rate per 10,000 ..	50·8	36·9	41·2	43·2	65·9	71·49	88·9	68·1	58·4	55·1	66·2	65·3	..	..	
Monthly rate rendered as rate per 1,000 per annum	60·96	43·38	49·44	51·84	79·08	85·78	106·68	81·72	70·08	66·12	79·44	78·36	72·47	Annual average per 1,000.	

N.B.—These figures are based on the returns of the Native Affairs Department, but do not include the Districts of Middelburg and Pretoria.

A. 2.—Actual Number of Deaths from Specified Diseases per Month for 1904.

Disease.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	—	—
(*a*) Pneumonia	138	68	76	39	83	52	66	..	..	..	..	..	..	..
Phthisis	23	15	24	20	32	39	33	..	..	..	..	..	..	..
Other Respiratory Diseases	12	7	11	9	19	17	16	..	..	..	..	..	..	..
(*b*) Meningitis	36	12	10	17	30	17	15	..	..	..	..	..	..	..
(*c*) Enteric	26	17	12	11	16	14	10	..	..	..	..	..	..	..
Dysentery	36	38	23	21	23	12	10	..	..	..	..	..	..	..
Other Diarrhœal Diseases	31	20	17	10	14	10	1	..	..	..	..	..	..	..
(*d*) Scurvy	26	5	6	1	4	3	2	..	..	..	..	..	..	..
(*e*) Malaria	6	3	5	5	7	5	7	..	..	..	..	..	..	..
(*f*) Other Diseases ..	26	19	17	23	31	44	24	..	..	..	..	..	..	..
(*g*) Accidents	19	22	31	60	28	23	32	..	..	..	..	..	..	..
(*h*) Unclassified	..	..	1	..	..	3	..	..	..	..	..	..	..	..
(*i*) Plague	..	..	1	..	2	..	..	..	..	..	..	..	..	..
Suspected Plague ..	..	..	..	..	1	..	..	..	..	..	..	..	..	..
Monthly Totals ..	379	226	234	216	290	239	216	..	..	..	..	..	..	..
No. of Boys employed ..	75,038	76,163	77,376	78,505	78,452	76,783	*68,544	..	..	..	..	..	..	..
Monthly rate per 10,000 ..	50·507	29·67	30·24	27·514	36·96	31·12	31·51	..	..	..	..	..	..	..
Monthly rate rendered as rate per 1,000 per annum	60·6	35·52	36·24	33·09	44·28	37·32	37·8	..	..	..	..	..	..	..

* Exclusive of contractors' boys.

A. 3.—Deaths for 1903 from Specified Diseases shown as rates per 10,000 per Month.

Disease.	Jan.	Feb.	March.	April.	May	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total rates per 10,000 per annum for each disease.
(a) Pneumonia	15·67	11·36	13·32	17·34	29·96	43·29	64·66	41·47	34·64	28·66	28·86	26·42	355·65
Phthisis	3·41	2·66	3·15	3·69	1·98	3·63	3·11	2·67	3·41	3·17	3·59	4·40	38·87
Other Respiratory Diseases	1·004 (20·08)	0·88 (14·90)	0·52 (16·99)	0·64 (21·67)	1·83 (33·77)	0·43 (47·35)	1·41 (69·18)	2·10 (46·24)	1·36 (39·41)	1·84 (33·67)	1·59 (34·05)	1·20 (32·02)	14·80
(b) Meningitis	2·61	4·26	4·03	5·73	7·79	7·55	8·50	6·88	3·00	2·90	2·92	3·60	59·77
(c) Enteric	1·205	2·48	3·68	3·21	1·52	1·59	0·425	0·98	0·13	0·26	1·72	3·73	20·92
Dysentery	6·63	2·66	7·71	5·29	7·79	3·05	2·26	1·54	2·18	3·56	6·53	7·33	56·53
Other Diarrhœal Diseases	4·22 (12·055)	2·13 (7·27)	1·05 (12·44)	0·48 (8·98)	2·44 (11·77)	2·32 (6·97)	1·13 (3·82)	2·53 (5·06)	1·22 (3·54)	1·45 (5·28)	3·59 (11·85)	3·33 (14·39)	25·89
(d) Scurvy	7·028	3·90	1·05	0·32	1·37	0·29	0·70	1·12	1·22	4·36	7·44	5·60	34·39
(e) Malaria	1·405	1·24	0·701	1·44	2·14	2·47	1·13	0·98	0·54	0·79	1·72	1·06	15·61
(f) Other Diseases ..	4·82	3·37	2·804	3·69	5·65	4·21	3·68	5·34	5·86	5·01	5·05	5·20	54·68
(g) Accidents	2·81	1·95	3·15	1·92	3·36	2·61	1·84	2·53	4·77	3·03	2·92	3·48	34·37
(h) Unclassified	..	..	..	..	..	..	..	..	..	..	0·26	..	0·26
(i) Plague	..	..	..	..	..	..	..	..	..	..	..	..	..
Total per 10,000 per month	50·812	36·89	41·165	43·19	65·89	71·48	88·90	68·19	58·37	55·09	66·26	65·35	..
Accidents	2·81	1·95	3·15	1·92	3·36	2·61	1·84	2·53	4·77	3·03	2·92	3·48	..
Total from sickness alone per 10,000 per month ..	48·002	34·94	38·01	41·27	62·53	68·87	87·06	65·66	53·60	52·06	63·34	61·87	..
Monthly rates rendered as per 1,000 per annum ..	60·96	43·38	49·44	51·84	79·08	85·78	106·68	81·72	70·08	66·12	79·44	78·36	72·47 Total rate per 1,000 per annum.

N.B.—These figures are based on the returns of the Native Affairs Department, but do not include the Districts of Middelburg and Pretoria.

A. 4.—Deaths for 1904 from Specified Diseases shown as rates per 10,000 per Month.

Disease.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	—
(a) Pneumonia	18·390	8·92	9·82	4·96	10·57	6·77	9·66	..	..	..	..	..	..
Phthisis	5·065	1·95	3·10	2·54	4·07	5·07	4·83	..	..	..	..	..	..
Other Respiratory Diseases	1·532	0·91	1·42	1·14	2·42	2·21	2·33	..	..	..	..	..	..
	(24·987)	(11·78)	(14·34)	(8·64)	(17·06)	(14·05)	(16·82)	..	..	..	..	..	..
(b) Meningitis	4·597	1·57	1·29	2·16	3·82	2·21	2·18	..	..	..	..	..	..
(c) Enteric Fever ..	3·464	2·23	1·55	1·40	2·03	1·82	1·45	..	..	..	..	..	..
Dysentery	4·597	4·98	2·97	2·67	2·93	1·56	1·45	..	..	..	..	..	..
Other Diarrhœal Diseases	4·131	2·62	2·19	1·27	1·78	1·30	0·14	..	..	..	..	..	..
	(12·192)	(9·83)	(6·71)	(5·34)	(6·74)	(4·68)	(3·04)	..	..	..	..	..	..
(d) Scurvy	3·464	0·65	0·77	0·127	0·51	0·39	0·29	..	..	..	..	..	..
(e) Malaria	0·766	0·39	0·64	0·63	0·89	0·65	1·01	..	..	..	..	..	..
(f) Other Diseases ..	3·464	2·49	2·19	2·92	3·95	5·72	3·46	..	..	..	..	..	..
(g) Accidents	2·532	2·88	4·13	7·62	3·56	2·99	4·66	..	..	..	..	..	..
(h) Unclassified	..	..	0·12	..	..	0·39	..	..	..	..	..	..	..
(i) Plague	..	..	0·12	..	0·25	..	..	..	..	..	..	..	..
Suspected Plague ..	..	..	..	..	0·12	..	..	..	..	..	..	..	..
Total rate per 10,000 per month	50·002	29·59	30·31	27·437	36·96	31·12	31·51	..	..	..	..	..	..
Accidents	2·532	2·88	4·13	7·62	3·56	2·99	4·66	..	..	..	..	..	..
Total from sickness alone per 10,000 per month ..	47·470	26·71	26·18	19·817	33·40	28·13	26·85	..	..	..	..	..	..
Monthly rates rendered as rates per 1,000 per annum	60·0	35·4	36·36	32·88	44·28	37·32	37·8	..	..	..	..	..	..

N.B.—These figures are based on the returns of the Native Affairs Department, but do not include the Districts of Middelburg and Pretoria.

A. 5.—DEATH RATES FROM SPECIFIED DISEASES IN HALF-YEARLY PERIODS.

Disease.	January to June, 1903.	July to December, 1903.	January to June, 1904.
Pneumonia	130·94	224·71	59·43
Phthisis	18·55	20·35	19·79
Other Respiratory Diseases	5·30	9·50	9·63
Meningitis	31·97	27·80	15·64
Enteric	13·68	7·24	12·49
Dysentery	33·13	23·40	19·70
Other Diarrhœal Diseases	12·64	13·25	13·29
Scurvy	13·95	20·44	5·90
Malaria	9·39	6·22	3·96
Other Diseases	24·54	30·08	5·90
Accidents	15·80	18·57	23·71
Unclassified	..	0·26	0·51
Plague	..	..	0·37
Suspected Plague	..	..	0·12
Total Rate per 10,000 per six months	309·89	401·82	190·44
Rendered as per 1,000 per annum	61·96	80·36	38·08

A. 6.—DEATHS FROM SPECIFIED DISEASES IN HALF-YEARLY PERIODS SHOWN AS PERCENTAGES OF TOTAL DEATHS.

Diseases.	January to June, 1903.	July to December, 1903.	January to June, 1904.
Pneumonia	42·22	55·92	31·20
Phthisis	5·98	5·06	10·39
Other Respiratory Diseases	1·74	2·33	5·05
Meningitis	10·31	6·91	8·21
Enteric	4·41	1·80	6·55
Dysentery	10·68	5·82	10·34
Other Diarrhœal Diseases	4·07	3·29	6·97
Scurvy	4·50	5·08	3·09
Malaria	3·03	1·54	2·07
Other Diseases	7·91	7·48	3·09
Accidents	5·09	4·62	12·45
Unclassified	..	0·06	0·26
Plague and Suspected Plague	..	..	0·19 and 0·06

B. 1.—NUMBER AND SOURCE OF NATIVES RECRUITED BY THE WITWATERSRAND NATIVE LABOUR ASSOCIATION DURING 1903.

The following are the numbers of Natives recruited during 1903, and the source:—

	Number.	Percentage of Total.
Cape Colony	7,082	8·29
Bechuanaland	2,730	3·19
Basutoland	2,008	2·35
Swaziland	273	0·31
Transvaal	11,775	13·79
Orange River Colony	50	0·05
Province of Mozambique—		
South of Latitude 22 degrees	43,625	51·09
Mozambique District	1,086	1·27
Quilimane District	447	0·52
Beira	84	0·09
British Central Africa Protectorate	941	1·10
German South-West Africa	620	0·72
Local	14,656	17·16
	85,377	100

B. 2.—NUMBER OF NATIVES RECRUITED FROM JANUARY TO JUNE, 1904.

	Number.	Percentage.
East Coast	9,910	27·74
Mozambique	556	1·55
Lydenburg	67	0·18
Pietersburg	4,512	12·63
East Coast, *via* Pietersburg	41	0·11
Massengeri	84	0·23
Cape Colony	3,446	9·64
Bechuanaland	1,069	2·99
Basutoland	704	1·96
Swaziland	32	0·08
Western Transvaal	198	0·55
Eastern Transvaal *via* Volksrust	588	1·64
Beira	149	0·41
Orange River Colony	17	0·04
Southern Transvaal	2	0·005
German South-West Africa	298	0·83
Zambesia Company	255	0·71
Nyasa Company	162	0·45
Rhodesia	484	1·35
Southern Rhodesia	29	0·08
Local	13,117	36·86
Total	35,720	100

C.—RETURN OF DEATHS AMONGST WHITE POPULATION OF JOHANNESBURG MUNICIPALITY FOR PERIOD NOVEMBER, 1902, TO JULY, 1904.

(See Chart 2.)

Month.	Total Deaths.	Pneumonia.	Other Respiratory Diseases.	Enteric Fever.	Dysentery and Diarrhœa.	Population.
1902—November	65	4	9	3	2	Old Municipality.
December	103	1	12	8	10	,,
1903—January	142	4	16	14	9	,,
February	90	2	7	19	12	,,
March	75	7	7	6	3	,,
April	62	11	10	5	5	,,
May	56	9	8	3	..	,,
June	84	16	16	3	..	,,
July	131	34	26	..	11	,,
August	106	33	35	3	1	New Municipality
September	135	43	18	2	5	,,
October	145	23	5	3	33	,,
November	147	4	15	..	52	,,
December	208	2	5	10	21	,,
1904—January	155	6	4	27	11	,,
February	118	3	19	21	16	,,
March	101	6	13	12	6	,,
April	82	5	9	8	3	,,
May	100	6	15	7	3	,,
June	103	6	14	5	3	,,
July	96	13	15	4	2	,,

D. 1.—STATISTICS SHOWING PERIOD OF SERVICE PRIOR TO DEATH AMONGST EAST COAST AND NORTHERN TRANSVAAL NATIVES, JUNE 1ST, TO DECEMBER 31ST, 1903.

Witwatersrand Native Labour Association.

Between June 1st and December 31st, 28,669 East Coast Natives (12 months contract) were allotted to members. Of these, Natives 1,083 were reported as having died by the 31st December. The following statistics give the period of service prior to the deaths of such Natives. :—

Period of Service.	Number.	Percentage.
Under 1 week	12	0·04
„ 2 weeks	89	0·31
„ 1 month	389	1·35
„ 2 months	270	0·94
„ 3 „	159	0·55
„ 4 „	66	0·23
„ 5 „	42	0·14
„ 6 „	39	0·13
„ 7 „	17	0·05
	1,083	3·76

Similarly, 3,137 Natives from the Northern Transvaal were distributed to members during the same period. The deaths reported were :—

Period of Service.	Number.	Percentage.
Under 1 week	..	..
„ 2 weeks	1	..
„ 1 month	14	0·44
„ 2 months	16	0·51
„ 3 „	11	0·35
„ 4 „	4	0·12
„ 5 „	9	0·28
„ 6 „	8	0·25
„ 7 „	nil.	..
	63	2·0

D. 2.—C. R. MINE HOSPITAL STATISTICS.

Number of East Coast Natives allotted since 1st of May :—138.

In Hospital (all injuries excluded).

Date.	Number of Boys.	Batch.	1–30		30–60		60–90	
			Sick.	Died.	Sick.	Died.	Sick.	Died.
21–5–04	5	A.	..	..	..	..	..	
4–6–04	4	B.	2	..	..	..	..	..
9–6–04	9	C.	2	..	..	..	..	..
24–6–04	29	D.	10	1	4	..	..	..
1–7–04	33	E.	1	..	2	..	..	..
16–7–04	4	F.	1	..	..	..	..	..
21–7–04	30	G.	2	..	1	..	..	
27–7–04	7	H.	5	1	..	..	..	..
29–7–04	16	J.	10	..	2	..	..	..
	138	..	33	2	9	..	..	..

NUMBER OF EAST COAST NATIVES LOCALLY ENGAGED SINCE 1ST MAY, 1904:—112.

In Hospital (All Injuries excluded).

1—30 days.		30—60 days.	
Sick.	Died.	Sick.	Died.
1	..	1	..
..	..	1	1
1	..	2	1

D. 3.—G. D. MINE HOSPITAL STATISTICS.

(1)—Mozambique Natives (North of Latitude 22°).

Gang.	Number.	Date of Arrival.	Number Sick within 30 days.	Number Sick over 30 and under 60 days.	Number Sick over 60 and under 90 days.	Deaths.	Remarks.
A.	62	March 29, 1904	55	26	14	4	Pneumonia
B.	35	June 16, 1904	24	15	..	5	

Gang B are natives from Quilimane District.

(2)—Portuguese Natives (South of Latitude 22°).

Gang.	Number.	Date of Arrival.	Number Sick within 30 days.	Number Sick within 60 days.	Number Sick within 90 days.	Deaths.	Remarks.
A.	69	March 25, 1904	42	24	17	3	..
B.	49	June 26, 1904	13	8	nil.	1	..

(3)—British Central Africa Natives.

Gang.	Number.	Date of Arrival.	Number Sick within 30 days.	Number Sick within 60 days.	Number Sick within 90 days.	Deaths.	Remarks.
A.	14	July, 26, 1904	9	..	..	1	..

D. 4.—WITWATERSRAND NATIVE LABOUR ASSOCIATION.

STATEMENT SHOWING NUMBER OF NATIVES DETAINED IN THE WITWATERSRAND NATIVE LABOUR ASSOCIATION'S DEPÔT, PRIOR TO ALLOTMENT, FROM THE 18TH JULY, 1904.

Date.	Number Received.	Origin.	Number Allotted.	Number Detained.	Date of Allotment after Detention.	Number Allotted.	Number still in Compound.	Remarks.
July 18 ..	51	Mozambique	4	47	August 3	38	..	One rejected as unfit.
					" 5	1	8	
" 25 ..	23	Tete	..	23	" 5	23	..	
" 28 ..	5	Beira	..	5	" 6	4	1	
" 28 ..	12	Chinde	..	12	" 6	8	4	
" 28 ..	41	Quilimane	..	41	..	..	41	

D. 5.—PROPORTION OF OLD BOYS RECEIVED IN GANGS FROM EAST COAST AND PIETERSBURG, JANUARY TO JUNE, 1904.

Date.	Number Recruited.	Number of Old Mine Boys.	Per Cent.	Number of New Boys.	Per Cent.
EAST COAST— January to June, 1904 ..	9,910	5,846	58·99	4,164	41·01
PIETERSBURG— January to June, 1904 ..	4,513	2,513	57·89	2,000	42·11

D. 6.—CLOTHING.

Since the 15th June, 1904, the following comprises the issue of clothing to natives from the East Coast :—

1 Cotton Sweater.
1 Cord Suit, Jacket and Trousers (second-hand).
1 Military or Police Overcoat.
2 Cotton Blankets.
1 Leather Belt.

This outfit is charged at 20s., against the natives' first month's wages.

Beginning in January next, the following issue will replace the above. :—

1 Undershirt or Vest.
1 Woollen Sweater.
1 Pair short Trousers.
1 Belt.
2 Cotton or 1 Woollen Blanket.
1 Duck Jumper.

This outfit will also be charged to the natives at 20s.

D. 7.—RETURN OF COLOURED LABOUR SHOWING NUMBERS OF NATIVES ADMITTED TO HOSPITAL AND MORTALITY AMONG SAME.

JANUARY, 1904, TO JUNE, 1904.

Month, 1904.	Pneumonia.				Phthisis.				Other Respiratory Diseases.				Meningitis.			
	Cases.		Deaths.		Cases.		Deaths.		Cases.		Deaths.		Cases.		Deaths.	
	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.
January ..	500	117	119	23	30	7	16	4	744	198	12	3	39	7	30	6
February ..	400	66	59	8	18	4	11	4	743	138	9	..	24	3	15	3
March ..	390	96	74	4	25	8	15	5	923	182	10	2	21	3	15	3
April ..	385	63	54	10	34	8	15	—	865	162	1	10	21	1	15	..
May ..	354	51	76	7	48	10	20	6	964	189	15	..	36	1	32	1
June ..	315	75	58	7	55	17	26	9	1,217	299	18	5	23	6	12	4
	2,344	468	440	59	210	54	103	28	5,456	1,168	65	20	164	21	119	17
Per cent. Mortality	18·77		12·60		49·05		51·85		1·19		1·71		72·56		80·95	
Total per cent.	17·7				49·6				1·3				73·5			

D. 7*a*.—RETURN OF COLOURED LABOUR SHOWING NUMBERS OF NATIVES ADMITTED TO HOSPITAL AND MORTALITY AMONG SAME.

JULY, 1903, TO DECEMBER, 1903.

Month, 1903.	Pneumonia.				Phthisis.				Other Respiratory Diseases.				Meningitis.			
	Cases.		Deaths.		Cases.		Deaths.		Cases.		Deaths.		Cases.		Deaths.	
	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.	U.	S.
July ..	1,154	239	305	53	38	8	21	3	989	320	10	4	45	3	34	4
August ..	758	183	225	40	34	7	11	4	1,043	268	14	..	43	6	38	5
September	676	200	203	34	41	5	15	3	993	248	12	2	29	2	15	3
October .	662	156	186	40	48	11	21	7	883	236	16	4	33	8	19	7
November ..	723	155	180	32	40	11	17	7	809	202	18	5	38	10	20	5
December ..	727	138	192	30	49	6	22	12	824	177	6	2	41	3	30	4
	4,700	1,071	1,291	229	250	48	107	36	5,541	1,451	76	17	229	32	156	28
Per cent. Mortality	27·47		21·3		42·80		75·00		1·37		1·17		68·12		87·50	
Total per cent. ..	26·3				48·0				1·33				70·5			

U.—Underground. S.—Surface.

E.—COMPARISON OF THIRTEEN SELECTED MINES. (See Chart 3.)

E. 1.—Average complement of Natives Employed from 1st July, 1903, to 30th June, 1904. Grouped Territorially.

	A.	B.	C.	D.	E.	F.	G.	H.	I.	J.	K.	L.	M.	Totals.
Cape Colony ..	10	9	40	89	161	201	348	4	43	18	62	312	12	1,309
Bechuanaland ..	2	..	2	..	2	..	1	..	..	..	4	..	..	11
Basutoland ..	49	3	19	296	22	124	2	18	3	1	..	11	8	556
Orange R. Colony	..	..	..	..	122	..	..	..	..	..	..	1	..	123
Transvaal ..	264	139	218	122	231	..	84	50	28	92	6	7	11	1,252
Portuguese—														
S. of Lat. 22° .	526	928	1,370	723	3,409	1,052	704	641	788	855	929	922	1,311	14,158
N. of Lat. 22°.	27	..	..	284	64	..	109	4	55	..	5	..	..	548
British C. Africa	..	..	..	..	295	..	..	..	..	..	..	..	..	295
German South-West Africa ..	..	..	..	..	1	..	52	50	..	..	..	..	..	103
Others	..	10	26	288	45	54	54	7	..	8	38	57	16	603
	878	1,089	1,675	1,802	4,352	1,431	1,354	774	917	974	1,044	1,310	1,358	18,958
Total recruited during year ..	1,107	979	1,945	1,879	4,281	1,261	1,360	633	671	789	1,441	1,512	1,358	..

E. 2.—Average Number of Natives Employed from each Territory, rendered as Percentages of Total Average Number Employed.

Sources of Supply between 1/7/03 to 30/6/03.	A.	B.	C.	D.	E.	F.	G.	H.	I.	J.	K.	L.	M.
Cape Colony ..	1·13	0·82	2·38	93	3·69	14·04	25·70	0·51	4·68	1·84	5·91	23·82	0·88
Bechuanaland ..	0·22	..	0·11	..	0·04	..	0·07	..	..	..	0·38	..	..
Basutoland ..	5·58	0·27	1·13	16·42	0·50	8·66	0·14	2·32	0·32	0·10	..	0·83	0·58
O. R. Colony ..	..	..	..	..	2·80	..	..	..	..	..	..	0·07	..
Transvaal ..	30.07	12·76	13·01	6·77	5·30	..	6·20	6·45	3·05	9·44	0·57	0·49	0·81
Portuguese—													
S. of Lat. 22° ..	59·90	85·21	81·79	40·12	78·33	73·51	51·99	82·81	85·93	87·78	88·98	70·38	96·53
N. of Lat. 22° ..	3·06	..	..	15·76	1·46	..	8·05	0·51	5·99	..	0·47	..	..
British C. Africa ..	..	..	..	..	6·79	..	..	..	..	..	..	..	..
German S. W. Africa	..	..	..	..	0·23	..	3·84	6·45	..	..	..	..	..
Others	..	0·91	1·55	15·98	1·03	3·77	3·98	0·90	..	0·82	3·63	4·35	1·17

E. 3.—Analysis of Recruiting Figures.

	A. Total Recruited.	B. Recruited Directly from Native Territories.	C. Voluntary (Locally Engaged).
A.	1,107	1,025	82
B.	979	911	68
C.	1,945	1,777	168
D.	1,879	1,454	425
E.	4,281	4,156	125
F.	1,261	907	354
G.	1,360	1,119	241
H.	633	468	165
I.	671	521	150
J.	789	752	37
K.	1,441	370	1,071
L.	1,512	657	855
M.	1,358	288	1,070
	19,216	14,405	4,811

E. 4.—Relation of Death-rates to Degree of Replacement.

	Death Rates.	Total Percentage Replacement.	Percentage Replacement Recruited directly from Native Territories.	Percentage Replacement Locally Engaged.
A. ..	91·0	126·0	116·7	9·3
B. ..	85·5	89·8	83·6	6·2 (16·8)
C. ..	85·0	110·1	106·0	10·0
D. ..	84·0	104·2	80·6	23·5
E. ..	83·2	98·3	95·4	2·8 (4·5)
F. ..	70·7	88·1	63·3	24·7 (36·6)
G. ..	56·5	100·4	82·6	17·0
H. ..	52·9	81·7	60·4	21·0 (39·3)
I. ..	51·3	73·1	56·8	16·3 (43·2)
J. ..	35·6	81·0	77·2	3·7 (22·7)
K. ..	32·1	138·0	35·4	102·5
L. ..	30·3	115·4	50·1	65·2
M ..	19·9	100·0	21·1	78·7
N. ..	33·4	116·0	56·2	59·8

E. 5.—Data of Foregoing Table.

	A.	B.		C.		D.		
	Average Employed.	Total Recruited.	Percentage of B to A.	Allotted.	Percentage of C to A.	Voluntary.	Percentage of D to A.	Death Rates.
A.	878	1,107	126·0	1,025	116·7	82	9·3	91·0
B.	1,089	979	89·8	911	83·6	68	6·2	85·5
C.	1,675	1,945	110·1	1,777	106·0	168	10·0	85·0
D.	1,802	1,879	104·2	1,454	80·6	425	23·5	84·0
E.	4,352	4,281	98·3	4,156	95·4	125	2·8	83·2
F.	1,431	1,261	88·1	907	63·3	354	24·7	70·7
G.	1,354	1,360	100·4	1,119	82·6	241	17·0	56·5
H.	774	633	81·7	468	60·4	165	21·0	52·9
I.	917	671	73·1	521	56·8	150	16·3	51·3
J.	974	789	81·0	752	77·2	37	3·7	35·6
K.	1,044	1,441	138·0	370	35·4	1,071	102·5	32·1
L.	1,310	1,512	115·4	657	50·1	855	65·2	30·3
M.	1,358	1,358	100·0	288	21·1	1,070	78·7	19·9
	18,958	19,216	..	14,405	..	4,811	..	..
N.	1,132	1,314	116.0	637	56.2	677	59·8	..

E. 6.—Comparative Numbers of East Coast Boys Recruited direct from Native Territories and East Coast Boys Engaged Locally.

	Portuguese S. of Lat. 22°—Recruited directly from Native Territories.	Voluntary (Locally Engaged).
A.	490	12
B.	707	31
C.	1,029	44
D.	515	159
E.	2,576	41
F.	266	102
G.	239	29
H.	314	44
I.	506	45
J.	550	32
K.	316	913
L.	469	248
M.	283	994
Totals	8,260	2,694

Appendix G 2.

E. 7.—TOTAL DEATH RATES, CALCULATED PER 1,000 PER ANNUM.

1ST JULY, 1903, TO 30TH JUNE, 1904.

Mine.	1903. July.	Aug.	Sept.	Oct.	Nov.	Dec.	1904. Jan.	Feb.	March.	April.	May.	June.
A.	92·6	155·3	89·0	127·7	189·9	195·7	78·9	..	23·0	25·1	13·0	81·2
B.	168·1	140·2	73·0	96·3	70·0	88·3	98·0	57·2	64·0	61·3	85·8	32·6
C.	57·9	83·3	90·0	48·8	175·1	81·1	107·9	70·9	71·7	85·9	72·3	75·3
D.	101·6	78·5	84·7	138·5	134·9	141·8	120·2	31·1	54·4	24·9	40·5	54·3
E.	97·5	120·4	91·1	77·8	96·6	170·0	111·5	24·7	62·6	33·1	71·7	50·4
F.	265·4	74·8	89·3	64·9	81·1	34·2	59·3	49·0	31·5	21·6	21·8	66·3
G.	87·0	81·0	59·6	29·1	43·9	105·0	75·9	17·8	16·0	25·7	54·7	72·4
H.	66·7	66·7	27 0	94·5	46·8	103·4	72·1	45·1	13·5	27·8	78·1	..
I.	115·6	45·2	54·9	36·0	63·4	37·6	65·9	67·5	51·4	..	76·9	..
J.	61·7	47·1	23·4	10·7	87·0	..	34·5	68·9	12·2	10·9	34·5	35·9
K.	103·8	51·0	26·3	21·1	10·2	41·0	90·3	9·3	17·9	7·6	24·5	16·5
L.	14·3	53·2	95·1	55·2	42·9	17·6	8·8	23·7	36·1	20·2	27·1	..
M.	28·1	26·0	16·5	8·6	25·3	39·7	8·0	39·7	7·8	7·8	32·2	..

APPENDIX G. 3.

Appendix G 3.

CHARTS.

CHART (1).—Mortality of Natives on Mines and Works, Witwatersrand and District. November, 1902—July, 1904. (See Table A. of Appendix G. 2.)

CHART (2).—Number of Deaths amongst Whites in Johannesburg from all respiratory diseases, pneumonia, enteric fever, dysentery and diarrhœa, from November, 1902, to July, 1904. (See Table C. of Appendix G. 2.)

CHART (3).—Comparison of Thirteen selected Mines. (See Table E. of Appendix G. 2.)

Appendix H.

APPENDIX H.

CALCULATION OF AIR-CHANGE.

The following letter was received from Mr. J. R. Williams:—

[COPY.]

Metallurgical Department,
H. ECKSTEIN & Co.

Johannesburg, Transvaal,
14th October, 1904.

Dr. JAMES MOIR, Secretary,
Air-Space Commission,
Johannesburg.

DEAR SIR,

I beg to send you, enclosed herewith, twelve copies of certain calculations which have been made, for the use of members of the Commission.

Yours faithfully,

JOHN R. WILLIAMS.

[ENCLOSURE.]

RESULTS AS PER EXPERIMENT FOR 35 BOYS IN ROOM OF 8,700 C.F. OF AIR-SPACE.

At 1 a.m.—

Average internal air	0·000685 c.f. CO_2 per c.f. air.	
Average outside air	0·000363	do. do.
Vitiation of air, difference ..	0·000322	do. do. in room.

Room contains 8700 c.f. air.

Total vitiation of air in room $8700 \times 0{\cdot}000322 = 2{\cdot}8014$ c.f. CO_2.

35 boys at 0·6 c.f. per boy per hour for 2 hours =

$35 \times 0{\cdot}6 \times 2$ .. .. = 42·0000 do.

If air were not changed vitiation would now be .. 44·8014 do.

At 3 a.m.—

Actual condition is:—

Internal air	0·000640
Average external air	0·000363
Vitiation	0·000277

$8700 \times 0{\cdot}000277 = 2{\cdot}4099$ c.f. CO_2.

Amount of CO_2 vented from room in 2 hours ..	42·3915 c.f.
Amount of CO_2 vented from room in 1 hour ..	21·19575 c.f.
Average vitiated air above outside air at 1 a.m. ..	0·000322 CO_2 per c.f.
do. do. do. 3 a.m. ..	0·000277 do.
Average	0·0002995 do.

Each c.f. of air vented per hour, therefore, carries away:

0·0002995 c.f. of CO_2 ∴ c.f. of air which must circulate per hour.

$$= \frac{21{\cdot}19575}{0{\cdot}0002995} = \frac{70770{\cdot}45}{8700} =$$ capacity of room

Air changed 8.1345 *times* = 2022 c.f. of air circulated per boy per hour.

If 40 boys had been in room and analyses of air are assumed the same as in experiment, then for

35 boys:	CO_2 to be vented per hour	=	21·19575 c.f.
5 extra boys = 5 ×	0·6 CO_2 per boy per hour	=	3·00000 c.f.
40 boys		=	24·19575 c.f.

Each c.f. of air vented per hour carries away 0·0002995 c.f. of CO_2.

$$\therefore \text{ c.f. of air that must circulate per hour} = \frac{24 \cdot 19575}{0 \cdot 0002995} =$$

80787·1 c. feet Room contains 8700 c.f.

$$\therefore \text{ Air of room must change } \frac{80787 \cdot 1}{8700} = 9 \cdot 2858 \textit{ times per hour.}$$

NOTES BY THE SECRETARY.

These *data* are evidently taken from the experiments done at the Village Deep Mine in rooms without fires on 16th September, 1904. Nevertheless, the value of the calculations is almost annulled by the fact that a number of incorrect figures and illegitimate assumptions have been employed.

Thus (1) the volume of CO_2 exhaled per man during sleep must be corrected for the altitude, and is, therefore, not 0·6 cubic feet, but 0·73 cubic feet. (2) The *available* cubic space of the room is about 8,100 cubic feet, since the volume of the louvred hutch must not be counted. (3) The amount of CO_2 in the external air at 1 and 3 a.m. has been averaged, whereas the individual figures should have been used. (4) The factor by which the total CO_2 vented must be divided, is the amount of CO_2 *at the end* of the period, not the average.

If these corrections are made, the result for 35 boys is 12·95 changes per hour, and for 40 boys 14·8 changes per hour, instead 8·1 and 9·3 respectively.

Appendix I.

APPENDIX I.

CALCULATION OF THEORETICAL RISE OF TEMPERATURE IN THE AIR WHEN 3,000 CUBIC FEET PER HOUR IS SUPPLIED PER HEAD.

According to Halliburton (1902) the production of heat in the body in 24 hours (on Ranke's diet) is 2,281,000 calories, of which 367,000 calories are accounted for by evaporation in the lungs, and 65,000 by loss in warming food, etc. Hence the amount available for heating the air is 2,281,000 *minus* (367,000 + 65,000) = 1,849,000 cal. This corresponds to 77,040 calories per hour.

If 3,000 cubic feet of air at 630 mm. pressure and 17° C. be supplied per head, and the heat assumed to be equally distributed over this volume of air, the rise of temperature of the outgoing over the incoming air will be

$$\frac{77{,}040}{\text{weight of air} \times \text{specific heat of air}}$$ in degrees Centigrade.

This equals

$$\frac{77{,}040 \times \frac{9}{5} \text{ (for Fahrenheit degrees)}}{3{,}000 \times 28{\cdot}316 \times \frac{630}{760} \times \frac{273}{290} \times 1{\cdot}29 \times 0{\cdot}24}$$ which works out at 6·8° F.

(litres.) N.T.P. (grammes.) (specific heat.)