1813. *By Mr. Pearson*—Men engaged on lead processes at Port Pirie regularly work in seven shifts per week—56 hours. Would you express any opinion as to whether it is desirable that there should be a reduction in those working hours?—I think there should be a reduction.

1814. To six days instead of seven?—To 48 hours.

1815. *By the Chairman*—Are there any further statements you would like to make to the Commission?—One point which I overlooked was in regard to the possibility of carbon monoxide poison occurring at Port Pirie. Do I understand that from the information given to you there were places where quite considerable quantities of carbon monoxide passed into the air? Before assuming that the cases reported are cases of lead poisoning, steps should be taken to see to what extent, if any, carbon monoxide absorption is taking place. In my opinion it is quite easy to examine persons at work in an industry to determine whether they are taking in carbon monoxide. If that were found it might profoundly modify one's interpretation of those cases which have been described to me at the commencement of my evidence.

1816. It is your opinion, then, that continued absorption of carbon monoxide may be provocative of certain symptoms comparable to those of early lead absorption?—I think that some of those descriptions read by you are typical descriptions of carbon monoxide poisoning, and those cases in which this curious tremor and wasting are observed, and no colic, look extremely like the pictures which have been described by other persons as cases of carbon monoxide poisoning. I am distinctly of the opinion that a Medical Board should have power to certify when persons have recovered from lead poisoning.

1817. *By Mr. Pearson*—Do you consider that the Medical Board should decide on the point whether men should be excluded from the industry?—Yes.

1818. *By Mr. Gepp*—How far, if it is felt necessary by the Commission that there should be a further survey in regard to a number of these cases in order to determine as nearly as we can definitely the reason for the very large increase, would it be possible for a consultation between South Australian medical men, who have been in touch with this subject, and yourself, and Dr. S. A. Smith, based to a considerable extent upon the clinical cards of all examinations which have taken place, presuming that those cards have been framed broadly on the lines of the cards you have laid down for use at Broken Hill?—I think we could make use of those cards. Personally, I would be very loth to form an opinion without seeing some of the persons, typical cases, before using what is recorded on the cards. After seeing how the cards are recorded it would no doubt be possible to make some use of the cards.

1819. How long would that take, provided we had, say, 100 cards, all prepared on a clinical basis, those cards being made out on the lines which you would ask for? How long would it take for men of experience, like yourself and Dr. S. A. Smith, to come to the point at Port Pirie whether you could advise the Commission as to your definite view in regard to those typical cases?—One could examine 100 persons in a week thoroughly.

1820. And as a result tell the Commission your view of what those cases are?—We would be in a position to give an opinion at the end of that week.

1821. Failing an arrangement of that kind being made, if the cards were sent to you here, and some of the men were sent here, such men being nominated by yourselves from the cards if you like, would that be a possible method?—I see no reason why the men should not be examined here as well as at Port Pirie, though I think it would be much easier for all concerned for them to be seen at Port Pirie.

The witness withdrew.

STEWART ARTHUR SMITH, medical practitioner, 147, Macquarie Street, Sydney, was sworn and examined:

1822. *By the Chairman*—What appointments do you hold? —I am Hon. Physician at the Royal Prince Alfred Hospital, and lecturer in Neurology in the University of Sydney.

1823. You were a member of a Technical Commission which inquired at Broken Hill into miners' diseases?—Yes.

1824. Will you give the Commission a brief description of the work and the type of cases you came across at Broken Hill, and also a statement of your experience among cases of lead poisoning subsequent to that?—At Broken Hill, for many months, I was considering the problems of lead poisoning as it was occurring in metalliferous miners who had been exposed to small doses of dust for long periods. The acute type of case was not met with in this investigation at the time of examination. The types of cases met with in Broken Hill were of a chronic type. In addition to my experience at Broken Hill, I have investigated for a considerable period of years several industrial groups in Sydney, namely, potters, printers, stove enamellers, and carriage painters, with a number of isolated instances among accumulator workers, gasmeter solderers, and others.

1825. During the work of that Commission at Broken Hill, the question of lead poisoning came under your notice?—Yes.

1826. Will you give this Commission your definition of lead poisoning, dealing with the mode of entry of lead into the body, and bearing in mind the fact that this Commission deals with lead in smelters?—Perhaps I might best start by defining lead absorption. Lead absorption is a term which has a purely bio-chemical meaning. It connotes the fact that lead has been absorbed by the tissues. If following this chemical effect there is evidence that the tissues have been damaged by the absorption, then lead poisoning has occurred.

1827. Could you give us some figures relating to absorption and the amount required to produce the poisoning in that connection?—I will first refer to the accepted standards, which are based largely upon Duckering's work, in which it was laid down that a daily dose of two milligrammes of lead is the lowest daily dose which, absorbed over a long period, may ultimately produce lead poisoning. In the case of a man working at manual work, for a full day's work, that may be taken to represent that he has been working for that period in an atmosphere containing about five milligrammes of lead, suspended as dust, per 10 cubic metres. At Broken Hill an estimate was made of the daily intake through inhalation by an underground work. This, necessarily, was only approximate. It was arrived at by consideration of the results of the dust sampling and applying those to the periods of time in the day when a man would be exposed to the varying conditions. By those means an estimate was made that an underground miner would be exposed in his ordinary work to the inhalation of a daily dose of somewhat less than two milligrammes of lead. Speaking from memory, I think that that amount was somewhere about 1.5 milligrammes. The incidence of lead poisoning in that large industrial group indicated that the lead hazard there was not a very big one, in comparison with other industries with which we are familiar. So I take it that the old accepted standard is somewhere near the truth. That means that men exposed in their daily work to the inhalation of an amount of lead as dust between one and two milligrammes will, if they are susceptible persons, in only a few instances develop lead poisoning. The majority of such instances will be lead poisoning of a minor grade. Industrial lead poisoning is an inhalation disease, that is, the portal of entry which forms the most and indeed the only considerable danger is by the respiratory tract. It is not possible to say that lead poisoning does not occur by ingestion in industry, but it is possible to say that that is a very inconsiderable cause. Lead poisoning arising from absorption through the skin does not occur industrially.

1828. Will you give a statement relating to the diagnosis of lead poisoning, especially dealing with the differential diagnosis, and the relative importance of signs and symptoms? —The signs of lead absorption are the blue line at the gums, lead in faeces, and lead in urine. The blue line is only a sign of lead absorption. In that it is dependent on the health of the tissues of the mouth, it is an irregular and relatively

infrequent sign of lead absorption. Lead in faeces is in the present state of our knowledge, of little value as a sign of lead absorption in that it is impossible to differentiate how much of the lead in faeces is lead which has been absorbed, and how much is lead which has passed through the digestive track without absorption. Lead in urine is the most reliable sign of absorption. All the lead present in urine has been absorbed before excretion, and it is a very delicate test of lead absorption. It is not necessarily a sign of lead poisoning. As to changes in the blood, many authorities regard these as indications of lead absorption, for example, basophilic degeneration of the red cells. The experience at Broken Hill of the almost complete absence of basophilic degeneration of red cells is one of the reasons why I hold the opinion that this is not a sign always of lead absorption. Since it occurs in such diseases as pernicious anaemia, malaria, and indeed in all severe anaemias, its value as a sign of lead absorption is limited. Also, it is an inconstant phenomenon in cases which are recognisably cases of lead poisoning. Other changes in the blood, in the red cells and in the white cells, are not reliable guides in diagnosis. Therefore, it devolves upon simple clinical examination and an attentive study of the history of the individual for a reliable diagnosis.

1829. There are no definite metrical standards at present, but it is rather a clinical question than anything else?—Yes.

1830. According to what we have just established, then, it does not require a laboratory for the diagnosis of lead poisoning on those lines?—No.

1831. At the same time I take it that a laboratory would be a very useful aid in diagnosis in many instances?—Certainly. Perhaps I might say that in the present state of our knowledge it is a clinical problem, but in my own practice I invariably make use of the laboratory in dealing with all cases.

1832. Will you give us a statement dealing with the influences, if any, of the state of nutrition, physique, nationality of sufferers, also of intercurrent diseases on the incidence of lead poisoning?—Of my own knowledge I have no evidence to show that physique has any influence on determining lead poisoning, nor have I myself any knowledge as to the affect of nationality. At Broken Hill the cases of lead poisoning were not sufficiently numerous to enable us to express an opinion as to the effect of nationality. The experience that Broken Hill supplied was that there was no evidence of the effect of intercurrent disease in producing lead poisoning, but my experience of lead poisoning in general has given me the opinion that diseases of the vascular and renal systems might determine the occurrence of lead poisoning to some extent. That is to say, an individual with chronic degenerative changes in the blood vessels or in the kidneys is more likely to be damaged by the absorption of lead than healthy people. I would add to that that diseases which affect the same organs as lead would prejudice the health of the individual if exposed to lead, such of alcoholism (over-indulgence in alcohol) and syphilis.

1833. *By Mr. Gepp*—Do you also include gout and oral sepsis?—I would include gout. I do not know that I would include oral sepsis.

1834. *By the Chairman*—Do you subscribe to the teaching of Hunter that oral sepsis is an influential process in many cases of pernicious anaemia?—I believe that in many cases of pernicious anaemia the evidence points to oral sepsis as having been the starting point.

1835. The clinical picture of pernicious anaemia would not be likely to be confused with the anaemia due to lead poisoning?—No.

1836. At Port Pirie a large percentage of the employees are Mediterranean Europeans of recent arrival in Australia. They live under conditions of filth in many instances. There are no indications of a great many of them bathing, and the general opinion of the Commission is that a great many of them live and sleep in their clothes in barracks during the early months of their residence in Australia. Their diet consists largely of tinned stuffs, tinned fish in particular, and it is among these people that a very large number of cases of reported plumbism are occurring. Do you consider that conditions of living, cleanliness, and feeding would influence the incidence of those cases?—In regard to cleanliness, I would say yes, from two causes: firstly, from the fact that clothing heavily impregnated with lead dust might easily be an appreciable factor in exposure to lead, both in and out of working hours. Secondly, because of the psychological effect of insistence upon cleanliness. I would qualify this by stating, however, that, no matter how clean the workmen are, if there is still a noxious amount of dust in suspension in the air, cases of lead poisoning will still occur with frequency. As regards diet, I have no observations of my own on which to base any opinion. My only knowledge of the effect of diet is from my reading.

1837. At the same time it would sound to be a reasonable hypothesis that a cheap diet, which would be insufficient almost to sustain life in an Australian, would not tend to add to the physique and general state of nutrition of those people, and there may be some indirect influence of that nature operating?—Yes. I have no definite evidence of such, but it is a matter of general knowledge. If the standard of living is too poor, obviously the general health must suffer.

1838. A medical witness in Port Pirie put forward the suggestion that the drinking of large quantities of acid wine might have a chemical effect in altering the solubility of lead within the body. Would you offer any comment on that statement?—I would not care to do so.

1839. Is it not a common experience for workers in lead to experience abdominal discomfiture shortly after their occupation commences?—Of my own knowledge I do not know that; according to text books, yes. I have, however, made a habit of inquiring of all individuals whom I examine—and I see quite a number every week—who are workers in lead. The general impression I have gained from them is different from that gained from text books.

1840. Do you regard it as likely, then, that a tolerance to lead is established in lead workers during prolonged work?—I think it likely, but I have no investigations of my own on which to base that opinion.

1841. If such were the case, the occurrence of large numbers of cases of reported plumbism with mild symptoms after a short period of service might possibly be cases who have not established that tolerance?—Yes. I might put that in another way. The occurrence of these cases with mild symptoms might indicate a mild degree of susceptibility in those individuals.

1842. Have you had any experience to indicate that that mild degree of susceptibility would disappear during prolonged work?—I have no experience of my own to guide me.

1843. In view of that, would you recommend that such individuals should be excluded from working in lead after recovering from those mild symptoms?—The occurrence of a single attack of slight or mild gastro-intestinal symptoms would not, in my opinion, warrant the exclusion of an individual from the industry. Repeated attacks, even if they be only of a mild character, would be a sufficient ground to exclude an individual from the industry. The occurrence of a single attack of outspoken nervous type of plumbism would, I think, warrant the exclusion of the individual.

1844. *By Mr. Gepp*—If that particular attack could be traced to a possibly accidental overdose, would that modify that statement?—Yes. I had in mind normal conditions of exposure when I made that statement.

1845. If a man got an overdose through accident, would you then say that man should go back and see whether he developed tolerance?—Yes.

1846. *The Chairman*—I presume, Mr. Gepp, you are referring to such a condition as arises, for innstance, when a furnace "blows through?"

1847. *Mr. Gepp*—Yes.

1848. *The witness*—There is on record, for example, an experience in white lead works where additions were being made to the factory. These necessitated the pulling down of some old buildings, on the rafters of which was the dust accumulation of years. As a result of the disturbance of this dust a sharp

epidemic of lead poisoning developed among the men working.

1849. *By the Chairman*—Are there any further points you would care to embody in a statement relating to the definition of lead poisoning diagnosis, and the question of susceptibility and tolerance?—I do not think there is anything very material.

1850. *By Mr. Gepp*—Is it possible to give an indication of the time you would expect mild attacks at the beginning of employment to last, attacks such as we have been talking about?—From my experience among workmen in this city these attacks might be expected to last from two to six weeks, at the end of which time the man might be expected to go back into his employment.

1851. *By the Chairman*—In view of what we have heard from you, do you think it practicable to prescribe a standard form of medical examination which would ensure uniformity in diagnoses of lead poisoning?—Yes; with the reservation that a good deal of experience among lead workers is necessary.

1852. Will you make a brief statement giving such criteria as should be established in making a diagnosis?—There is no single criterion by which the presence of lead poisoning can be determined. An attentive study of the history of the individual is of great importance. It is necessary to inquire closely into his industrial history and into the accounts of past illnesses from which he has suffered. The history given by the patient of "colic" is not of itself sufficient. Careful inquiries must be made as to the type of pain, its duration, and the factors which affected it. I find from experience that it is usually possible in such cases to satisfy oneself if the pain complained of by the individual was the characteristic lead colic. A history of paralysis or weakness is also insufficient. Careful inquiry must be made as to the distribution of the paralysis or paresis. One attaches more importance to a definite history of paralysis of the extensor muscles than to any other form of paralysis. The examination of the patient must be carried out with extreme care. The occurrence of that peculiar pallor, which is difficult to describe, but which experience teaches is a very real thing, is of great importance.

1853. *By Mr. Gepp*—Have you had any experience in detecting that particular pallor in men of very dark complexion?—No.

1854. From your experience with that pallor, would it be very difficult definitely to diagnose that pallor in men of very dark complexion, such as Mediterranean Europeans?—I think there would be greater difficulty with them, but I am of the opinion that it would be a definitely recognisable thing.

1855. It would take some experience, I presume?—I think so.

1856. Is that pallor the result of anæmia?—Only partly. It is due partly to vaso-motor spasm. It is a very striking experience that men who show profound pallor do not show on examination of the blood as much diminution in their haemoglobin value or in their red cell count as one would expect from their appearance.

1857. It is not in any way a lead pigmentation?—No. The state of the nutrition is of considerable importance. In individuals in whom marked changes in nutrition are present, and in whom careful examination fails to reveal a clearly defined cause for this, if they have been exposed to a lead hazard, it is of considerable importance in diagnosis. The occurrence of peripheral neuritis, especially of a motor type, and more especially the extensor muscles of the arm, must also be given great weight. The occurrence of tremors and exaggeration of the reflexes are also to be noted, but where occurring without other and more definite evidence of lead intoxication are of limited value in diagnosis. The occurrence of signs and symptoms of chronic degeneration in blood vessels and (or) kidneys presents one of the most difficult problems when one comes to assess its value in diagnosis. I have made a careful examination of the incidence of chronic arterio-renal disease in the various occupational groups examined at Broken Hill and have compared them with a similar analysis of over 700 workers in sandstone in the Sydney district who have not been exposed to a lead hazard. This supplies evidence which points to the fact that arterio-renal disease occurs to a greater degree in lead workers whose past history, or whose present condition, reveals other evidences of lead poisoning. I am of the opinion that it is possible to arrive at a conclusion as to the influence lead has had in determining arterio-renal disease in any individual by searching in his past history or present condition for other evidences of the occurrence of lead intoxication. In other words, it is very doubtful if arterio-renal degeneration occurs in lead workers as the only evidence of lead intoxication.

1858. In Port Pirie at present the method of notification and compensation under the Workmen's Compensation Act is briefly as follows:—Certificates are made out by any one of the local practitioners in the town. In the event of the man or his employers being dissatisfied with the diagnosis the patient is referred to a medical referee. That throws a good deal of responsibility on the local practitioner, especially in estimating incapacity. The Commission has under consideration a recommendation for the formation of a referee board to consist of three medical officers whose decision would be final. They would be in the position both of certifying officers and referees. In your opinion, would that be a preferable procedure, and would you care to comment upon it?—I feel strongly that some such system as you suggest would be much preferable to the one at present in existence. In acute outspoken cases of lead poisoning no difficulties of diagnosis present themselves, but there occur so many doubtful and difficult cases that a more satisfactory decision will, I am sure, be arrived at by a board who are continually dealing with cases of this type. It also tends to ensure a uniform adoption of criteria in diagnosis.

1859. Do you consider it advisable that all applicants for work in lead processes should undergo a preliminary examination?—Yes.

1859A. Do you consider periodical medical examinations, conducted, say, by a medical officer in the employment of the works, an advisable scheme?—Very.

1860. That is whether the men are complaining of illness or not?—Yes; a general medical examination.

1861. In the event of a medical staff being organised in such works, do you consider its augmentation by a dental service would be beneficial to the men, especially from the standpoint of preventing lead poisoning, but also on general lines?—I do not believe it would have any marked specific effect in preventing lead poisoning, but it is undeniable that it would have an admirable effect upon the general level of health of the employees.

1862. Are there any other remarks that you are in a position to make which you think would help the Commission with its problem?—There is, perhaps, the question of the powers of the Medical Board. I think the Medical Board should be charged with the duty not only of determining when individuals are affected with lead poisoning, but also with the duty of determining when they have recovered. The board should also have the power to call up for examination at set periods individuals whom they have previously certified as suffering from plumbism.

1863. *By Mr. Pearson*—I take it that you mean the Board should also have the duty of determining whether any susceptibles should be excluded from the industry?—Yes.

1864. *By the Chairman*—Do you consider that lead poisoning should be made a notifiable disease in South Australia?—Yes.

1865. *By Mr. Gepp*—With the permission of the Chairman I am handing you a translation of an article on lead poisoning by Professor Biondi, of Vienna, which has been forwarded to Australia for the criticism of the Commonwealth Department of Health by the International Labor Office of Geneva. With the agreement of Professor Chapman would you be so good as to supply in writing to this Commission your general comments upon this article?—Yes.

1866. As a pure suggestion, and with nothing at the moment to base it on, I would like to mention to you that at Broken Hill the conditions underground are approximating to saturation in moisture whereas the percentage of humidity at Port Pirie is very low. Whilst, of course, it is impossible for you to make any comment on that at the moment, would you discuss the matter with Professor Chapman and see if you think

it in any way affects the position the Commission has before it, namely the very large number of mild cases reported by the local medical practitioners? Will you communicate in regard to that question with the Commision in writing?—Yes.

1867. Would you be good enough to look at the references to the Commission by the South Australian Government. (Handed to witness.) I also submit to you Table L, which is a summary of the statistical evidence tendered by the Smelting Company. (Table L shown.) You will notice that Mediterranean Europeans about 10 per cent., also that cases of the Nordic races—British, Germans, and Scandinavians—have risen from 1 to 3 per cent., with some indication of a reduction over a recent period. That is one of the problems we are faced with. You have had no experience in your work either at Broken Hill or in Sydney which would throw any light on that extraordinary state of affairs?—No.

1868. Is it possible that if small quantities of lead were being taken into the system by an almost invariable diet of tinned fish it might aggravate a position which might not otherwise show up in the way of statistics?—That is quite possible.

1869. What is your opinion of the living conditions in their effect upon the resistance of men who have come to Australia within, say, 12 months, and are employed at the smelters? By living conditions I mean housing, diet, and personal hygiene? —Unsatisfactory conditions of diet in so far as they effect nutrition, and of hygiene in so far as they affect cleanliness, would undoubtedly have an effect upon the general level of health of any group of men.

1870. In industrial work generally, the man with a knowledge of the hazards would be able to protect himself against a considerable number of the dangers, would he not?—Yes.

1871. Is it, in your opinion, possible for a supplementary cause, that a number of these men are unable to speak English, and unable to read notices even in their own language, and understand the precautions which it is advised should be taken? I think that is probably a very important cause.

1872. You say that from your general knowledge of industrial hygiene, quite apart from any special lead risk?—Yes.

1873. The main cause of plumbism has been stated to us by a large number of witnesses, and is also stated in literature on the subject, as being dust taken in through the respiratory passages. Do you agree with that?—Yes. There are, of course, a number of very eminent authorities who hold the view that it is dust taken by ingestion, but all are agreed that it is dust.

874. Therefore in all these lead industries, every effort is made to reduce the amount of dust in the atmosphere?—Yes.

1875. Have you any experience of any special methods for the removal and prevention of dust in any of the industries with which you are associated professionally? I mean the prevention of dust reaching the lungs through getting into the atmosphere?—Yes.

1876. Could you tell us any that might be applied under the conditions of a lead smelting works?—I am not familiar enough with the conditions of a lead smelting works to give any suggestion.

1877. Do you know of any large scale works with motor vacuum apparatus or device which would obviate the distribution of considerable dust whilst dust was being removed, that is, the dust which has accumulated on the walls, purloins, and rafters of buildings?—No, not in a lead industry.

1878. Or in any other industry, taking the question generally of the removal of dust in difficult circumstances in a factory which is somewhat old?—No, I have not any experience.

1879. In the design of new buildings, I presume that a recommendation, if you were asked to make one, would be that the lodgment of dust should be eliminated by all possible means?—Yes.

1880. The Commission is considering all other possibilities apart from lead as being the cause of this large number of reported cases. If small but toxic quantities of carbon monoxide were present in the atmosphere, what effect would that have at such works as the Port Pirie smelters, first of all upon the health, and secondly, upon the diagnosis?—It would produce a lowering of the general level of the health of the men exposed, and might produce changes in the nutrition, in the blood, and in the nervous system which might give rise to difficulties in differentiating between the effects of carbon monoxide and lead.

1881. The Commission is considering the advisability of recommending methods of conveying to all employees, including new employees, education in regard to the hazards of the industry, and the methods by which they can protect themselves, and for the further purpose of rendering co-operation between the company and the men and the Government departments concerned easier. Have you any personal experience as to details of the methods which might be adopted for that purpose, for instance, by means of notices, booklets, special lectures, and so forth?—Yes, I know of the use of notices in Broken Hill and in other lead industries in this State, where the Board of Health has caused notices to be exhibited drawing the attention of workmen to the dangers and the methods of avoiding them. I believe that these have an excellent effect immediately, and a further influence of an educational nature, the effects of which are not seen so immediately, but which go on increasing with time.

1882. For many years there have been statutory regulations governing work in the lead industries of a number of countries, including Austria, Germany, and Great Britain. We were told yesterday by one of our witnesses, who had had 24 years' experience, that the results of statutory regulations in Great Britain were very definite, very quick, and satisfactory. From your experience, would you feel that regulations by law would be advisable in such an industry?—Basing my opinion upon the experience in Great Britain, I would say, yes.

1883. Are there statutory regulations in Broken Hill?—In some respects, yes. If a man disobeys certain regulations underground is he liable to be prosecuted under law?—I believe so.

1884. From your advices since you left Broken Hill have the results been satisfactory there?—Very.

1885. From your experience would you favor some workable and practicable scheme of clothing being laundered at regular intervals wherever lead dust might be flying about?—Yes.

1886. From the content of the lead in the urine can any indications be drawn for diagnostic purposes between absorption and poisoning?—I do not know that there is any definite work on that yet.

1887. The lead is estimated quantitatively, but conclusions have not yet been drawn?—On our present knowledge no definite conclusions on that point are warranted.

1888. From your experience of men in the lead industry could you tell us whether fat men or lean men are the more susceptible?—I have been unable to draw any conclusions.

1889. *By Mr. Pearson*—In connection with the question of bringing the dangers of lead poisoning under the notice of employees exposed to lead hazard, I notice the position at Port Pirie is that quite a number of the workmen are illiterate foreigners. I take it that under conditions such as those you would consider it useful to have their attention called to the hazard by interpreters when they are engaged, and make it one of the conditions of their employment that they are cognisant of the hazard they are undertaking?—I consider that it should be driven right home.

1890. The men employed in the lead processes of the smelters regularly work seven shifts a week, 56 hours; do you consider that the physical strain of employment under those conditions would lessen the resistance to lead poisoning?—Yes, it would, and it increases their exposure.

1891. Are you of the opinion that there should be shorter hours if it is possible to arrange for them?—I think so.

1892. Would you regard 48 hours as the maximum?—Yes.

1893. *By Mr. Gepp*—If the Commission desire your assistance for a week or a fortnight at Port Pirie, with that of Dr. Chapman, could that be arranged?—Yes.

The witness withdrew.

The Commission adjourned.

No. 57.

Saturday, June 6th, at 10 a.m.

[At Town Hall, Port Pirie.]

Present—

Dr. K. R. Moore (chairman).
Mr. H. W. Gepp.
Mr. J. L. Pearson.
Mr. W Robinette

JOHN HERBERT STEPHEN LEAHEY, assistant town clerk, Port Pirie Corporation, Town Hall, Port Pirie, was sworn and examined:

1894. *By the Chairman*—Have you prepared a statement showing the number of employees of the smelters who own their own houses in Port Pirie?—Yes. I have prepared a report, which is as follows:—

As directed by the Royal Commission on Plumbism, I have perused the pay-roll of the B.H.A.S. Proprietary, Limited, with a view of ascertaining the number of employees engaged at their works, who occupy houses owned or being purchased by them. The company submitted their pay-sheets for the fortnight ended March 11th, 1925, and these covered all men working on the works, with the exception of officers who are employed at a salary. I found that 319 of the employees own their homes. This information has been gathered from records made available to me by the corporation of Port Pirie, and I vouch for the correctness of the figures on these records.

1895. *By Mr. Gepp*—What was the number of men on the pay-sheet?—The company were going to supply me with the number of men on the pay-sheet, but have not done so.

1896. *By Mr. Robinette*—You have the pay-sheets in the office?—Yes, but the names were duplicated on occasions, and I could not arrive at the correct figure. The company would have to do that.

The witness withdrew.

JOSHUA RETCHFORD, stores manager, Broken Hill Associated Smelters' Co-operative Council, Port Pirie, was recalled and further examined:

1897. *By the Chairman*—I understand that for the information of the Commission you have prepared a statement setting out the quantities sold of certain of your goods?—Yes. I have made up the figures, and for the six months, November 1st, 1924, to May 1st, 1925—this is the fish selling period of the year—the lines ran as follow:—87 cases of salmon, each containing 6 dozen tins; 15 cases of herrings, each containing 100 tins; 110 cases of sardines, each containing 100 tins; 75 cases of kippered snacks, each containing 100 tins; 6 cases of red herrings, each containing 6 dozen tins, with six herrings to a tin.

1898. *By Mr. Robinette*—You do not keep a record of the number of people who deal at your store?—Not an actual record. There is no record of the actual number of sales made over the counter.

1899. Can you form an estimate of the total number of your customers?—I am afraid I could not give you that. The comings and goings at such a busy counter would be beyond my power of making even a rough estimate.

1900. *By the Chairman*—It is all cash trade?—Yes.

1901. *By Mr. Robinette*—Approximately, what is the turnover of the store in a year?—Somewhere about £80,000.

1902. Can you form any estimate of the number of employees who deal at the store?—I would not dare to make a definite statement, but I should say that we did fully 60 per cent. of the trade of the smelters.

1903. You have had much experience in storekeeping, have you not?—A life's experience.

1904. Would you consider the fish sold in the period you mentioned an abnormal quantity in an £80,000 turnover?—Not considering the class of men——

1905. Would you consider the sales to be abnormal in an £80,000 turnover?—I cannot answer the question unless I do it in my own way. I said that the sales were not abnormal according to the class of men who bought the fish. My answer must be guided by the class of men dealt with.

1906. I shall leave Port Pirie out of it. You have had much experience outside of Port Pirie. In places, other than Port Pirie, would you consider such sales as you mentioned abnormal in an £80,000 turnover?—In Rundle Street I should.

1907. Where has your experience in storekeeping been derived?—In Western Australia and South Australia.

1908. Which part of Western Australia?—Perth.

1909. You have never been a storekeeper in a country town?—Not until I came here.

1910. So that you are not competent to say whether the quantity of tinned fish sold here is abnormal for a country area?—For a country area, no.

1911. What store were you in in Rundle Street?—Foy and Gibson's.

1912. In the grocery department?—No.

1913. You have had no experience in South Australia in dealing in this class of goods?—Yes. I had six years and eight months' wholesale experience with J. W. Grasby & Co., Limited.

1914. Your wholesale experience would not enable you to know whether this is an abnormal amount of fish to be sold in a retail business?—It would not.

1915. Were you in the retail business in Western Australia?—Yes, with Foy & Gibson's.

1916. Did you have any idea of the turnover there?—No, and if I had I would not divulge it.

1917. Are the figures for the sale of tinned fish here out of proportion to those for the sale of similar goods by Foy and Gibson's Western Australian store?—I could not answer that question.

1918. How do you know the figures you have given us are out of proportion?—I made a statement to you just now. I can only imagine it.

1919. Do you know or do you not know whether these figures are out of proportion with other experience you have had, in an £80,000 turnover?—I cannot say.

1920. *By Mr. Gepp*—In answer to a previous question by Mr. Robinette you expressed the opinion that, from your general knowledge, the quantity of tinned fish sold here was greater, in proportion, than in Rundle Street, Adelaide?—I should think so. If I had been allowed to answer the question in my own way I should have made the thing plain.

1921. With the permission of the chairman, I should like you to explain the point of view you desired to make in answer to the general questions put to you by Mr. Robinette?—When I mentioned the class of men and was interrupted, I was about to say that it stood to reason that in an industrial centre of this kind, where so many men are single and "batch," this class of food would be used much more largely than in a city centre, where there are wives, restaurants, and so on, and where men would not be called upon to use tinned food as a quick expedient.

1922. From your knowledge is fresh fish available in Port Pirie as well as tinned fish?—From my experience fresh fish is hard to get, unless you catch it yourself.

1923. Comparing Port Pirie with a country town well inland, would there be more fresh fish available here than in a town like, say, Kalgoorlie?—Without a doubt there is more fresh fish to be had by the people here.

1924. Is there any other point you would like to make in order to round off your evidence?—No.

1925. *By Mr. Robinette*—Could you give us the retail prices of the items you mentioned?—Yes. The retail counter price of the salmon would be 1s. 5d. a tin, herrings 1s. 2d. a tin, sardines 3d. a tin, kippered snacks, 3½d. a tin, and the red herrings 1s. 1d. a tin.

The witness withdrew.

HENRY ST. JOHN SOMERSET, general superintendent of the Broken Hill Associated Smelters, Port Pirie, was recalled and further examined:

1926. *By the Chairman*—I understand you have some further information to supply in response to a request by the Commission?—Yes. The Commission asked me to prepare a graph showing the employment and lead poisoning statistics, having regard to the main plant alterations that had taken place over the period from the end of 1919 to the end of 1924. I put in the graph as requested. (Graph put in and marked Exhibit No. 24.) In order to get the information on a sheet of reasonable size we have had to plot the graphs in on two scales. The Commission will notice that in the extreme left-hand corner is the starting-point of a graph relating to the

total lead cases. The points of the graphs have regard to half-yearly periods covering the time with which the graph deals. In the half-yearly period ended 23/12/19 there were very few cases indeed. The graph runs along giving all the cases for each half-yearly period and from a point in the period ended 22/6/21 the foreign lead cases graph joins the main graph. Furthermore, in the period ended 21/12/21 the graph begins to rise very suddenly. The Commission will see that the British lead cases, the foreign lead cases, and the total lead cases are all shown from then to the final period. That section of the graph is self-explanatory after a little study. The graph shown in the next heavier white line relates to the foreign labor turnover. In interpreting the graph, if the Commission will look at the period ended 23/12/19 they will see that, approximately, 80 individuals of foreign extraction were employed on the works during that half-year. Then the graph explains itself. Going further up the sheet, it will be seen that the next graph line shows the average number of employees per day during each of the half-yearly periods. The next line shows the British turnover and the line above gives the total turnover.

1927. *By Mr. Gepp*—As I understand it, the lower lighter lines must be read entirely by themselves? No comparison is possible between the lower lighter lines and the top lines, because the former are on a scale five times smaller than the latter?—That is so. The Commission asked me to prepare certain tables so far as practicable up to date. We have compiled the information up to May 31. The first table I was asked to amend was that marked "C" (Exhibit No. 2). I now put in table "C1," showing the number of persons compensated for lead poisoning for the period 28/6/17 to 31/5/25. (Table put in and marked Exhibit No. 25.)

TABLE "C1."—REPORTED CASES OF LEAD POISONING.

Number of Persons Compensated for Lead Poisoning for the Period 28/6/17 to 31/5/25.

Half-year ended.		British.	Greek.	Maltese.	Italian.	German.	Scandinavian.	Russian.	Others.	Total No.
26/12/17	Per cent.	(100·00)	—	—	—	—	—	—	—	(100)
	No.	1	—	—	—	—	—	—	—	1
	Per cent.	·36	—	—	—	—	—	—	—	·19
26/6/18	Per cent.	(75·00)	—	—	—	—	—	—	(25·00)	(100)
	No.	3	—	—	—	—	—	—	1	4
	Per cent.	1·07	—	—	—	—	—	—	4·76	·77
25/12/18	Per cent.	(100·00)	—	—	—	—	—	—	—	(100)
	No.	1	—	—	—	—	—	—	—	1
	Per cent.	·36	—	—	—	—	—	—	—	·19
25/6/19	Per cent.	(100·00)	—	—	—	—	—	—	—	(100)
	No.	2	—	—	—	—	—	—	—	2
	Per cent.	·72	—	—	—	—	—	—	—	·38
23/12/19	Per cent.	(100·00)	—	—	—	—	—	—	—	(100)
	No.	3	—	—	—	—	—	—	—	3
	Per cent.	1·07	—	—	—	—	—	—	—	·57
23/6/20	Per cent.	(100·00)	—	—	—	—	—	—	—	(100)
	No.	4	—	—	—	—	—	—	—	4
	Per cent.	1·43	—	—	—	—	—	—	—	·77
22/12/20	Per cent.	—	—	—	—	—	—	—	—	—
	No.	—	—	—	—	—	—	—	—	—
	Per cent.	—	—	—	—	—	—	—	—	—
22/6/21	Per cent.	—	—	—	—	—	(100·00)	—	—	(100)
	No.	—	—	—	—	—	1	—	—	1
	Per cent.	—	—	—	—	—	10·00	—	—	·19
21/12/21	Per cent.	(100·00)	—	—	—	—	—	—	—	(100)
	No.	2	—	—	—	—	—	—	—	2
	Per cent.	·72	—	—	—	—	—	—	—	·38
21/6/22	Per cent.	(83·33)	(4·17)	—	—	—	—	(8·33)	(4·17)	(100)
	No.	20	1	—	—	—	—	2	1	24
	Per cent.	7·17	·82	—	—	—	—	25·00	4·76	4·59
20/12/22	Per cent.	(87·51)	(6·25)	—	(3·12)	—	(3·12)	—	—	(100)
	No.	28	2	—	1	—	1	—	—	32
	Per cent.	10·04	1·64	—	3·33	—	10·00	—	—	6·12
20/6/23	Per cent.	(78·93)	(5·27)	(2·63)	(5·27)	—	(5·27)	—	(2·63)	(100)
	No.	30	2	1	2	—	2	—	1	38
	Per cent.	10·75	1·64	2·27	6·67	—	20·00	—	4·76	7·27
19/12/23	Per cent.	(72·55)	(17·65)	—	(3·92)	(3·92)	—	—	(1·96)	(100)
	No.	37	9	—	2	2	—	—	1	51
	Per cent.	13·26	7·38	—	6·67	22·22	—	—	4·76	9·75
2/7/24	Per cent.	(55·34)	(22·34)	(3·88)	(9·71)	(1·94)	(0·97)	(1·94)	(3·88)	(100)
	No.	57	23	4	10	2	1	2	4	103
	Per cent.	20·43	18·85	9·09	33·33	22·22	10·00	25·00	19·05	19·69
31/12/24	Per cent.	(40·47)	(23·66)	(18·32)	(9·92)	(0·76)	(1·53)	(3·05)	(2·29)	(100)
	No.	53	31	24	13	1	2	4	3	131
	Per cent.	19·00	25·41	54·55	43·33	11·11	20·00	50·00	14·29	25·05
1/1/25 to 31/5/25 (5 months	Per cent.	(30·16)	(42·86)	(11·90)	(1·59)	(3·17)	(2·38)	—	(7·94)	(100)
	No.	38	54	15	2	4	3	—	10	126
	Per cent.	13·62	44·26	34·09	6·67	44·45	30·00	—	47·62	24·09
	Per cent.	(53·35)	(23·33)	(8·41)	(5·74)	(1·72)	(1·91)	(1·53)	(4·01)	(100·00)
	No.	279	122	44	30	9	10	8	21	523
	Per cent.	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

Numbers in parentheses represent percentage of the total numbers in the last column. Numbers not in parentheses represent percentages of the totals at the foot of the table.

In order to make the new table as useful as possible we have repeated table "C," which appears on page 9, with the necessary additions to bring it up to date. The figures for the five months ended 31/5/25 show that there were 38 British persons compensated for lead poisoning. Those 38 represented 30.16 per cent. of all the cases compensated during those five months. Further, they represent 13.62 per cent. of all the British cases reported for the whole period of eight and a half years since 1917. The black percentage figures refer to the headings under which the figures come and the red figures are the percentages on the whole of the nationalities set out.

1928. It is interesting to note the small number of Italian and large number of Greek cases?—Yes.

1929. Do the figures indicate that the high percentage of Maltese is maintained?—Yes.

1930. In our inspection of the town we came across foreigners who said they were Jugo-Slavs. Under which heading would they come?—Under the heading "Others." I put in table "M2," which shows the reported cases of lead poisoning during the period 28/6/17 to 31/5/25 having relation to the department of origin of contraction. (Table put in and marked Exhibit No. 26.)

TABLE "M2."—REPORTED CASES OF LEAD POISONING—28/6/17 TO 31/5/25.

Department of Origin of Contraction.

Period.		Refinery.	Top Floor.	Bottom Floor.	Dwight and Lloyd.	Huntington-Heberlein.	Ropp Roasters.	Ore Discharging.	Slag Pit.	Skinner Furnaces.	Acid Plant.	Service Depts.	Total.
28/6/17 to 21/12/21	Per cent.	(5·56)	(22·22)	(11·11)	(27·77)	—	(5·56)	(5·56)	(11·11)	—	—	(11·11)	(100)
	No.	1	4	2	5	—	1	1	2	—	—	2	18
	Per cent.	·95	5·19	1·92	6·41	—	9·09	20·00	33·33	—	—	2·63	3·44
22/12/21 to 21/6/22	Per cent.	(16 67)	(33·33)	(16·67)	(16·67)	(8·33)	—	—	—	—	—	(8·33)	(100)
	No.	4	8	4	4	2	—	—	—	—	—	2	24
	Per cent.	3·81	10·39	3·85	5·13	4·00	—	—	—	—	—	2·63	4·59
22/6/22 to 20/12/22	Per cent.	(12·50)	(31·26)	(9·37)	(25·00)	(6·25)	(9·37)	—	—	—	—	(6·25)	(100)
	No.	4	10	3	8	2	3	—	—	—	—	2	32
	Per cent.	3·81	12·99	2·88	10·26	4·00	27·27	—	—	—	—	2·63	6·12
21/12/22 to 20/6/23	Per cent.	(13·16)	(7·89)	(28·95)	(15·79)	(2·63)	(2·63)	(2·63)	—	(2·63)	—	(23·69)	(100)
	No.	5	3	11	6	1	1	1	—	1	—	9	38
	Per cent.	4·76	3·90	10·58	7·69	2·00	9·09	20·00	—	10·00	—	11·84	7·27
21/6/23 to 19/12/23	Per cent.	(25·49)	(5·88)	(25·49)	(21·57)	(7·84)	(1·96)	—	—	—	—	(11·77)	(100)
	No.	13	3	13	11	4	1	—	—	—	—	6	51
	Per cent.	12·38	3·90	12·50	14·10	8·00	9·09	—	—	—	—	7·90	9·75
20/12/23 to 2/7/24	Per cent.	(22·33)	(11·65)	(15·54)	(16·50)	(12·62)	(2·91)	(·97)	(·97)	(·97)	—	(15·54)	(100)
	No.	23	12	16	17	13	3	1	1	1	—	16	103
	Per cent.	21·91	15·58	15·39	21·79	26·00	27·28	20·00	16·67	10·00	—	21·05	19·69
3/7/24 to 31/12/24	Per cent.	(29·02)	9 92)	(16·79)	(6·87)	(13·74)	(1·53)	—	—	(3·05)	(·76)	(18·32)	(100)
	No.	38	13	22	9	18	2	—	—	4	1	24	131
	Per cent.	36·19	16·88	21·15	11·54	36·00	18·18	—	—	40·00	100·00	31·58	25·05
1/1/25 to 31/5/25, 5 mnths	Per cent.	(13·49)	(19·05)	(26·19)	(14·29)	(7·94)	—	(1·59)	(2·38)	(3·17)	—	(11·90)	(100)
	No.	17	24	33	18	10	—	2	3	4	—	15	126
	Per cent.	16·19	31·17	31·73	23·08	20·00	—	40·00	50·00	40·00	—	19·74	24·09
Total	Per cent.	(20·08)	(14·72)	(19·89)	(14·91)	(9·56)	(2·10)	(·96)	(1·15)	(1·91)	(·19)	(14·53)	(100)
	No.	105	77	104	78	50	11	5	6	10	1	76	523
	Per cent.	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

Numbers in parentheses represent percentage of the total numbers in the last column. Numbers not in parentheses represent percentages of the totals at the foot of the table.

All the information given in previous table "M" appears on this new table, and in addition, at the foot of the table figures are shown covering the five months from 1/1/25 to 31/5/25. Take, for example, the refinery section. There were 17 cases there from 1/1/25 to 31/5/25. Those 17 cases represent 16.19 per cent. of all the cases that have come from the refinery during the period under consideration. Further, they represent 13.49 per cent. of all the cases that occurred during that five-monthly period.

1931. *By Mr. Pearson*—The figures show that the incidence of lead poisoning appears to be increasing in the blast furnace and D. and L. plant sections. Forty-five per cent. of the cases reported in the last five months are in connection with the blast furnaces?—Yes.

1932. *By the Chairman*—For the period ended 31/12/24 the figure for the top and bottom floors and the D. and L. plant was 31 per cent., but for this period of five months it is 60 per cent.?—Yes. I cannot understand that, because the practice has not changed in any of our sections.

1933. *By Mr. Gepp*—The refinery figures have dropped more than 50 per cent.?—Yes.

1934. Is it not very difficult to tie down the origin of contraction because of the number of changes that go on? It is hard to understand why the figures vary so greatly?—Yes.

1935. *By Mr. Robinette*—Have there been any alterations in those departments?—Alterations were going on, but they were not in operation during the period covered by the latest figures.

1936. There has been an alteration in the D. and L. plant?—No. Less work is being done on the H. and H. plant, but that comes under a separate heading.

1937. In the D. and L. plant there has been an alteration in the process?—No.

1938. *By Mr. Pearson*—With the reduction in the quantity of material treated by the H. and H. plant I take it that increased tonnage has been put through the D. and L. plant?—Yes, but the increased tonnage is treated in precisely the same way as before. The same number of machines are working, but they are working in a different way. More men are not required to work there.

1939. *By Mr. Gepp*—Has there not been a more intense campaign in settling dust and in watering down during the last five months?—No.

1940. It is just about the same?—Yes.

1941. From an inspection of the D. and L. plant it seems very hard to understand the cause of the lead cases there, as there is plenty of fresh air, the atmosphere is clear, and there is little dust. Yet here is this rise in the number of cases?—It is very hard for me to appreciate, especially in view of the fact that in the old D. and L. plant operations the men were completely boxed in and did not get the benefit of the fresh air to the degree that they do now.

1942. *By Mr. Robinette*—Did you not say in your previous evidence that the advance in the D. and L. plant was due to the elimination of the H. and H. pots?—Not the elimination; I said the reduction.

1943. There must be an alteration in the process?—No. There is only a different bed on the machines. The machines are working in just the same way.

1944. There must be some alteration in the process to do away with those pots?—There has been no alteration in the process. All we have done has been to deepen the charge on the B section of the D. and L. machines.

1945. *By Mr. Pearson*—Previously it was so many inches thick, now it is thicker?—Yes.

1946. *By Mr. Robinette*—More heat is required to solidify that?—No.

1947. The belts travel more slowly?—Yes.

1948. So there has been an alteration?—Not in the process.

1949. But in the method of treatment?—Yes.

1950. *By Mr. Gepp*—Can you see how that would make any difference in the atmosphere?—Taking the combined D. and L. and H. and H. plants there would be less hazard now than there was previously.

1951. *By Mr. Robinette*—It would take more water to damp down a 9in. bed than a 3in. bed?—Yes.

1952. Are you using more water?—Yes. We damp it down thoroughly. I propose to put in a further table marked "Q" showing the labor turnover and employment at the smelters. (Table put in and marked Exhibit No. 27.)

TABLE "Q."—LABOR TURNOVER AND EMPLOYMENT.

Half-year ended	23/12/19.	23/6/20.	22/12/20.	22/6/21.	21/12/21.	21/6/22.	20/12/22.	20/6/23.	19/12/23.	2/7/24.	31/12/24.	1/1/25 to 31/5/25 (5 months).
1. Labor turnover.....	2,412	1,415	1,302	905	1,338	1,545	1,746	2,308	2,213	2,552	2,615	2,650
2. Daily average strength	1,079*	651*	794*	419*	683*	1,004	1,208	1,339	1,430	1,595	1,601	1,681
2 as per cent. of 1	44·73	46·01	60·98	46·30	51·05	64·98	69·19	58·02	64·62	62·50	61·22	63·43

* During these periods the rotation scheme was in operation. During the shut-down period from July, 1919, to August, 1921, owing to the Broken Hill strike and the fire at the D. & L., a labor roster was drawn up, and the available work distributed among the men to minimise distress.

This table shows the labor turnover in half-yearly periods from 23/6/19 to 31/5/25 and the daily average strength. It also sets out the daily average strength as a percentage of the total turnover each half-year. It will be seen nat in line 2 certain of the figures are followed by the letter "a." That letter refers to the note at the bottom of the table. It simply explains why the turnover in some instances was less or greater than in others.

1953. *By Mr. Gepp*—Why was the percentage of 69.19 in the period ended 20/12/22 so much in excess of the other percentages? Is there any explanation?—None that I can give.

1954. Was it due to the fact that you had a period of partial employment?—With one exception the percentages are low where the figures are followed by the letter "a." The reason is this. When the plant was shut down the available work was distributed among our employees in turn. There was no work for any other people, so that our labor turnover figure with regard to the number of people on the books naturally was smaller, because new men could not get on the books, there being not sufficient work to go round among the men already on.

1955. *By Mr. Pearson*—You took no applications for employment?—We could not.

1956. *By Mr. Robinette*—I understand you have a doctor employed at the works now?—It depends upon the sense in which you use the word "employed." He is not a member of our staff.

1957. In what capacity is he there?—In our behalf he is examining the men at present receiving compensation for lead poisoning.

1958. He is employed by the company?—He is employed for that purpose. He is not on the staff.

1959. The daily paid men are not on the staff, but they are employed by the company?—Yes.

1960. What are the doctor's duties?—To examine the men and to report to us whether or not they are suffering from plumbism.

1961. On the works?—Yes.

1962. Can you tell the Commission who authorised him to go to the Commonwealth laboratory to examine the beneficiaries?—I do not know that he has examined any men at the laboratory.

1963. Who authorised him to be present at Professor Chapman's and Dr. Smith's examinations of the men. Was that done at the instigation of the company?—No.

1964. Do you approve of the attitude of a doctor employed by the company in being present at an examination by another doctor?—I express no opinion on it at all. It has nothing to do with me.

1965. You will not say whether you approve of it or not?—No.

1966. *By Mr. Pearson*—Can you give us any information with regard to the dust survey and what is being done in connection with it?—We are still carrying it on. In the first instance we are making a general dust survey covering the whole works at all those places where the men are working. Then we shall, of course, repeat the tests at those places over and over again until we get figures that we regard as being somewhere near the average working condition of those places. It is obvious that one dust test taken in a given place does not necessarily represent the average working conditions at that place. We wish to take a number of tests at each place. When that is done we can definitely assess the hazard at each place.

1967. What apparatus are you using?—It is an apparatus that was developed at the South Mine, Broken Hill, and is regarded by those who have had previous experience as being the best type to secure. It is known as the "Read" type.

1968. Can you give the Commission any indication as to when you will be likely to have any definite results or estimate?—From my point of view I think it essential to have a number of tests made at each place before expressing an opinion. Conditions vary so much. On one day a strong north wind may be blowing, on another a strong southerly, while a third day may be calm. Then on another occasion it may be raining. I feel very loth indeed to put out any figures as ex-

pressing my belief that they are correct figures until I have had a number of tests made under varying conditions. You will see it is quite a long job. We have not finished the first general survey yet and have two machines working on it constantly.

1969. *By Mr. Robinette*—The Commission have not asked you for these figures?—No.

1970. You are anticipating that they will want them?—I do not know.

1971. Why are you preparing them?—For our own information so that we can assess the hazard in different parts of the works.

1972. Did anybody suggest the thing to you?—Yes; Mr. Wainwright made the suggestion in the first instance.

1974. *Mr. Pearson*—I suggested the making of a dust survey to members of the company's staff before the Commission was formed.

The witness withdrew.

The Commission adjourned.

Monday, June 8th, at 10 a.m.

[At Town Hall, Port Pirie.]

Present—

Dr. K. R. Moore (chairman).
Mr. H. W. Gepp.
Mr. J. L Pearson.
Mr. W. Robinette.

Mr. Robinette—I lodge an objection against any evidence being given by Professor Chapman or Dr. Smith on the ground that the inquiry they made here was illegal. Further, if it were essential for them to obtain the clinical and medical records of the beneficiaries from Dr. Moulden it was also necessary that they obtain those records from the beneficiaries' own doctors. I consider that evidence given by Professor Chapman and Dr. Smith cannot be complete until such time as they have consulted with the men's medical advisers. The whole procedure is highly improper, and the evidence of Professor Chapman and his colleague, in my opinion, will be of no value.

The Chairman—I think we should hear what evidence Professor Chapman and Dr. Smith may give. We can all form our opinions on that.

Mr. Robinette—I wish my objection to be noted. Do you rule that the evidence of Professor Chapman and Dr. Smith is admissible?

The Chairman—Yes. Professor Chapman and Dr. Smith were asked by the Commission to come here and examine the beneficiaries on lines that were the most expeditious that we could arrange, and we shall now take any evidence they can give.

HENRY GEORGE CHAPMAN, Professor of Physiology in the University of Sydney, was re-called and further examined:

Professor Chapman—Before I give evidence I wish to draw attention to certain facts. You are aware, Mr. Chairman, that as chairman of the Commission, you asked Dr. Smith and me to come to Port Pirie to look at the works and examine certain persons, whom I think you speak of as the beneficiaries. You obtained departmental railway tickets for us to come here, and in Adelaide I was handed this letter, signed by the secretary of the Royal Commission on Plumbism:—

am enclosing herewith orders for tickets for your journey to and from Port Pirie. So far as the return journey is concerned, I am not sure whether you will motor to Snowtown or come all the way by train from Port Pirie, but the order for the ticket will be applicable to either case.

I have received from the B.H.A.S. Limited a list of persons said to be suffering from lead poisoning, and am enclosing two copies, one for yourself and one for Dr. Smith. The times mentioned have been suggested by the B.H.A.S. Limited, but my instructions from the chairman were that you would fix the times and on that account, I am sending herewith a letter addressed to each person whose name is on the list, so that you may fill in the time and place at which you wish to examine him. Mr. Woodward, of the B.H.A.S. Limited, has arranged to have the letters delivered. . . . .

I also return the remainder of the letters and envelopes handed to me.

Mr. Gepp—Would it not be as well for Professor Chapman to put in his letter of authorisation to complete the story.

Professor Chapman—I have not got the letter of authorisation here. We came to Port Pirie and made an inspection of the works before we decided how we were going to examine these persons. We also examined, as was suggested to us, the cards and records made by Dr. Moulden at his examination. You will recollect that the Commission asked us whether we could give an opinion on the facts recorded on those cards. I stated that I did not think it possible to give an opinion on the cards without an examination of the persons. In the light of what we saw on the works we thought it better to examine these persons in different order from that set out on the list.

1975. *By Mr. Robinette*—Did you not comment on the men's condition in the presence of Dr. Moulden?—No.

1976. You did not comment on the men's condition at all in the presence of Dr. Moulden?—We asked Dr. Moulden what this stood for and what that stood for.

1977. Did not you and Dr. Smith pass remarks on the men's condition?—Not on the findings and what was the matter.

1978. On the men's condition?—If you define "men's condition," I answer the question in the negative.

1979. You are sure that you did not make any comment on the men's condition in the presence of Dr. Moulden?—Not on their condition.

1980. Did you make any comments at all?—Yes, but not on their condition.

1981. What were those comments?—We might have asked Dr. Moulden who made the blood examinations and how the results were obtained. We might have asked him why he wrote words down in a particular way and what that plus or minus meant.

1982. Did Dr. Moulden make any comments?—He answered what we asked him.

1983. In examining the men did you not say, in the presence of Dr. Moulden, that certain symptoms were suggestive of a certain disease?—I might have said that.

1984. Did you or did you not?—It depends upon what you mean by the words "certain disease."

1985. Did you make any comments suggestive of a certain disease or any disease?—Yes, undoubtedly. We said, possibly, that a man looked as though he had kidney trouble.

1986. Did you not consider that highly improper in the presence of the company's doctor, who was deciding whether these men should receive benefits or not?—No. I did not consider it improper at all.

1987. I do not think you understand the ethics of the medical profession?—That is a matter of opinion. After looking at the records, in the light of what we saw at the works, we altered the order in which the letters were delivered. I return the list handed to me, and put in a record handed to me by Mr. Woodward that certain letters were served. (List put in and marked Exhibit 28.) The next thing we thought of importance was that although we had come in contact with the names of the beneficiaries, in examining them, as our information was for the Commission and was not to be made use of in respect of the persons personally, we must not know their names.

1988. You must have known their names, as it was on the clinical records?—We did not know their names. We dealt with them as numbers. We examined a certain number of people, beginning on Tuesday afternoon last. The examinations were carried out at the Commonwealth laboratory, and I invited Dr. Moulden to be present at the examinations.

1989. Why did you not invite the men's doctors to be present? You must have known that they had other medical advisers?—I simply regarded Dr. Moulden as a medical practitioner from Adelaide, who had been asked to examine certain persons, whose records were known.

1990. How did you know Dr. Moulden had examined them if you took them by numbers and did not know their names?—I simply accepted it as a fact that he had examined them. We accepted what he had written on the cards as being the results of his examinations.

1991. You must have known the men's names?—No.

1992. How did you know, then, who a man was?—When we went to the room with Dr. Moulden he took his cards with him.

1993. Those cards bore the names of the men?—I think the men's names were there. The first man called in was No. 1. I then said to Dr. Moulden, "What number does this man bear on your sheet." He gave me the number, and I then asked him to read out what was written on the sheet. In that way we had Dr. Moulden's record brought before us. We then questioned the man, asked him about his condition, and made an examination. Those results were recorded ourselves and afterwards we came to our conclusions about those persons. The conclusions were arrived at in private, not at the beginning, but after we had considered the whole number of persons. The examinations were begun and went on in a perfectly satisfactory way, but on Wednesday I received this telegram:—

Consider Commission's action summoning men appear before you unlawful. Offer strong protest except under supervision of men's representative.—Robinette, Commissioner.

That came to us on Wednesday afternoon.

1994. You continued in the presence of Dr. Moulden after receiving that telegram?—Yes.

1995. You conducted the Broken Hill inquiry, did you not?—Yes.

1996. You knew that the men's representatives were present at that?—Not at the medical examination.

1997. They were supervising it?—The unions' representatives there were the paid servants of the Commission. They were paid for arranging to select the men and for bringing them to the Commission.

1998. And they kept the company from knowing the men who were being examined?—They did not. I did that.

1999. Why did you not do it here?—Because the company knew we were examining these men. Their names were supplied to us through the company. What the company would not know would be our findings on them. I am only putting it to you that the fact that Dr. Moulden was there did not reveal the names. The list of names was given to me by the Commission. They were known to the company. We did not tell Dr. Moulden what our findings were.

Mr. Gepp—The point is quite clear—if not, it should be made so—that the only list available was the list of beneficiaries supplied by the company, because there is no Government record.

Mr. Robinette—But there is a union record.

Mr. Gepp—It may not necessarily have included all the beneficiaries.

Mr. Robinette—It would include the biggest part of them. We do not know that these men are beneficiaries until we go through our ilst. We should have been able to check the list to ascertain whether the men on it were beneficiaries. It is obvious that it was the intention of the company to see that the whole of the men were examined. I want to know who authorised the sending of the 50 summonses to summon men who were not beneficiaries. Was it the company or this Commission?

Mr. Gepp—The point I am bringing out is this. As far as we as a Commission knew, there was only one complete record of beneficiaries. We thought that had been previously accepted by the Commission. If I am wrong I should be glad to know it. There is no Government record, and we have no evidence, so far as I can remember, that every beneficiary is an unionist. That may be so, but I could not say. In any case I think the point should be brought out that the list supplied by the company was the only record available.

Mr. Robinette—You do not know that.

2000. *By Mr. Gepp*—I am expressing my own appreciation of the situation. The second point is that the names of the men were not necessarily known to the Commission's doctors. There is no intention on the part of the Commission to bring out the names in the evidence of the doctors. We propose definitely and specifically to eliminate the names?—If I make any remarks about the findings I have no idea to which persons those findings apply.

2001. We have been very careful to protect the individual in regard to this inquiry. We have endeavored in every way to keep out names and to do everything we could to make it of general application only?—We continued our examinations of the men until Thursday, and on that day we found that certain persons, on whom letters had been served, failed to appear. I do not know exactly the names of the persons who failed to appear. I do happen to know the name of one man, because he came to us and asked to be examined. He said that he desired to be examined, although his union objected. I then said, "You refuse to be examined," and he replied, "I do not refuse to be examined. I should like to consult the union so that I may be examined, because I want to be examined." I told him to go and to ask. He came back and said that the union objected, but that he wanted to be examined. I wrote his words down so that there should be no doubt about what he said. He told me he was afraid of the union.

Mr. Robinette—You will be afraid of it before you are done.

2002. *Professor Chapman*—I then said to him, "Do you refuse?" He answered, "I do not refuse." Of course, we were not going to force a man to be examined. We had little doubt that he wished us to ask him to come in and be examined. However, considering the circumstances, we thought it better for his sake not to ask him.

2003. *Mr. Robinette*—How did he fail to appear?—We asked eight or nine persons to come. I do not know whether they were served with letters, but the list will determine that. There was none there to be examined.

2004. *By Mr. Robinette*—Do you not think the union had the right to tell the man to refuse to be examined?—I do not know that.

2005. Why comment on it? You must be biased in your opinion?—Not at all. I am just recording the facts of the case. When we came here and looked at the works we thought that, in order to arrive at an opinion about the persons we were going to examine, it was very necessary to make some examinations of persons who were at work. I, therefore, sent a telegram to Mr. Sincock asking him to send us some blank forms. Certain blank forms and signed forms were sent to us, and I now hand them back to the Commission. Further, I would also like to hand back the remainder of the summonses which were entrusted to me to serve on behalf of the Commission.

2006. *By the Chairman*—Will you give the Commission your conclusions from the examinations you made?—Yes. I have prepared lists of the results of the individual medical examinations.

2007. *By Mr. Robinette*—Do you consider your investigations complete?—On these individuals, yes.

2008. Do you consider them complete without conferring with the men's doctors?—Yes.

Mr. Gepp—I do not know how far Professor Chapman appreciates the point we have endeavored all the time to keep in front of us, namely, that no evidence should connect up with individuals who could be traced. What I mean by that, Mr. Chairman, is this. I would suggest that you ask Professor Chapman so to frame his evidence so that, neither by inference nor in any other way, can any particular case be traced to a man or a few men. I think that is extremely desirable.

Mr. Robinette—Professor Chapman has his instructions on it, has he not?

Mr. Gepp—I do not know what instructions he has had, except that Mr. Sincock wrote on behalf of the Commission and asked Professor Chapman and Dr. Smith to work on numbers.

The Chairman—Further, the numbers have been changed since the original list was compiled.

2009. *By Mr. Robinette*—Who supplied the list with the

hours that the men had to appear?—Mr. Sincock gave me that list. We did not do the men in the order on the list.

2010. Did Mr. Sincock fix the times and everything?—Yes. I told you I altered it when I came here.

2011. This Mr. Sincock is a genius if he fixes the times from Adelaide. You have admitted that you filled in the times. Why did you alter them?—Because of what we saw when looking at the cards we decided that we would examine the men in a certain order as the result of the symptoms they showed.

2012. The company shoved the doctor in on you after you had decided to examine them in the order already fixed on the list?—I had nothing to do with the preparation of the list. It was handed to me in Adelaide.

2013. Who fixed the times on the list?—This sheet of paper, a copy of which I hand in, was given to me on Sunday in Adelaide. (List put in and marked Exhibit 29.) It was the first time I ever saw it. It came with other documents from Mr. Sincock and was handed to me by Mr. Smith, who came down to the train.

2014. So that Mr. Sincock fixed the times and the dates?—Yes.

Mr. Robinette—He is a genius. I fail to understand how Mr. Sincock fixed the times without consulting Professor Chapman. It is obvious that there is some underhand work going on. It is obvious that Mr. Sincock could not fix the times. The professor admits now that he knew nothing about it until he reached Adelaide on the Sunday. The whole thing was then fixed up, with the times and everything. Who fixed it?

Mr. Gepp—What does it matter?

Mr. Robinette—It shows that there was underhand work going on somewhere.

The Chairman—No.

Mr. Robinette—Who fixed the times and who instructed Mr. Sincock? He could not fix the times. He did not know how long the doctors would take to examine these men. They had never met before.

The Chairman—That is a matter for Mr. Sincock. The professor says that he did not follow the list.

Mr. Robinette—It does not matter whether he followed the list or not. The times were fixed.

Mr. Gepp—The point I wish to impress upon the witness is that he should not make any statements which would tie up with individuals.

Mr. Robinette—I am not afraid of him doing that.

2015. *By Mr. Gepp*—The object of the Commission is to secure the principal results of the examinations?—I have no principal results. The first person on my list is a young man, whom we found to be suffering from lead poisoning. In regard to his occupation, the first point of importance was that, although he had only worked three years in the smelters, he had worked on the bin into which the lead dross, which contains litharge, was thrown. Further, from an examination of the place where this man worked, I am satisfied that he worked in the fumes that come up from the slag hoods at the side of the blast furnace on the bottom floor. When I examined the place the fumes from the chimneys were passing absolutely over the man working on that bin. This man undoubtedly is suffering from lead poisoning, and in our opinion he suffers from colic, extensor paresis, pallor, and anaemia.

2016. *By Mr. Robinette*—Did you ascertain how long this man had been working on the slag-bin?—He had been working on the bins most of the time. I went over his industrial history, but did not record it in detail. The next man had been 27 years in the smelters and is 43 years of age. He had worked on the bottom floor for 17 years. He has some points of very great importance in his history. It sheds light on the condition from which these men suffer in Port Pirie. Firstly, we think he is an undoubted case of lead poisoning. He has suffered from colic for years, and has extensor paresis, pallor, and tremor. There is neither anaemia nor general wasting, but on his symptoms we agree that he suffers from lead poisoning. Dr. Smith and I agreed upon the opinions I am giving. This man gave us another interesting point in his history, namely, that, at times, he had to go into the bag-house for a few weeks before he became ill. The fumes from the bag-house made him sick, and he had to go without his food. He is suffering from lead poisoning, but in the light of other cases we think that observation is of great importance. The third man has been eight years at work, and is 33 years of age. He worked in what he called the Ropp roasters for five years, but the point we think of importance is that he worked on the B.R. furnaces for five months. He suffers from colic, general wasting, extensor paresis, pallor, and tremor, and, in our opinion, is an undoubted case of lead poisoning. The next man gives an industrial history of four years. This period, from the point of view of his industrial history, might be checked. I would not lay great stress on the four years, as he has worked on and off at the smelters for 14 years. He is a brickmaker by trade, and is always doing work at the smelters. His age is 43 years. The point in his occupation of importance, and, we think, it should be put to the Commission, is that he has been feeding the D. and L. belt for 10 months. He suffered from colic for years, from general wasting, extensor paresis, and pallor. In our opinion he is an undoubted case of lead poisoning. The next man has worked for 12 years, and is aged 43 years. He has a varied industrial history, working on the roasters, the top floor, the zinc plant, and the pottery. For the last four months that he worked—he has been ill for six months—he was employed on the bottom floor. He had colic for years, general wasting, extensor paresis, pallor, tremor, and no anaemia. We wish also to give some facts about him that we think of importance. While at work on the top and bottom floors he suffered from attacks of dizziness. He said he became dizzy and felt that as if he had lost consciousness of his surroundings. Further, we noted another interesting fact. His blood was examined in the Commonwealth laboratory and showed a result, we think, of considerable significance, namely, that his red blood cells had increased in number. They were high.

2017. *By Mr. Robinette*—They were above normal?—Yes. This man is an undoubted case of lead poisoning. The next man has been 11 years at work and is 47 years of age. In his industrial history he worked on the zinc plant for five years, in the refinery for varying periods, and for the last 30 months he had worked on the Skinner furnaces and the B.R. furnaces. His history has a significance from another point of view. He has only had colic since November, 1924, he has no wasting, no paresis, but he has pallor and anaemia. In our opinion he is an undoubted case of lead poisoning. The next man has an industrial history of 15 years and is 37 years of age. He has worked on roasters and zinc plant. The point we think of significance is that for the last three and a half years he has been on the D. and L. belt.

2018. Is that the belt feeding the D. and L. machine?—Yes. I refer to the point where they unload the trucks, and shovel the material on to the belt. This man suffers from colic and extensor paresis, but he has no general wasting, no pallor, no tremor, and no anaemia. In our opinion he is an undoubted case of lead poisoning. He also has some interesting points in his history. He had a fit of unconsciousness while at work in 1915, and also has an increased number of red blood cells. Now we come to another list we have prepared relating to the men examined, whom we do not consider to be suffering from lead poisoning. I do not think it necessary to worry the Commission with their industrial history, seeing that we do not think them cases of lead poisoning.

2019. The men you will now refer to are beneficiaries?—I do not know. All I know is that they were on the list supplied to me, with the exception of two persons who applied for compensation while we were here. These two men brought certificates and came to us to be examined.

2020. They were men who had applied for compensation?—I presume they were people who produced certificates from their doctors while we were here.

2021. *By Mr. Gepp*—We can assume that, with the exception of two, all the cases you will now refer to were beneficiaries, because they were on the list supplied by the company?—I know them only as men who came to us to be examined.

2022. *Mr. Robinette*—Your evidence now is in regard to men who are off from lead poisoning. They may be shift bosses, etc.?—They are persons on whom I served a subpoena, with two exceptions. The excepted persons came to us with certificates from doctors.

2023. With two exceptions the men to whom you are going to refer are included in the list supplied to you?—Yes. Where we were able to do it we have determined the medical condition from which they are suffering. We have put that on the list, and it is our definite finding. In respect to some cases, I shall tell you just why we were unable to arrive at a conclusive medical diagnosis. The first man is 58 years of age, with an industrial history of 25 years. He has not got colic—I mean he has not got it at present. Where men have had colic in the past I have recorded that fact, because it may mean they were cases of lead poisoning in the past. This man has no colic, no paresis, no pallor, but he is suffering from tremor and anaemia. A medical examination showed that he is suffering from cardiac hypertrophy and emphysema.

2024. *By Mr. Gepp*—You do not indicate the cause of your diagnosis?—It does not arise from lead and it does not arise from anything having regard to an industrial condition at the works. It is a condition to which all people are more or less liable if the particular circumstances that produce it come along.

2025. *By Mr. Robinette*—I understand that this man had been certified by one of the local doctors to be suffering from plumbism?—I take it so. We can tell you definitely that he is not one of the two exceptions referred to. The next man is 37 years of age, and had worked here for 17 years. He does not suffer from colic, paresis, pallor, tremor, or anaemia. He suffers from a condition of epigastric tenderness. This man, in our opinion, requires a further examination. He should be placed in hospital and X-rayed and various other examinations should be made of him. We think he requires thorough investigation. The next man is 40 years of age and has an industrial history of five years. He has no colic, no paresis, no pallor, and no tremor, although he suffers from anaemia. He also had an abdominal condition that requires investigation. The next man is aged 40 years and has an industrial history of 12 years. He has no colic, no paresis or pallor, but is suffering from tremor and anaemia. He also suffers from pyorrhoea and has a very septic mouth. He requires investigation of a definite character. His blood wants to be examined for organisms and things like that.

2026. You took blood tests?—No; there was no time to do that.

2027. How did you arrive at your previous cases?—We took Dr. Mathew's certificates. We have done no blood tests ourselves.

2028. You have no record of a blood test in this case?—There had been a blood test made in this case, but not the one required. I have no doubt the blood cells were counted, but we thought his blood should be tested for the presence of bacteria. That has not been done. The next man is 40 years of age with an industrial history of 15 years. At present he has no colic, no paresis, no pallor, but he has tremor and anaemia. This man had undoubted colic in the past. He went to the war, but says that he has had no colic since he returned. He has a blood pressure of 150 millimetres.

2029. What is normal?—Normal is lower than that. It varies in different individuals, but we think this man's blood pressure is on the high side. It might be normal, but it might not be. He has a change in his heart, and aortic sounds are accentuated. We have recorded the fact that he has no albumen in his urine. The next man is 61 years of age, with an industrial history of four years. He suffers from tremor, but has no colic, no paresis, no pallor, and no anaemia. As the result of our examination we found definitely that he is suffering from a condition of the gall bladder, namely, cholecystitis. He has inflammation of the gall bladder. The next man is 30 years of age, with an industrial history of two and a half years. He has no colic, no paresis, no pallor, no tremor, and no anaemia. He has pyorrhoea, and I have put in inverted commas on my list "appendix." He has appendix trouble. The next man is 33 years of age, with an industrial history of only seven months. He has no colic, no paresis, is suffering from pallor, tremor, and anaemia. He is suffering from myoxdema, which is a well-known complaint due to a deficiency of the thyroid gland. The next man is also 33 years of age, with an industrial history of five and a half years. He has no colic, no paresis, no anaemia, but has pallor, tremor, he has distinct albuminuria, and I have marked him with two queries. He would be required to be watched for some weeks. He is suffering either from nephritis, which is inflammation of the kidneys, or a deficiency in the thyroid gland.

2030. What is likely to cause that?—I do not know. Sometimes you get growths in them, sometimes tubercle.

2031. *By Mr. Gepp*—Is it a disease known in industry?—No. It is very rare.

2032. He is not suffering from any industrial disease?—It has nothing to do with that.

2033. *By Mr. Robinette*—Could it be a sequelae of lead poisoning?—No. The next man is of great interest. He is 52 years of age, with an industrial history of two years. He has no colic, no paresis, no pallor, no tremor, and no anaemia. He has worked on the top and bottom floors, and has 5,500,000 red blood cells. This is what I have written about him—"He is not a case of lead poisoning now. He is fit for work." By that I mean that at present we think he could go back to work.

2034. Why did you do that?—That was not part of your duties?—We have used the phrase as emphasising the fact that, in our opinion, he is now a completely recovered man from whatever disease he was suffering from. I shall point out something when dealing with other cases that may show what was wrong with this man, because we are now incapable of saying from what he was suffering. He is now a healthy man, and his history is not sufficiently decisive for us to say that he had lead poisoning or to offer any suggestion.

2035. Do you not think that if you had consulted the man's private doctor it might have assisted you?—We may have learned something more about him. The next man is 25 years of age, who has worked here for five months. He has no colic, no paresis, no pallor or tremor, but he has anaemia. This man, in our opinion, is suffering from appendicitis. In confirmation of that, 10 days before we examined him his appendix was cut out.

2036. *By Mr. Gepp*—Is he still suffering?—He still has a sore stomach.

2037. *By Mr. Robinette*—It would be sore, naturally, seeing that only 10 days before his appendix had been snipped off?—He has more tenderness than that. The next man is 27 years of age and has an industrial history of eight and a half months. The points in regard to this man are of great importance. He has no colic, no paresis, and no pallor. He has tremor now and no anaemia. His blood was examined in the bacteriological laboratory in Adelaide in April and he had anaemia then. This man gave a very interesting history of having become dizzy and losing all sense of his surroundings while at work. Then he had a fit in the street. He was taken to the hospital, and was unconscious for many hours. Since coming out of the hospital he has been a sick man with tremor. In our opinion it is most likely that this man suffered from acute carbon monoxide poisoning.

2038. Where did this man work?—He worked definitely on either the top or bottom floor. Dr. Smith informs me that he worked on the top floor. As the result of what we saw on the

works we undoubtedly think that carbon monoxide poisoning might occur on the top floor in the neighborhood of the blast furnaces, and also on the bottom floor.

2039. Why do you think that?—Because of some of the men's histories and from tests done on the works, in addition to certain observations we actually made. The next man is 49 years of age, with an industrial history of two years. At present he has neither colic, paresis, pallor, tremor, nor anaemia. This man we have diagnosed as an undoubted case of carbon monoxide poisoning. An important point in his examination is that he has an increased number of red blood cells.

2040. Would they be accentuated by carbon monoxide poisoning?—It is very common in carbon monoxide poisoning. It is not the only condition that causes increased red cells. In chronic forms you get it.

2041. The number of red cells would be above normal?—Yes.

2042. Have you known of cases of carbon monoxide poisoning where the red blood cells were below normal?—Yes. This man was asked to go into the bag-house. He went there and fell. He then went outside and recovered. He returned to the bag-house and fell again, and hurt his leg. He then went to his doctor. In our opinion this man is a case of carbon monoxide poisoning.

2043. Is he still incapacitated?—No. I think he has recovered.

2044. Could you tell us for how long he was incapacitated?—Sub-acute poisoning like that should affect him for about 14 days. We see similar cases in the coal mines. Dr. Smith has had much experience of them. The next man is 40 years of age, with an industrial history of 15 years. He has no colic, no paresis, no pallor, and no anaemia. He undoubtedly had colic years ago, but not recently. He is suffering now from an enlarged liver, and is passing blood by the bowel. We could have told you more about this man if we could have examined him further. It is a question whether he is not passing blood at present. The next man is 40 years of age, with an industrial history of four years. He has no colic, no paresis, but is suffering from pallor and anaemia. He is suffering at present from sub-acute nephritis, and we notice that now he has oedema of the legs. The next man is 38 years of age, with an industrial history of 17 years. He has no colic, no paresis, but he has pallor. He has neither tremor nor anaemia. He is suffering from advanced arterio-sclerosis.

2045. That is unusual in a man of his age?—It is early, but there is a cause which produces it early. This man is suffering also from arthritis. With the single examination we were unable to decide the exact cause of the arthritis.

2046. Arterio-sclerosis is a sequelae of lead poisoning?—Yes.

2047. You did not ascertain what was the cause of the arterio-sclerosis?—No.

2048. Did you endeavor to do that?—By making what examination we could at the time, yes, but he would have required to be before us two or three times for us to decide definitely.

2049. Is arterio-sclerosis also a sequelae of diseases other than lead poisoning?—Yes.

2050. Of what other diseases would it be a sequelae?—The most important would be syphilis, taking his age as a young man.

2051. Would alcoholism cause it?—Yes; but his early age makes one think of syphilis.

2052. That would need a Wassermann test?—Yes. In our experience, persons who get arterio-sclerosis from lead poisoning are more than 40 years of age, as a rule.

2053. A lot would depend on how long they had worked in lead, would it not?—Yes. This man has no history of colic at any time. He did not give us anything positive on the lead side.

2054. *By Mr. Gepp*—He has 17 years' service at the smelters?—Yes.

2055. A man could suffer from lead poisoning, and show no signs of colic?—Yes. In our experience here lead poisoning without colic is very uncommon, but in other parts of the world they seem to have seen severe lead poisoning without colic. The next man is 30 years of age, with an industrial history of 14 years. He has no colic, no paresis, no tremor, and no anaemia. In our opinion this man is fit for work.

2056. *By Mr. Robinette*—How long has he been fit?—I cannot say. I did not record it on this sheet. The next man is 32 years of age, with an industrial history of 17 years. He has no colic, no paresis, and no anaemia, but has tremor. He had colic years ago, and in our opinion requires careful investigation. He wants to be brought into hospital and kept under observation. From our examination we were unable to say what was the matter with him. The next man is 27 years of age, with an industrial history of 16 months. He has no colic, no paresis, no pallor, no tremor, and no anaemia. In our opinion he is in good health. Suggesting what may be the matter with him, we have put down the query influenza. The history of the case was suggestive of influenza. The next man is 37 years of age, with an industrial history of 13 months. He has no colic, no paresis, no pallor, no tremor, and no anaemia. He has gained 14lbs. since leaving work. In our opinion he is fit for work. The next man is 28 years of age, with an industrial history of seven months. He has no colic, but has paresis. He has no pallor and no anaemia, but has tremor. We think this man has had encephalitis, and that he requires further examination.

2057. *By Mr. Gepp*—Are you referring to infective encephalitis?—Yes. His history showed that for two weeks he was off with a medical certificate which stated that he had influenza. Our experience enables us to know that other cases of encephalitis have been diagnosed as influenza. Encephalitis is inflammation of the brain. It is a condition which, in a general way, is not unlike that which produces infantile paralysis.

2058. *By Mr. Robinette*—Does it cause paresis?—The after effects may cause that. A man suffering from encephalitis may recover completely or he may be permanently damaged. This man should be thoroughly examined and watched. The next man is 57 years of age, and has an industrial history of 34 years. He has no colic, no paresis, no pallor, no tremor, but he has anaemia. He is suffering from arterio-sclerosis with nephritis. I was asked to make a summing up from these examinations. We feel that we could not do that without further examining these people, nor could we come to any general conclusions. We should like, however, very much to draw attention to certain of our findings. These findings, in our opinion, make it extremely desirable that an examination should be made here into the possibility of carbon monoxide poisoning, which occurs in two main forms. Men who are exposed to a very considerable quantity of carbon monoxide—the quantity of carbon monoxide that produces poisoning is very small, say, something about 150 cubic centimetres—and breathe that, in a comparatively short period of time get what is known as acute carbon monoxide poisoning. They fall, and if they remain breathing it they die. If they are taken out they make a fairly rapid recovery. But in some cases, after apparent recovery, they suffer from injury to their brain, which is very similar to encephalitis, and which is particularly characterised by a lesion known as degeneration of the lenticular nucleus. Some persons who have had acute poisoning of this type develop sequelae, which may last for months. In addition to acute carbon monoxide poisoning, there is a chronic form of carbon monoxide poisoning, which is produced by the inhalation of small quantities of carbon monoxide. Air containing as little as one part of carbon monoxide in 10,000, or even less, may give rise to chronic carbon monoxide poisoning. When inspecting the works we were shown some results of tests made upon individuals working around the top and bottom floors. There were 14 individual tested, and the tests show that all these men were taking carbon monoxide into their blood.

2059. *By Mr. Robinette*—Who conducted these tests?—I

should not like to say. They were conducted under the general direction of Mr. Hemingway.

2060. *Mr. Robinette*—Mr. Chairman, is this evidence? In my opinion it is not. The professor has a sheet of paper bearing information, but he does not know who compiled it.

The Chairman—The professor's conclusions drawn from a perusal of the information can be taken as his opinion.

Mr. Robinette—We do not know whether his conclusions are correct. He may not be taking into consideration all the facts. He cannot give evidence on that basis.

The Chairman—Professor Chapman is not commenting on the list.

Mr. Robinette—I object to evidence being given on the information on that sheet of paper, unless we know who made the tests. I certainly object to the list going in, unless the Commission is assured that evidence will be given on it. The bald statement that an investigation was made should not be admitted. I want to know who conducted the investigation. This is hearsay, not evidence. The professor does not know who made the tests. Any person could write down something on a sheet of paper and hand it to the professor.

The Chairman—The professor can use his discretion as to any statement he may make.

Mr. Robinette—Until evidence is taken regarding the conducting of the tests the professor's opinion is useless.

Mr. Gepp—Mr. Chairman, with your permission we intend to call Dr. Moulden in Adelaide on Friday, and shall put the list in as evidence then.

Mr. Robinette—That is putting the cart before the horse. The professor's evidence is useless unless I can cross-examine him as to the authenticity of his information. The whole thing is mixed.

Mr. Gepp—May we not go ahead on the basis that we assume this is Professor Chapman's opinion on this for what it is worth. The cross-examination can be made later. Professor Chapman will give us his opinion on the results of the tests. If we conclude those tests are sound and well carried out, that is one position; if we do not conclude that, there is the other position.

2061. *By the Chairman*—That is a fair conclusion. Go on, professor?—Assuming carbon monoxide is found in the blood, such as is stated here on the list, I think there is great risk, not only of chronic carbon monoxide poisoning, but of acute carbon monoxide poisoning, because these quantities can produce it. These figures in some cases are low, but in other instances I consider them quite high.

Mr. Robinette—Until those figures are accepted by the Commission I do not see how the professor can give evidence on them.

The Chairman—He can give us his opinion.

Mr. Robinette—Supposing that list is found to be incorrect, it will destroy the value of that opinion. I object, Mr. Chairman, to evidence being given on that document until such time as it is sworn to.

2062. *By the Chairman*—We must take this opportunity of getting Professor Chapman's opinion. If, later, the document is proved to be valueless, it destroys the value of his opinion. Will you go on, professor?—Assuming that we find that persons show 2, 3, 4, or 5 per cent. of carbon monoxide haemoglobin in their blood, such persons are likely, if exposed sufficiently long, to suffer from chronic carbon monoxide poisoning. Assuming that persons show 23 or 24 per cent. of carbon monoxide haemoglobin, or, say, 25 or 27 per cent. in their blood, such persons are liable to suffer from acute carbon monoxide poisoning. I might say that with 60 per cent. of the blood converted, a fatal result, either immediately or within a few days, is very likely. Further, while going around the plant we noticed slag being drawn off, and observed the way in which certain flames burnt on the slag. That suggested to me that carbon monoxide was being given off, and was being burnt as it came in contact with the air. That was on the bottom floor.

2063. *By Mr. Robinette*—It was only suggested to you. You made no tests?—I had nothing there to make a gas analysis, but my observation suggested to me that tests should be made. Further, while I was on the top floor I understand that the contents of the furnace bubbled up. At any rate, as the result, large quantities of fumes, smoke, and flames were coming out at the top. Having had experience of what happens in these furnaces, I recognised that carbon monoxide must be given off under these conditions. I stayed there quite a time looking at and observing the color of my own nails and skin. I also looked at the color of Dr. Smith's hands. I observed the color of the ears of one or two people walking around there. I thought they showed the peculiar cherry red color, which is found when carbon monoxide is being taken in.

2064. Was that among the workmen?—No. It was among people walking about the place and who were only in the vicinity for a few minutes. To me that was evidence that a quantity of carbon monoxide was being given off quickly.

2065. *By Mr. Gepp*—What place are you referring to?—The blast furnaces.

2066. They were blowing through on to the working floor?—On to the top floor, yes. In connection with all these observations it appears to me very essential for the protection of the men working there that an examination should be made on two lines. Firstly, there should be a definite analysis of the air on the top and bottom floors under varying conditions, until proper samples are secured, to determine the quantity of carbon monoxide that goes into the air on the top and bottom floors round about where the lead is tapped and the slag drawn off. That would give an idea of the time likely to be required to produce sub-acute or chronic carbon monoxide poisoning. Secondly, I think that observations should be made of the men there to determine how much the people there are actually taking in. The next point I would make is that with figures of that kind available it would be possible to protect the men at work. Such figures would show what changes would have to be made, and how long they would have to be continued before the carbon monoxide was reduced absolutely to safe limits. Reverting back to my medical lists, we think we have examined persons who, we are satisfied, suffered from carbon monoxide poisoning. In regard to some of the men labelled "fit for work" it may be that they also suffered from carbon monoxide poisoning. I should like to emphasise that at the time persons become ill it is possible to determine these facts accurately. If a man is at work and is taken ill, without a doubt it can be determined definitely whether he is suffering from carbon monoxide poisoning. If you have to form an opinion about it after some weeks it becomes difficult.

2067. *By Mr. Robinette*—You can determine it within a few hours of a man taking ill?—Yes.

2068. It would depend upon the exposure?—You might be able to determine that a man was suffering from carbon monoxide poisoning three or four hours after he was taken ill at work. You might be able to do it one or two days afterwards. It depends upon the quantity taken in.

2069. *By Mr. Gepp*—There would be more positive indications of the amount taken up by testing the man on the job?—If you do it on the job you know who is exposed to it and what is likely to be taken in. We should not get figures like these on this list, whether they are correct or not.

2070. Did you ascertain what class of men were tested?—Yes. There are names on the list.

Mr. Robinette—I think the names should be given privately to the Commission. I want to know what men were tested and where they were working. These men may have been located right over the furnace.

Mr. Gepp—Details will be given when Dr. Moulden gives evidence, but we do not press for the names. They are all staff men, with the exception of one who volunteered.

Mr. Robinette—Put in Dr. Moulden and let us examine him now.

Mr. Gepp—We shall put him in when we are ready.

Mr. Robinette—"We," you say. To whom are you referring?

You are running this Commission, all right! This matter has not been discussed by the Commission, yet you say "We shall put him in when we are ready." If this Commission decides that the company's man shall be heard first, he shall be heard first.

Mr. Gepp—The company is prepared to submit the witness for evidence when the evidence is ready.

Mr. Robinette—That is only a detail. It is ready now.

Mr. Gepp—It is only part of the programme the company advises me it desires to submit.

Mr. Robinette—I submit that you are putting the cart before the horse. I want to know where the tests were taken. I object to the professor giving evidence on this without knowing where the tests were taken. A man could stick his head in the furnace box for half an hour and produce these results.

The Chairman—Professor Chapman is giving an opinion on the percentages of carbon monoxide.

Mr. Robinette—I object to the procedure, which is highly improper.

2071. *By the Chairman*—I do not think your objection is valid. Professor Chapman is giving evidence on the results of certain percentages of carbon monoxide haemeglobin in the blood. He knew that of his own knowledge before he left Sydney. Please, proceed, professor?—I formed the opinion from the cases I have seen, and from direct inspection of certain parts of the works, that a technical inquiry into the conditions there is necessary. Blood tests of men working there should be taken, and analyses of the air are desirable. In my opinion the conditions disclosed show that they are a menace to the health of the men, and they should be examined.

2072. *By Mr. Robinette*—You really do not want that document at all?—No.

2073. Why use it, then?—It is a part of various things. I saw the conditions. I will not say whether the figures supplied are strictly correct or not, but they show me carbon monoxide is there undoubtedly, and they help me to say there is great need for examination on that account.

2074. Carbon monoxide is invisible, is it not?—Yes.

2075. You could not see it, yet you say it was there. How do you know that?—I am a chemist, and know what happens in blast furnaces. I knew what is put into them and what comes out of them. Then I told you that I saw the flames on the slag dump, and knew that carbon monoxide or zinc gas was there.

2076. It might have been either?—Yes.

2077. You do not know whether carbon monoxide was there or not?—I am prepared to say definitely from my general knowledge that carbon monoxide comes out of the top of those blast furnaces whenever they blow off, and that carbon monoxide can be found in the gas coming out of those hoods where they draw off the slag.

2078. You could not determine the quantity without an analysis?—No.

2079. Carbon monoxide is generated when a person smokes a cigarette?—A little.

2080. You could not say whether the quantity given off at the slag hoods was as much as that generated by the smoking of a cigarette?—No. I have no idea how much is given off there, but it is being given off. It is recognised all over the world as one of the things from which workmen should be protected. Investigations should be made, so as to protect the men. I walked around the works a couple of times, and saw a number of the operations there. I saw the medical results upon certain individuals. I was shown certain dust counts that had been made to determine the quantity of lead in the dust at different places. On the results of those I should like specially to direct the attention of the Commission to certain parts of the works, where I think a very distinct risk exists to the workmen from lead dust. I have already given evidence that lead dust is harmful if inhaled, and represents a particular risk of lead poisoning in industries of this kind. I think that the determination of the quantities of lead in the air is necessary in regard to certain parts of the works, and I suggest that it should be a recommendation of this Commission that such changes should be introduced in those places as would diminish the lead in the air. I suggest that proper tests should be carried out so that it could be known on the works continuously that the methods of preventing the accumulation of lead in those places were working satisfactorily. In other words, there should be a continuous inspection, with the use of proper methods, to make sure that the lead dust is not accumulating. Places to which I direct attention are:—The point where the material is fed on to the D. and L. belt. The men there should receive instruction from an hygiene officer. For example, when we were there, the two men shovelling material on to the belt were within a few feet of each other. A wind was blowing from one man toward the other. The material was wet, but we know just what the stuff is like. The dust produced by one man's shovelling was blown straight on to the other man. There is 150ft. of belt there, and there was no reason at all why the two men should not have been so separated that the dust from one's shovelling did not blow over the other. I suggest generally that an hygiene officer should instruct the shift bosses in things of that kind. The same thing occurs when men unload trucks. Very little care would ensure that the dust did not blow over other men at work. Further, it seems to me that it would be readily possible to arrange sprays. The material is wetted a little later to go into the pre-roaster, and there is no reason why sprays should not be arranged over it at the end of the belt where it begins to ascend. You do not want things like hoses, that give large drops of water, but fine sprays, from which the water falls and beats down any dust containing lead. Such a spray clogs the dust with water, and moulds it into large lumps so that it falls. Then underneath the belt there is boarding. There is no reason why that should not be made dust proof. At present some of the spillage from the belt falls through the floor, and is distributed over people working below. It is quite simple to arrange for a dust-proof floor there. With these changes I have no doubt that that could be made a safe operation. That it is a dangerous place is revealed by cases I examined. One man was actually damaged there from working in that dust. I wish also to draw attention to the B.R. furnace. There again is an accumulation of dust, which could be prevented by the use of proper methods. Further, in putting those methods into effect systematic dust tests should be made to prove that the methods introduced were satisfactory. A third place is underneath the pre-roasting section of the D. and L. machines. We had a good look at the "A" section, and underneath is a place where there is a distinct danger of lead poisoning being produced. By the introduction of suitable means that danger could be alleviated.

2081. *By Mr. Robinette*—Do you refer to the point where the tray conveyor is tipped?—Yes. Another thing that obviously wants correction at once is in connection with the bins that collect the material that comes from the pre-roasters and other places, and from which the material is run to the top of the blast furnaces. Those bins could be arranged, and the tipping arrangement altered, so that the men would be able to get out of the dust when tipping the skips. Further, the chimneys over the slag hoods should be raised, because at present the fume from them goes right over the men.

2082. They are about on the same level as the top of the bins?—Yes. I think that quite a lot of things should be done in the refinery. An attempt should be made to draw off the fume that comes off the furnace there. Some systematic designing should be carried out there to do other things. Tests should be made to determine the amount of lead in different places.

2083. *By Mr. Pearson*—You have in mind an exhaust ventilation arrangement in connection with the refinery?—No; I do not like fans, because they stop and can be turned off. I prefer chimneys, which are there continually and cannot be turned off.

2084. *By Mr. Gepp*—When you mention lead, do you mean lead and carbon monoxide in all cases where there is any suggestion of them being combined?—I do not know anything about carbon monoxide in the refinery. It might be there, but it might not. I saw nothing that suggested it to me. The last point I should like to deal with concerns certain figures that were shown to us in Sydney. We were asked to comment on them, and when we came here we examined the figures in detail.

2085. *By Mr. Robinette*—To which figures do you refer?—Those in table "L" particularly, which shows the number of people of different nationalities, the number of men working, and the number who had lead poisoning in each six-monthly period. I expressed the opinion that the figures set out in table "L" are not satisfactory for the purpose of comparison. In determining the extent to which people are injured, our experience tells us that there is only one sound method of doing it. That method is to get the actual number of persons who worked over a period and then determine on that number how many of them have lead poisoning. You get the percentage then, or what is generally known as the morbidity rate. You get, then, the number of persons with 12 months' service who acquired lead poisoning. You also secure the percentage of those men with one to two years' service who contracted lead poisoning. In that way you will be able to determine whether nationality affects the sueceptibility to lead and so on. On some tables that were shown to me certain conclusions were drawn as to the susceptibility of people, which I do not think were justified, and I do not think they can be determined from those tables. It is very difficult to get these tables out exactly, but it seems to me that a very valuable indication in regard to the matter could be got elsewhere. We tried to get the figures, but they have not been supplied to us in time to enable us to put them before you. If a representative fortnight in a six-monthly period is taken you will have so many men who work three months, so many a year, so many one to two years, so many two to three years, four to five years, and so on. Then you may take it that a given number of men were employed over that period, and that they were distributed generally in that way. It is obvious that, except for short abnormal periods, this method must be quite correct, because these men in order to work at the smelters for long periods must be working there during the fortnight. If you do that for one or two years to see how they lie it is possible to prepare a morbidity sheet on that assumption, which would be of value. I think that would enable you to secure an idea of the amount of lead poisoning in this industry compared with other industries. On the figures supplied to the Commission it is not possible to do that, and I suggest that the Commission obtain figures on the lines indicated to determine how much lead poisoning is occurring and what period is required to produce so many cases. The Commission could then distinguish between the forms of lead poisoning that occur in people at the work and detect the susceptibles, who should be eliminated from the industry. If you do not do that—the susceptibles form, roughly, 3 per cent.—there is the risk of these men being permanently injured. If, however, in the first two years you put them out of the industry, they will recover from any slight injury and will not be damaged. All the hygiene work done on lead in recent work shows the importance of educating these men and letting them understand that they should not work in an industry in which there is a lead risk.

2086. *By Mr. Gepp*—You mentioned the desirability of making tests for carbon monoxide on the job. There are two methods of securing definite indications in this regard, the first being an analysis of the air, and the seoond an examination of the men?—Yes.

2087. In industries where carbon monoxide is suspected are the men examined on the job or after they leave?—Either on the job or within a few minutes of leaving. You need not necessarily examine them where they are working. They can go away and be examined five, ten, or fifteen minutes later.

2088. *By Mr. Robinette*—What works are you referring to?—The coal mining and iron and steel industries and wherever they use blast furnaces. The place where carbon monoxide poisoning is most common is in connection with collieries where you get carbon monoxide gas, and secondly, in connection with iron and steel manufacture.

2089. *By Mr. Gepp*—Anywhere where large quantities of coal are used or burnt?—Yes, or wherever they make producer gas.

2090. How long would an examination take?—You would only require the presence of the individual for a minute or two. You only have to draw a sample of his blood.

2091. What amount of blood is necessary?—A drop or a couple of drops.

2092. Will you briefly explain to the Commission the method of testing?—The method is to take the blood, dilute it, then compare it with the standard. Sometimes you treat the blood by adding, with water, some chemicals. Sometimes you do not do that. It depends upon the way the standard is prepared. Then you compare the color of the blood drawn from the subject with the color of the standard, and from that you can determine the amount of carbon monoxide.

2093. Does that mean that the absorption of carbon monoxide by the haemoglobin of the blood alters the color of the haemoglobin?—Yes. That is the basis of the test.

2094. How long would carbon monoxide take to affect blood that absorbed it?—The effect would be instantaneous. For example, in Sydney we get the students to breath ordinary gas, which contains carbon monoxide, and then draw their blood and examine it to see how much they have got.

2095. Could you give the Commission an indication of the minimum quantity of carbon monoxide which is toxic over periods of employment? Would it be .001 or .003?—The text boks give .01 per cent., but I am inclined to think that less quantities might do. My opinion on it, however, is not a very good one. I have not worked much on a very low quantity. So far, in this country, we have not had very extensive measurements of the quantity in the air around works. Very little of that has been done.

2096. With an apparatus such as the Weiskoph what is the percentage that could be estimated with certainty?—You can estimate quite small percentages. I think .001 could be estimated.

2097. You told the Commission you are Professor of Physiology at the University of Sydney?—Yes.

2098. Could you give us your career from the time you graduated?—I graduated in 1899 in the University of Melbourne, and for about a year afterwards was medical superintendent at St. Vincent's Hospital. In the next year I was acting Professor of Physiology in the University of Adelaide in place of Professor Stirling. Then, for a few months, I was in private practice at Kadina. I then became Demonstrator of Pathology in the University of Melbourne, and was also tutor at Ormond College. At the end of 1902 I went to the Sydney University as Demonstrator of Physiology. I have remained on the staff of the Physiology Department in Sydney ever since. I cannot tell you the exact dates from memory, but I became Chief Lecturer and Demonstrator in Physiology somewhere about 1909 or 1910. In 1913 I was made Assistant Professor, and in 1917 was made Professor of Pharmacology. Upon the death of Sir Thomas Anderson Stuart I was appointed to the Professorship of Physiology in 1920, the Chair of Pharmacology being reunited with the Chair of Physiology. In addition I have done lecturing for the Department of Education in New South Wales.

2099. You were Chairman of the Technical Commission at Broken Hill?—Yes. In 1919 I was appointed Chairman of the Technical Commission established by the Board of Trade. In November, 1920, I went back as Chairman of a Technical Commission, responsible only to the Government.

2100. How long did that investigation continue?—About 2½ years. We worked at Broken Hill from December, 1919, to June, 1920. We then returned to Sydney and prepared our report, which was published some months later. We went back to Broken Hill in November, 1920, being then responsible

to the Government, and worked there until the end of 1921. Our report was presented in 1922.

2101. Is it permissible for you to indicate the cost of the inquiry carried out at Broken Hill?—I should not like to say off-hand, but it was somewhere about £25,000.

2102. What was the constitution of the Commission responsible to the Government?—I was appointed by the Government as Chairman, and the instructions were all issued to me. I was asked to associate with myself, as members of the Commission, certain persons I might choose to assist me on the work. I associated Dr. Smith and another gentleman with myself.

2103. On an average, how many did you have on the staff?—About 20.

2104. There you were dealing with two main subjects, namely, pneumonoconiosis and lead poisoning?—Yes.

2105. For a number of years you have been interested in the question of industrial hygiene and industrial disease?—Yes.

2106. Have you done any work in that connection apart from what you did at Broken Hill?—Yes. I did a lot of work in connection with the Board of Trade's inquiry into the possible prohibition of white lead. Further, for the information of the Arbitration Court, I made inquiries into the health of printers exposed to lead, and also into the health of persons engaged in other industries.

2107. Have you done any work in the way of improving methods of technical manufacture. For example, I understand you are supervising a bakery?—In 1916 we established an experimental bakehouse in connection with the work of the Technical College, and have been making bread there continuously. We get a subsidy of £500 from the Commonwealth Government with the object of demonstrating that it is possible to make bread by day. We make bread there, working from 9 o'clock in the morning and finishing at 5 o'clock in the evening.

2108. Were you in England last year?—Yes.

2109. Did you attend the Empire Congress on Mining and Metallurgy, which dealt with industrial hygiene generally?—Yes.

2110. Could you tell us what occurred at the meeting at Wembley, when I happened to be present?—Yes. We had a discussion on mining hygiene following on a general statement on mining hygiene that was opened by Professor Haldane, who is an authority on mining hygiene, and who might be regarded as the initiator of mining hygiene in England. His work on the health of the Cornish miners is a classic in the history of mining hygiene. I was asked by the officials of the Congress to open a discussion on mining hygiene, following on Professor Haldane's paper.

2111. Professor Haldane was also connected with the initial work on miners' phthisis in South Africa?—I think that work was really initiated by Dr. Irvine, who spoke to the Congress in London, but the carrying out of systematic work designed to prevent miners' phthisis was done undoubtedly by Dr. Haldane.

2112. At the Congress there was also a considerable discussion in regard to the methods of treatment of carbon monoxide poisoning?—There was some discussion.

2113. Did you have the opportunity of having any further discussion with Professor Haldane?—Yes. I discussed mining hygiene with him.

2114. This question being one of your specialities, did you have the opportunity of meeting any other leading men in that particular line while you were in Europe?—Yes. I had a commission from the Commonwealth Government to the Minister of Health, and his Secretary asked me if there were people I should like to get acquainted with while I was there. I said I should like to meet Dr. Legge, the great authority on lead poisoning. I saw Dr. Legge, and had a number of interesting discussions with him. I told him I wanted to meet other persons interested in lead poisoning, and Dr. Legge kindly arranged for a number of those gentlemen to meet me when they came to London. I had two days with Professor Collis, and I also met Dr. Bridges. In addition I went out to the laboratory of the Ministry of Health, known as the Medical Research Department, at Hampstead. There I met Dr. Leonard Hill, who is greatly interested in methods of ventilation. I also met Sir Kenneth Goadby in London and Cambridge. I discussed with him some of the methods by which it is possible to determine the amount of absorption of lead by persons exposed to definite quantities of lead.

2115. You mentioned Dr. Legge, who has been knighted since your visit, and Sir Kenneth Goadby. Are they the authors of the standard work on lead poisoning?—Yes.

2116. So that while you were in Europe last year you took the opportunity so far as possible of bringing yourself up to date on this question?—Yes.

2117. During the meeting of the Pan-Pacific Congress in 1923 did you meet Dr. Watkins Pitchford, of South Africa?—Yes.

2118. Will you tell us of the work for which he is noted?—Yes. He is noted for his work in connection with the mines on the Rand in Johannesburg. In that he demonstrated the conditions to which miners are liable. Particularly he worked out the actual conditions with regard to the dust in the air of the mines which produce miners' diseases. Further, he was instrumental in having steps taken to diminish that dust. In addition, he laid down methods to determine the quantity of dust, so that it became possible to measure what any improvement did to lessen the amount of dust in the air.

2119. Had you a long discussion with Dr. Pitchford?—Yes. He travelled with a number of us from Sydney to Broken Hill, thence to Adelaide. We were able to show him conditions at Broken Hill, and to have talks with him regarding the difficulties there and in South Africa.

2120. I remember a meeting of the Pan-Pacific Congress held in the University of Melbourne, which I attended, and Dr. Pitchford was discussing a summary you gave of the work of the Commission, of which you were Chairman, in Broken Hill. Was that so?—Yes.

2121. My recollection is that Dr. Pitchford, who is a very high authority, expressed admiration of the work your Commission had carried out?—I believe he was kind enough to say so.

2122. During the same Pan-Pacific Congress did you meet Dr. Sayers, of America?—Yes. He is the principal medical officer of the United States Bureau of Mines. I also met his predecessor, Dr. Lanza.

2123. The work in America in the Departments of Industrial Hygiene and Mining Hygiene has been developed very thoroughly?—Yes.

2124. Would you consider Drs. Sayers and Lanza of high standing in those matters?—Yes. Dr. Lanza, especially, had first-hand experience in sulphide of lead mines at Bute and Joplin. He was connected with the work done at both those places.

2125. What was Dr. Lanza's position at the time of the Congress?—He had been lent to the Commonwealth Government by the International Health Board of the Rockefeller foundation of the United States of America. He was lent for the purpose of giving advice and assistance in instituting a department of industrial hygiene in the Commonwealth. Such a department is now operating.

2126. Can you tell us any work that Dr. Sayers has done which would show his high standing?—There is one thing of interest in connection with this inquiry. Dr. Sayers has done a considerable amount of work in regard to carbon monoxide poisoning. Other work of his has been in connection with the general problems of ventilation and composition of the air in factories, as to the conditions which are favorable and those which are unfavorable.

2127. Are these two bulletins I hand you written by Dr. Sayers, with other gentlemen?—Yes.

2128. The first one deals with the elimination of carbon monoxide from the blood by treatment with air, with oxygen, and with a mixture of carbon monoxide and oxygen. It is by R. R. Sayers, surgeon, United States Public Health Service, and Chief Surgeon of the Bureau of Mines, and by W. P.

Yant, Assistant Chemist, Bureau of Mines, Department of the Interior. The reference number is 865 from the Public Health Reports, September 7th, 1923, pages 2053-74?—Yes.

2129. The other relates to the pyro-tannic acid method for the calculation and determination of carbon monoxide in blood and air, by R. R. Sayers and W. P. Yant and E. W. Jones, the latter being Assistant Gas Chemist, Bureau of Mines, Department of the Interior?—Yes.

2130. You had the privilege and opportunity of full discussions on matters of industrial hygiene with Drs. Sayers and Lanza?—Yes. I had many talks with Dr. Lanza, who was in Australia for some years. He came to Broken Hill with us, once when we were at work on the Technical Commission, and also when we went there in 1923.

2131. Based upon your impressions from the discussions you had with these gentlemen in Australia, and the men you met during your visit to Europe, do you feel that you are able to say that the knowledge of yourself and your colleague in matters of industrial hygiene is thorough and up to date?—We think so.

2132. *By Mr. Pearson*—You have had, I understand, considerable experience in connection with the Workmen's Compensation Act of New South Wales. Could you tell the Commission whether carbon monoxide poisoning is a compensable disease there?—Yes. It is in New South Wales.

2133. *By Mr. Robinette*—Is it a compensable disease in any other country?—I cannot say straight off, but I think it is.

2134. *By the Chairman*—Probably it is in the United States on the strength of Dr. Sayers' work on the subject?—I cannot say from my own knowledge.

2135. *By Mr. Robinette*—You are sure it is in New South Wales?—Yes.

2136. *By Mr. Pearson*—In connection with the question of dust, during the Broken Hill inquiry did you fix any standard of permissible dust intensity?—No.

2137. In the publication of the proceedings of the International Congress there is a tentative standard mentioned as applying to Broken Hill. The quantity mentioned is that the dust shall not exceed five milligrammes per cubic metre?—I can say that that was wrong.

2138. You quoted a lower figure in your Sydney evidence?—Yes. We did not lay down a standard because there were many different kinds of working places. In certain working places it was possible to get a very much greater elimination, and we did not think we should fix a standard that was high, and which in certain places could be made much lower. So that, intsead of fixing a standard that applied to the worst places which had to be treated, we recommended that discretion should be given to a Government officer there and that the dust should be reduced to what he considered a satisfactory figure in each kind of working place.

2139. In regard to the matter of ventilation in the refinery, I think you mentioned in your Sydney evidence that a current of 40ft. per minute passing through places where lead dust was produced would prevent accumulation?—Yes. With a current of 40ft. per minute passing over places where dust was being produced, if you collected the air, no appreciable dust could be measured in it. It was all washed away.

2140. The same thing would apply to carbon monoxide?—I presume so, but I would not say what the figure would be to dilute it. I should think it would dilute it, but would not express an opinion without testing. In Broken Hill we actually moved the dust to places where other people worked, but with the 40ft. per minute current, the dilution was so great that men who took it in had no weighable dust.

2141. *By the Chairman*—I should like to refer to a statement on page 3 of the second report of the Broken Hill Commission. In brief, it is as follows:—

Of a certain number of men examined, 2,491 were normal; 3,018 showed some ill-health, which was not plumbism; 443, or 6.7 per cent., showed no definite history of colic, paresis, or other signs, but showed evidence of an altered state of the heart and kidneys; 525, or 8 per cent., gave a past history of colic or ill-health, but not at the time of the examination; and the remainder, 61, were classed as lead poisoning cases.

Can you give the Commission the grounds on which the 525 class was removed from the category of lead poisoning? Were those standards arbitrarily chosen or were they accepted standards?—The 525 cases consisted of men who said, perhaps, "We have worked 25 years at Broken Hill." When asked whether they had suffered from lead colic they said they had during the first five years they were at Broken Hill, but had not had it since. When we examined them there was nothing whatever the matter with them which could be ascribed to lead. They were persons who gave a past history of having suffered with colic years ago. The 61 persons were those who were suffering from lead poisoning at the time we examined them.

2142. Estimations of carbon monoxide are now being carried out under the supervision of a chemist appointed by this Commission, and so far a Weiskoph apparatus, which is intended for small quantities, is being used. Do you know of any apparatus you can recommend to the Commission for larger quantities, say, above 25 per cent.?—Yes. I think such tests can be made by the Haldane gas analysis apparatus. With that apparatus one takes a measured quantity of gas and removes the gases that are soluble in alkali. One then passes an electric current through a wire so that it incandesces and leaves the gas exposed to that high temperature for a sufficient time. One then measures the gas which is soluble in alkali and determines from that the quantity of carbon monoxide present that has been burnt.

2143. *By Mr. Gepp*—That is after removing by suitable means any hydro carbons that may exist?—Yes.

2144. Supposing you had any methane, ethylene, &c., there, what would you have to do then?—You would remove them first by suitable means.

2145. You mentioned nephritis, which I understand is inflammation of the kidneys, as well as arterio-sclerosis. You have said that the latter disease can be caused by lead and also by other diseases. Can you tell us whether you can differentiate between the nephritis caused by lead and the nephritis caused by other diseases?—We think so in our experience. When lead is taken so that it produces nephritis it also produces other injuries in the body which can be recognised.

2146. You can co-relate with those?—Yes.

2147. Is that information published and generally known for the benefit of the medical profession?—I think that a paper Dr. Smith has written on it will have it all set out in print. The paper has not been printed yet, but it is ready.

2148. It will be available shortly for the information of medical men who have to diagnose cases of lead?—Yes.

2149. *By Mr. Pearson*—In your experience of industrial operations do you know of any vacuum apparatus that has been adopted for the cleaning down of the collection of dust on buildings?—I know of some things that have been used. In the United States of America they construct houses with a whole system fixed in, and the dust from every flat is shot out. They have a vacuum cleaner with a general system of collection. I think that, even in Sydney, there are buildings in which they have installed similar systems to collect the dust from the buildings.

2150. The point I am concerned about is in regard to the dust that lodges on the buildings at the smelters. There is quite an accumulation of dust, and the question has been raised by a previous witness as to whether it is safe to clear it?—I think it is quite safe to clear it. Before I leave I should like to add something to my previous remarks. Considering what we have observed here regarding the occurrence of cases of lead poisoning and carbon monoxide poisoning, and considering what we have seen on the works in regard to the accumulation of lead dust in the air, and the high probability of carbon monoxide poisoning in the works, we think that, in the interests of hygiene, the appointment of a technical committee of inquiry to determine what the risk is and advise how that risk might be diminished, is desirable.

2151. *By Mr. Gepp*—To be appointed by whom?—By the State or this Commission.

2152. What would be your idea of the constitution of that committee?—It should be purely a technical committee, and

consist entirely of persons of technical training. By that I mean persons thoroughly conversant with methods of hygiene, with medical examination, and with the methods of determining the risk of lead and carbon monoxide. They should be sufficiently acquainted with these things to be able to recommend conditions that would lead to the diminution of dust and carbon monoxide.

2153. Do you think it is possible for an outside committee like that definitely to recommend the details of the methods to be adopted, or should they recommend general principles?—I think such a committee would do well, mainly to lay down principles and standards and the methods to be empolyed. Further, such committee should test the proposals for the eliminations and see how they work, so that they make recommendations in regard to those which are beneficial.

2154. Would that be before even the indication of general principles by this Commission, and would the recommendation of such a committee be a matter of departmental action by the Government, working in conjunction with the company and the men?—I think that the method I recommend more certainly ensures that it is done.

2155. For instance, in the explosive industry inspectors are appointed, and they have such powers that everything is carried out that they even indicate?—Yes. I favor a committee. Take, for example, the dust in the mines at Broken Hill. Under the Mining Act the Mines Department of New South Wales had plenty of power, and also laid down in a regulation that no dust should be produced in mining. It looked generally at methods, and said that the dust should be got rid of, but it never measured to see whether the dust had been eliminated. It had no idea of the quantities of dust in various places. That is more likely to be done by a committee, who would see that the work was properly and efficiently carried out.

2156. *By Mr. Robinette*—Do you not think that a lot of the dust in the smelters could be prevented without the aid of a technical commission?—Yes.

2157. Quite a lot?—Yes.

2158. *By Mr. Gepp*—Would your committee consist of technical men only?—No. I think you must have a person who is able to form a personal judgment on the methods used to remove carbon monoxide and lead dust. You would not have a purely medical man who had had no experience in these things, but a man trained as a hygienist.

2159. If your whole purpose is carried out you would also have to have men skilled in metallurgy and in engineering metallurgical work, so that they could indicate practical methods, would you not?—That might be desirable.

2160. Medical men would not be able to say whether a particular trouble could be overcome most efficiently and cheaply?—That is so.

2161. It would depend upon the metallurgical engineer to say that?—Yes.

The witness withdrew.

STEWART ARTHUR SMITH, medical practitioner, 147, Macquarie Street, Sydney, was recalled and further examined:

2162. *By the Chairman*—You have been associated with Professor Chapman in the work that has been done during the past week? I should be glad if you would give the Commission your comments on it?—In conjunction with Professor Chapman I made two visits of inspection to the works, and also examined 29 men who had been at work here. After the examination of those men, I came to the conclusion that seven of the men were suffering from lead poisoning. They have been indicated by the professor. The remaining 22 men, details of whose examination were given by Professor Chapman, were, in my opinion, not suffering from lead poisoning. Two of them were, in my opinion, fit for work. In the case of others, the cause of their disability was recognised as not being due to lead poisoning, being due to some condition not arising out of the course of their employment, with the exception of instances, in which it seemed probable, that carbon monoxide poisoning had been the reason for their disability. In some cases it was not possible to define accurately the exact nature of the disease from which they were suffering. In these latter instances further observation and investigation would be necessary before a definite conclusion could be arrived at. I have no points of difference to make to the evidence given by Professor Chapman, which I heard, but would add this. One man, who is not suffering from lead poisoning, but who, in my opinion, was suffering from the sequel of carbon monoxide poisoning, had worked for eight and a half months at the smelters. Three and a half months of that period had been spent in work about the bag-house. The remaining five months had been spent entirely in feeding the furnaces on the top floor. Before the actual onset of the illness, which ultimately disabled him, he had had two attacks which strongly suggested acute carbon monoxide poisoning. In these attacks he had fallen from the staging on which he was working in a sudden fit of unconsciousness. This fit came on suddenly, and he recovered quickly in the fresh air.

2163. *By Mr. Gepp*—You mean that that would be symptomatic of carbon monoxide?—Yes. With Professor Chapman I also made inspections of the works, and I am in agreement with the opinions he has given in his evidence, but I would add that our examination and investigation being comparatively short, indications for the necessity of precautions in such places as the feeding belt of the D. and L. machines and in the B.R. roasters were obvious to us. There are many places, however, in the works upon which, with the information at my disposal, I cannot offer an opinion. I feel, however, that every part of the works in which men might be exposed to lead or to carbon monoxide hazard, should be considered, especially in the light of dust counts in the atmosphere and carbon monoxide estimations of the blood of the men working, so that these hazards might be removed. Each place should be considered on its merits, so that the necessary means for rendering these places less noxious can be determined. Beyond the statement that it is necessary to reduce the dust, there is no general statement that I can make in regard to the lead hazard. Each case should be considered almost as a separate problem and dealt with accordingly.

2164. *By the Chairman*—Can you give the Commission an idea of the clinical picture of industrial disease at Port Pirie?—Yes. In our experience there occurs at Port Pirie lead poisoning of a definite and recognisable type, which is not essentially dissimilar to lead poisoning elsewhere. In this disease, as we have seen it here, colic occurs in all cases. Among the seven men found to be suffering from lead poisoning, all of them had complained of colic, in three cases extending over some years, in other cases for a less period. The colic appeared for the most part comparatively early after exposure to the lead hazard. Signs of definite complete paralysis, such as produced wrist drop, were not present in any person examined, but in six of the seven examined there was definite evidence of weakness of muscles, especially in the forearm. This is, in reality, a partial paralysis. Definite pallor was present in six instances, and anaemia, as revealed by an examination of the blood, in two. Marked nutritional changes causing general wasting of the sub-cutaneous and muscular tissues, were present in three persons. Tremor was present in three out of the seven. The presence of these signs, considered after a careful estimation of the statements made in the history of past health, contributed to the definite picture of lead poisoning. In reference to these men, in whom no evidence of present lead poisoning now exists, lead colic was not present in any case. In one case out of the 22 in this group, paresis of the forearm muscles was present. This, however, was accompanied by other signs of a severe nervous disease, the result of encephalitis. Pallor was present in three instances in this group. In these persons the presence of such diseases as myxoedema and arterio-sclerosis explained the presence of the pallor. Tremor was present in 10 individuals. Anaemia, as revealed by an examination of the blood, was found in eight cases. Further, from an examination of the blood counts in which the number of red cells were estimated, it appeared that the presence of more than five million red

cells was observed in a higher number of individuals than one would expect in the sample of an ordinary population.

2165. In that respect do you take five million per cubic millimetres as the standard?—Yes. My experience in New South Wales is that the red cell count of a normal adult male lies between four and three-quarter millions and five millions red blood cells per cubic millimetre. I am aware, however, that in the opinion of some clinicians the red cell count in Australia is somewhat higher than that. That is not my opinion. In considering the histories both of those suffering from lead poisoning and those who were not suffering from lead poisoning, there are two facts which make their appearance. I have already mentioned one of the conditions, namely, the occurrence of acute illness, in which the legs suddenly give way and momentary unconsciousness occurs, which suggests the probability of carbon monoxide being responsible. It is impossible to state definitely in these cases that the cause was carbon monoxide, because too much time has elapsed since these attacks for it to be determined. The second group of facts which emerge are that, in addition to the red cell counts being high, a common complaint is that of dizziness at work, headache, and tremulousness. My experience of carbon monoxide poisoning of the chronic type is not as extensive as that of acute carbon monoxide poisoning, but I recognise that chronic carbon monoxide poisoning produces in some individuals a train of symptoms in which minor nervous disturbances, accompanied by tremulousness, occur. The occurrence, therefore, of cases of acute carbon monoxide poisoning, with clinical pictures which might possibly be due to chronic carbon monoxide poisoning has led me to the opinion that a thorough survey of the carbon monoxide hazard is necessary in the industry here. It is not possible to get more definite evidence on this point unless such survey is made, which would include as one of its main features an examination of the blood of the men at work, or immediately upon cessation of work. Such an examination would supply valuable evidence in determining if these minor nervous disturbances were caused by the chronic inhalation of carbon monoxide or to other conditions of work.

2166. *By Mr. Robinette*—Where did you ascertain the history of the men?—From the men themselves.

2167. You did not take any notice of Dr. Moulden's history?—Yes. We looked at his histories, but we obtained the information for ourselves. Dr. Moulden would tell us that such and such a man had been working for five and a half years, but we would ask him ourselves.

2168. So you did know who the man was?—We did not know his name. We knew him as a man who had worked in the bag-house or on the top floor, and so on.

2169. *By Mr. Gepp*—You referred to lead colic. That is quite distinct and distinctive as compared with ordinary colic?—It is quite distinct from abdominal pain not caused by lead. One cannot distinguish in the past history of a man with certainty between colic caused by lead and colic caused, for example, by gall stones, but one can distinguish between colic and abdominal pain that is not colic. In most cases, however, colic due to causes other than lead is definitely located to one area of the abdomen, is definitely increased by pressure, and in most instances is accompanied by vomiting early in the attack. Lead colic, on the other hand, is not characteristically definitely located in one area of the abdomen. It is relieved by pressure and is not associated with early vomiting. Lead colic, furthermore, is of an exceptionally severe character, which renders it impossible for a man suffering from it to continue with his work, it usually producing a disability lasting for some days.

2170. Recurring how often in those days?—Recurring frequently, but in severe cases being almost continuous.

2171. You mean by frequently every few hours?—Every half-hour.

2172. Is the cause of that known? Is it due to the action of the lead on the nerve endings, and the action of the nerve endings on the muscular portions of the intestines?—I do not suppose we know beyond question what the cause of it is, but it is presumed to be due to the action of the lead on the nerve endings and the bowel wall.

2173. With the experience you have had here during the past week are there any cases which might be carbon monoxide poisoning, which might be benefited by a treatment with a mixture of oxygen and carbon dioxide?—None that I saw.

2174. *By the Chairman*—That treatment is really a means to save life?—It is an emergency way of saving life.

2175. With regard to cases of the neurasthenic type, which may be due, at least partially, to carbon monoxide, is there any treatment which may prove beneficial?—In the neurasthenic cases, no. My experience leads me firmly to the belief that cases of this type, after a reasonable period of rest and fresh air, are much better off if they return to work, provided they do not work in an atmosphere in which the same hazard continues.

2176. *By Mr. Gepp*—What were the nationalities of the 29 men you examined? Have you any list of them?—No; but I remember. Of the 29 men, 27 were Nordics, including Australians. The remaining two were Southern Europeans.

2177. Could you briefly give the Commission the story of what I may call the mechanics of carbon monoxide poisoning?—Carbon monoxide when inhaled is immediately taken up, displacing the oxygen and combining with the haemoglobin of the red blood cells. The blood is thereby damaged in its oxygen carrying capacity. If the amount of carbon monoxide in combination with the haemoglobin rises beyond 40 per cent., life is in immediate danger. If, however, the amount of carbon monoxide haemoglobin is considerably less than that, life is not endangered, but there is a risk to the individual of damage to the tissues of the body, especially of the nervous system. The amount of damage that results depends not only upon the amount of carbon monoxide contained in the blood, but also on the idiosyncrasy of the individual. The amount of the carbon monoxide content of the blood depends upon the quantity in the air inhaled and for the time for which it is inhaled. The opinion is held by some authorities that the damage done by carbon monoxide is due simply to its interference with the oxygen carrying capacity of the blood. It is believed, however, that in addition to that, it has a specific poisonous effect upon the human tissues. Some cases of carbon monoxide poisoning of an acute type recover without damage or disability. Some, however, reveal its effects after a period of delay, and in some cases changes are set up some days after the inhalation of the poison, which has a selective effect upon certain nervous tissues in the brain. In this way tremor, rigidity of the muscles, as well as what I usually call neurasthenic symptoms, are found in these cases.

2178. In the case of big works where, possibly, you get small quantities of carbon monoxide in the air, the effects are very slow in their action?—I believe so.

2179. The effects would not be permanent if the matter were taken up and cleaned up?—Quite so.

2180. When you come to the question of a 40 per cent. saturation, you are indicating a fairly high percentage?—Yes; one which would immediately become obvious.

2181. You see a large number of lead cases in your practice in Sydney?—Yes.

2182. Do the insurance companies refer their cases to you?—Very largely.

2183. They come from all industries?—Yes. They cover painters, coach painters, gas meter manufacturers, accumulator manufacturers, potters occasionally, and printers occasionally.

2184. Have you had any cases from automobile body factories?—Yes.

2185. What would be the cause there?—The dry rubbing down of the bodies and the inhalation of dust containing lead.

2186. There is no spray painting on them—There is spray painting in one establishment in Sydney.

2187. Have you had any experience at all in the use of what are called plus pressure helmets for use in a particularly dangerous spot that may accidentally occur?—No.

2188. You were here this morning and heard Professor Chapman's evidence?—Yes.

2189. In which he indicated that diseases other than lead poisoning can cause arterio-sclerosis and nephritis?—Yes.

2190. Do you agree with his statement that nephritis from lead can now, in his opinion, be distinguished from nephritis caused by other things?—Yes.

2191. *By Mr. Pearson*—Would sufferers from carbon monoxide be more susceptible to lead poisoning?—No. I know of no connection.

The witness withdrew.

HENRY GEORGE CHAPMAN, Professor of Physiology in the University of Sydney, was recalled and further examined:

2192. *By Mr. Gepp*—Would you tell the Commission the bio-chemical action of carbon monoxide?—The blood contains a coloring matter called haemoglobin. That carries oxygen, which is carried from the lungs, where it is taken out of the air breathed in, to the tissues where it is used for burning up. One gramme of haemoglobin carries 1.34 cubic centimetres of oxygen and, roughly speaking, 100 cubic centimetres of blood in Australia usually carry 20 cubic centimetres of oxygen. One gramme of haemoglobin when saturated with carbon monoxide carries 1.34 cubic centimetres of carbon monoxide. One hundred cubic centimetres of blood will, therefore, carry, when saturated, 20 cubic centimetres of carbon monoxide. It varies with the weight of the individual, but, taking a rough figure, a person contains 5,000 cubic centimetres of blood, or, approximately, 9 pints. So that with the blood completely saturated with carbon monoxide, the blood of such a person would carry 1,000 cubic centimetres of carbon monoxide. The figures show that a person becomes acutely affected by carbon monoxide when 30 per cent. of his haemoglobin is saturated, and it is reckoned that the result is likely to be immediately, or within a few days, fatal when 60 per cent. of the blood is saturated with carbon monoxide. That would be 600 cubic centimetres. When the blood is carrying oxygen as it passes through the capillaries, and comes to the veins, the oxygen is diminished, so that the blood contains 8 to 12 centimetres of oxygen per 100. The blood containing carbon monoxide passes through the capillaries and reaches the veins containing the same amount of carbon monoxide. Carbon monoxide is not given up in the tissues at all, or if it is, in only extremely small quantities.

2193. It is mainly the reduction of the oxygen being carried to the tissues that makes carbon monoxide so serious?—Yes.

2194. *By the Chairman*—Really the reduction of the oxygen causes starvation of the tissues?—Yes. It has exactly the same effect as that caused to a person when he is completely immersed in water. If you take a bag containing 5 litres of air and add to it 100 centimetres, or 2 per cent. of carbon monoxide, and let a person breathe that air in out of the bag, for practical purposes the whole of the carbon monoxide disappears in half a dozen breaths, the carbon monoxide being taken up in preference to the oxygen. If you take a mixture of 300 parts of oxygen and one of carbon monoxide the blood takes up equally a quantity of carbon monoxide and oxygen. That means that in order to wash any of that carbon monoxide out you must have more oxygen to carbon monoxide. Your washing-out mixture must contain a larger proportion of oxygen than 300 to one. That is why it takes such a long time to wash carbon monoxide out.

The witness withdrew.

HENRY ST. JOHN SOMERSET, general superintendent of the Broken Hill Associated Smelters, Port Pirie, was re-called and further examined:

2195. *By Mr. Gepp*—You heard the evidence of Professor Chapman this morning?—Yes.

2196. You heard his references to particular places in the works which he thought needed particular consideration?—Yes.

2197. The Commission would be pleased to know what the company is doing in regard to those places. Those that immediately occur to me are some of the places on the D. and L., particularly the mixing belt and mixing bins, the B.R. and Skinner furnaces, the slag hoods over the slag pots, and the fume that passes with a north-west wind and similar winds from the slag pot ventilators across the bins feeding the blast furnaces? Those are all the points he mentioned.

2198. Will you tell the Commission what the company is doing in regard to those particular points?—Taking first the mixing bins at the D. and L. plant, we have received authority from the managing director to build a completely new set of mixing bins, and these have already been designed in such a way that the dust hazard that undoubtedly exists at that point will practically disappear. The drawings are being got out, and when Mr. Colin Fraser, the managing director, comes here, probably next week, he will give his final approval, and the work will go on. The next point mentioned by Professor Chapman was in regard to the vacuum chambers underneath the D. and L. plant on the "A" section. Regarding this, we are continually experimenting in an endeavor to reduce the quantity of dust forming in the intermittent operation of the cleaning chambers, and we hope entirely to overcome the trouble at that point. Just at present, however, we have not been able completely to do away with it. However, the matter is still having our earnest consideration.

2199. I think Professor Chapman was referring to the delivery from the tray conveyors?—Dr. Smith told me he did not mean that, but meant underneath the machines themselves. However, if it were the tray conveyor, the tray conveyor will, in a comparatively short space of time, entirely disappear, and the discharge end of the "A" machines will be so arranged that I am practically certain that the dust hazard at this point will disappear also. The next point was the top of the blast furnace bins. At present, according to Professor Chapman, the platform, on which the man who tips the skips stands, is so placed that sometimes he cannot get out of the dust that is formed when tipping the skip. I shall look into this matter at once, and see if it is not possible to make a better arrangement, but I might tell the Commission that some time ago we tried a different arrangement of platforms on the top of the bin, but they were so broken by the skips bumping them that we reverted to the old type of platform. That was some years ago. We shall, however, attend to that matter.

2200. The smoke from the blast furnace slag hood escape pipes in certain winds blows over the men who are dumping the skips?—These hoods take the smoke given off by the slag when slag tapping is being done, and we are now changing them; in fact, one furnace, and I think two furnaces, are already equipped in a different way, so that the smoke which comes off the slag pots, instead of being delivered through small stacks into the air, is sucked into the main blast furnace flue, and goes through the bag-house. The whole of the furnaces will be equipped in this way in a very few weeks, and then no more smoke will issue from the little stacks over the slag pots. The other places mentioned by Professar Chapman were the Skinner furnaces and the B.R. roaster furnaces. I might inform the Commission that Mr. Gepp, as general manager of the Electrolytic Zinc Company, has authorised the expenditure of a very considerable sum of money in order to make these two sections as free as practicable from health hazard. At present he has some of his own engineers over here assisting with their advice to do the best practicable with these sections of the plant.

2201. Professor Chapman mentioned also the ventilator shafts in the refinery?—We are already taking certain steps in the hope of improving conditions in the refinery, and if these are not sufficient we shall experiment further until we obtain some satisfactory method of ventilation.

2202. There is a portion of the refinery building that has no lantern. That point is worth considering?—I shall do everything I can.

The witness withdrew.

The Commission adjourned.

Saturday, June 13th, 1925.

[At Parliament House, Adelaide.]

Present—

Dr. K. R. Moore (chairman).
Mr. H. W. Gepp.
Mr. J. L. Pearson.
Mr. W. Robinette.

OWEN MEREDITH MOULDEN, medical practitioner, 80, Unley Road, Unley, was sworn and examined:—

2204. *By the Chairman*—What degrees do you hold?—Bachelor of Medicine and Bachelor of Surgery, Adelaide University, 1911.

2204A. *By Mr. Gepp*—Will you tell the Commission your career since you graduated?—After graduating I did 12 months' hospital work in Adelaide. I then went to England for nine months, doing hospital work. I returned, and within a few months went to Broken Hill, where I entered into general practice. I remained there for 11 years, and 18 months ago I came to Adelaide, and have practised here since.

2205. Whilst you were at Broken Hill did you have particular experiences in regard to industrial diseases?—Yes.

2206. What experiences were they?—For a period of some years I acted as medical officer to various mining companies in Broken Hill in connection with lead poisoning as it was dealt with under the New South Wales 1916 Act. When the Technical Commission started its operations at Broken Hill I interested myself in its work, without having any official connection with it, and particularly in its results. Following that I was asked and consented to act as representative of the Mine Managers' Association on the Medical Board of three appointed under the terms of the Lead Poisoning, 1922, Act. I acted in that capacity for about 12 months, prior to and up to my leaving Broken Hill.

2207. You were following the work of the Technical Commission, presided over by Dr. Chapman and Dr. S. A. Smith, from its inception right through?—I kept in touch with it purely from the point of view of scientific interest.

2208. And you had a number of cases of your own at Broken Hill connected with industrial diseases, particularly lead poisoning?—Yes.

2209. Did you follow the work relating to dust at Broken Hill in connection with Dr. Chapman's Commission?—I am aware that the work was done.

2210. For how many years were you at Broken Hill?—Eleven.

2211. Since you returned to Adelaide have you had any special connection with industrial work?—During this year I was asked by the executive of the South Australian branch of the Printing Industry Employees' Union of Australia to examine a group of men for the presence of industrial diseases, for the purpose of supporting, or otherwise, their case before the Arbitration Court. I agreed to do so, and completed the work. Within the last week I have been asked to examine a further group for the same union.

2212. Have you furnished a report giving the results of your examination to the union?—Yes; it was private.

2213. Have you been doing some work lately at Port Pirie for the Broken Hill Associated Smelters?—Yes.

2214. Have you conducted an examination of beneficiaries under the Workmen's Compensation Act for the company?—Yes.

2215. How many beneficiaries have you examined so far?—Ninenty-seven.

2216. For what period have you carried on that work?—Approximately, four weeks.

2217. Have you made a thorough examination of those beneficiaries?—Yes; it was what might be called an exhaustive clinical examination, with other examinations as were thought necessary.

2218. Those examinations were carried out by you for the company in connection with the powers given to the company to call men up for examination under the Workmen's Compensation Act?—Yes.

2219. Will you briefly tell the Commission your own story of plumbism generally as you have developed it from your own experience and reading?—After a man has been exposed to lead for varying periods he may show evidences of lead absorption. This condition is generally evidenced by such symptoms as loss of weight, pallor, and possibly constipation. It is rare at this stage to have colic, tremor, or paresis present. In the majority of cases a man passes on from this condition, in spite of his still being exposed to lead hazard, and becomes apparently again in normal health. However, in a certain proportion of instances his condition becomes progressively worse, and he is then said to be suffering from lead poisoning. This condition is most conveniently divided into three clinical types. The first is gastro-intestinal, the second nervous, and the third arterio-renal. The gastro-intestinal type is commonly caused by the absorption of small quantities of lead over a short period. The nervous type is commonly caused by the absorption of larger quantities of lead over a short period, whereas the arterio-renal type is alwayss the result of absorption of lead over a prolonged period of years. Symptoms existing in the gastro-intestinal type are colic and pallor with or without anemia or tremor. The lead colic is, in the majority of cases, readily distinguished from any other colic. The pallor is the result of two processes: firstly, the effect of lead on the circulating blood causing a reduction of its haemoglobin percentage, and, secondly, its effect on the capillaries of the circulation as a constrictor. In the nervous type the common symptoms are colic and pallor, and, most important of all, tremor and paresis. The colic and pallor are comparable to those in the first type. The paresis usually takes the form of a weakness of the extensor muscles of the forearm. There are three other less known forms of paresis. Tremor is practically a constant symptom, and is probably the early manifestation of the same poisonous process as produces paresis. Both of them are caused by the effect of lead circulating in the blood acting on the nerve endings in the muscles. In the arterio-renal type the evidences of disease most commonly present are arterio-sclerosis (thickening of the arteries) and nephritis, that is, inflammation of the kidneys. They are both the result of long continued circulation of small quantities of lead in the blood, acting on the tissues.

2220. *By the Chairman*—In connection with arterio-sclerosis caused by lead and the attendant nephritis, is it common to find diminution of the vision comparable to that of ordinary Bright's disease?—No. Diminution of vision is more commonly found in a type of lead poisoning I have not mentioned, viz., an encephalo-pathic condition, which is an acute manifestation of the nervous type. It is a condition affecting the brain which is a portion of the nervous system.

2221. With the latter type you find eye changes not common to the ordinary arterio-renal type?—They are different.

2222. *By Mr. Robinette*—Does the encephalopathic condition occur in acute or chronic cases?—In acute cases.

2223. It would not occur in chronic cases?—No.

2224. One of our men died from that condition, and the doctor certified it was not due to lead poisoning. Would that be due to lead poisoning or infection?—The two things are completely different and could be readily diagnosed.

2225. *By Mr. Gepp*—Encephalopathy can occur from other causes than lead?—Yes.

2226. *By Mr. Robinette*—Have you known of a man suffering from lead poisoning to die of that type of the disease?—No.

2227. *By Mr. Gepp*—Will you explain "susceptibility," "immunity," and "tolerance," having reference to the disease known as lead poisoning?—Amongst a large group of men exposed to lead absorption a certain proportion will possibly show evidence of lead absorption. The majority of these regain normal health, but a proportion get progressively worse and then suffer from lead poisoning.

2228. If still exposed to the same hazard?—Yes. These are susceptible persons. Again, if a man has already suffered from lead poisoning and has recovered therefrom, and again exposes

himself to a lead hazard and again contracts lead poisoning, he is a susceptible person, given that the hazard is an average one. By immunity in regard to plumbism is meant that a person can withstand the effects of lead absorption to a comparatively great extent, and will not contract lead poisoning unless exposed to a further and greater hazard. By tolerance is meant the process of acquiring immunity to lead; that is to say, a man working and exposed to lead may develop symptoms of lead absorption as mentioned before. Usually, although still exposed to the same hazard, he will gradually regain normal health, in which case he has gained his tolerance.

2229. Would you say that the mechanism of the tolerance is that his elimination equals his absorption?—Yes.

2230. What is your view of the words "predisposing causes" in plumbism?—Lead poisoning may result from one of two processes—one, the absorption of quantities of lead; the other a decrease in the elimination of lead. Lead is eliminated by two channels—the large bowel and the kidneys. Any condition which reduces the efficiency of either of these two organs may be called a predisposing cause of lead poisoning. Such are alcoholism, syphilis, gout, and pyorrhoea by its effect on the gastro-intestinal tract generally.

2231. Would the predisposing causes include anything which tends to cause intestinal stasis or constipation?—Yes.

2232. Some authorities say that pyorrhoea, anaemia, and exposure to lead, when co-existing, may very easily be wrongly regarded as lead anaemia. What would be your comment on that? I speak now of the practitioner who has not been able to give long intensive study, as a specialist, to lead poisoning?—In certain cases it would be very difficult to distinguish between the two causes of anaemia.

2233. With experience and special training can they be distinguished?—I am not prepared to give a definite answer. Investigations in this direction are not yet completed.

2234. What is your experience with a blue line on the gums in relation to the diagnosis of cases?—When lead is circulating in the blood stream and reaches the margins of the gums, if pyorrhoea or any other septic condition of the gums be present, the lead particles are converted into lead sulphide and are deposited in the tissues along the edges of the gums. The condition can be most readily determined by the use of a magnifying glass, which shows a definite punctate appearance. The condition is easily mistaken for other conditions; one, that due to deposition of lead under the gums on the teeth, the other a condition of blueness or cyanosis caused by a chronic inflammation of the edges of the gums. A blue line is diagnostic of lead absorption only, not of lead poisoning.

2235. We have had before us in evidence the Burtonian line and the false lead line. Will you explain those?—The Burtonian line refers to the true blue line. The false line refers to the two conditions last mentioned by me.

2236. What is the mechanism of the effect of lead on the nervous system?—After absorption the lead circulates in the blood stream, and in certain cases on reaching the capillaries in the sheaths of the nerve terminals in the muscles, has a rotting effect on the walls of those capillaries, causing small haemorrhages to occur. These act by destroying the function of those nerve endings. As a consequence, the muscle fibres supplied by those nerve endings waste, and partial or complete paralysis of the whole muscle belly results. A second effect of lead on the nervous system is probably one of a direct protoplasmic poison.

2237. What use do you make of estimations of lead in the urine?—The presence of lead in the urine is diagnostic of lead absorption only, and not of lead poisoning.

2238. *By Mr. Robinette*—Irrespective of the quantity?—That is rather difficult to answer. It may depend entirely on the efficiency of the kidneys. Small quantities of lead in the urine of a man with deficient kidneys might indicate severe lead poisoning, whereas another man might be only a mild case because his kidneys are efficient.

2239. *By Mr. Gepp*—Has there been any work leading to a connection of lead in the urine with the diagnosis of lead absorption as against lead poisoning?—Professor H. G. Chapman, of Sydney, has recently evolved a previously unused electrolytic method of estimating the presence of lead in the urine.

2240. But from the amount of lead you cannot at the moment say whether a man is only absorbing lead or is lead poisoned?—No.

2241. Does the medical profession find it difficult to diagnose a nervous type due to lead as compared with a nervous type due to other causes?—The majority of cases are readily diagnosed, but in certain cases there may be some difficulty.

2242. You have made an examination of nearly 100 men. On the average what time did you spend on each examination?—For the first, say, 12 or 15 examinations, about two hours was spent on each case, and as light was thrown on the position, the time grew shorter and shorter until about an hour was spent on each of the later cases.

2243. Your report covers specifically the cases you have examined. Are your conclusions general or specific to these particular cases in relation to the whole number of employees?—They refer specifically to the 97 beneficiaries examined, and to them only. I am not prepared to generalise on the question of lead poisoning in Port Pirie.

2244. Will you explain the results you have obtained by reason of your four or five weeks' work at Port Pirie, and give us any conclusions you feel justified in giving?—Yes. I read the following report:—

LEAD POISONING IN THE SMELTING WORKS OF THE BROKEN HILL ASSOCIATED SMELTERS PROPRIETARY LIMITED, PORT PIRIE.

Adelaide, June 11th, 1925.

An exhaustive examination of 97 men receiving compensation for lead poisoning has been made, constituting the whole of those men at the present time receiving compensation. The examination comprised a close investigation into each man's industrial history, social history, history of past health, history of previous lead poisoning, and history of present illness, besides a subjective and objective clinical examination, supplemented by a detailed examination of the blood.

It was decided that the most convenient way of grouping the undoubted lead poisoning cases clinically was as follows:—1, gastro intestinal; 2, nervous; 3, arterio-renal.

Further, for the purposes of this report it was found convenient to divide the cases into two broad nationality groups as follows:—1. Northern Europeans. These include (*a*) British, (*b*) German, (*c*) Scandinavian. 2. Southern Europeans. These include (*a*) Greeks, (*b*) Maltese, (*c*) Jugoslavs.

The above grouping has been proved accurate by certain data available.

After the clinical examination of the whole of the beneficiaries had been completed it was found that there was a group constituting a large proportion of the cases in which the symptoms and physical signs were of an indefinite nature, and which constituted essentially the picture of neurasthenia, with or without digestive disturbances. The men comprising this latter group were undoubtedly suffering from some disability of greater or lesser degree, and it was only after mature consideration, and later by an investigation into the possibility of chronic carbon monoxide poisoning existing amongst them, that it was possible to more or less satisfactorily account for the causation of these men's condition. It is as well to state here that before the whole of the cases in this group can be satisfactorily explained it will be necessary to conduct further investigations into the question of the existence of carbon monoxide in the air breathed by the workmen in the different sections of the works.

Of the 97 men examined, 26 were found to be suffering from undoubted lead poisoning; 71 were found not to be suffering from lead poisoning.

Undoubted Lead Poisoning Cases.

Of the 26 definite lead poisoning cases, 14 were Northern Europeans=53.9 per cent.; 12 were Southern Europeans=46.1 per cent.

The 14 Northern Europeans represent 1.2 per cent. of the total Northern Europeans employed on the works. The 12 Southern Europeans represent 2.5 per cent. of the total Southern Europeans employed on the works. The total number of employees in each of these two nationality groups is taken from figures representing the average daily number employed during the fortnight ending 24/4/1925.

There is the possibility that variation in the intensity in relation to the period of exposure to lead exists in the two nationality groups, and consequently conclusions drawn from this and certain ensuing tables may be slightly affected; but, in my opinion, based on my observations and knowledge, this is not serious.

If we now divide the cases into their three clinical groups we have:—

	Gastro-Intestinal (3 cases). Per cent.	Nervous (20 cases). Per cent.	Arterio-Renal (3 cases). Per cent.
Northern Europeans ..	33.3	50	100
Southern Europeans ..	66.6	50	—

From these figures it will be seen that the percentage of Northern European cases increases in direct ratio to the severity of the clinical type. The gastro-intestinal type is usually due to the absorption of small quantities of lead over a comparatively short period; the nervous cases are generally due to the absorption of larger quantities of lead over a comparatively short period; whilst the arterio-renal cases are usually the result of the absorption of lead over a prolonged period of years. Consequently, it will be seen that in the above cases, broadly speaking, the Southern Europeans contract lead poisoning to a comparatively greater extent than Northern Europeans after a short period of exposure. In the arterio-renal type all the three cases are Northern Europeans, because there are no Southern Europeans who have been exposed to lead absorption over a sufficiently long period to cause this type.

Age.

As there are no Southern European cases in this latter arterio-renal type, it will be better in comparing the ages at which lead poisoning is contracted to limit the figures to the gastro-intestinal and nervous cases, which together can be called cases of sub-acute lead poisoning, whereas the arterio-renal cases can be called chronic lead poisoning.

Of the 23 cases the average Northern European age is 39.3 years; Southern European age is 34 years.

These figures show that in the above cases Southern Europeans contract lead poisoning at an earlier age than Northern Europeans.

Period of Service prior to Contraction of Lead Poisoning.

The average period of exposure before infection in the total 26 cases is 8.97 years.

The average period of exposure before infection in the 23 sub-acute cases is:—Northern Europeans, 13.4 years; Southern Europeans, 2.2 years. These figures show the increase of susceptibility to lead poisoning in the Southern Europeans.

The average period of exposure before infection in the three chronic cases is 18.1 years. As mentioned before, all three cases are Northern Europeans, and these figures show that very many years of exposure to lead are necessary before chronic lead poisoning occurs.

Toxicity of the Different Sections of the Works.

The following figures relate to the number of sub-acute cases of lead poisoning found during the present investigation in the different sections of the works shown below.

It is as well to point out here that of the total 23 sub-acute cases, three were from the service department, but by careful investigation it could be shown that the contraction of lead poisoning in these cases took place in one of the under-mentioned sections.

The total number of men employed in each section is taken from figures covering the fortnight ending 24/4/25, so that the percentages must be taken relatively to one another only.

Of the 23 sub-acute cases:—5=21.3 per cent., are from the bottom floor; 3=13.1 per cent., are from the top floor; 3=13.1 per cent., are from the refinery; 4=17.4 per cent., are from the D. and L. plant; 5=21.3 per cent., are from the H. and H. plant; 2=8.7 per cent., are from the B.R. and Skinner furnaces and acid plant; 1 case occurred in a man who had been working in the slag pit for three months.

Taking the number of lead cases as a percentage of the number of employees in each of the sections used above, the following is disclosed:—

Section.	No. of Employees.	No. of Lead Cases.	Percentage of employees in each section affected with lead poisoning.
Bottom floor	129	5	3.87
Top floor	78	3	3.84
Refinery	271	3	1.1
D. and L.	132	4	3.1
H. and H.	48	5	10.41
B.R. and S. furnaces ..	82	2	2.43

From these figures it will be seen that the H. and H. plant is by far the most toxic, whilst the refinery is the least toxic.

Comparison of Physical Standard between the two Broad Nationality Groups.

	Northern Europeans.	Southern Europeans.
Average height	66.2 inches	65.9 inches
Average weight	143.8 lbs.	136.6 lbs.
This shows that the average weight per inch of height is ..	2.172 lbs.	2.073 lbs.

Clinical Picture.

The appended Table B is a condensed account of the 26 undoubted cases of lead poisoning.

To take the three clinical type groups separately:—

1. *Gastro-intestinal Type.*—In the cases of this group, colic, pallor, blue line, and tremor existed, with or without anaemia.
2. *Nervous Type.*—In the cases of this group, tremor and paresis are constant. The paresis most commonly takes the form of a weakness of the extensor muscles of the forearms. These two prominent symptoms may or may not be accompanied by colic, pallor, blue line, anaemia.
3. *Arterio-renal Type.*—With this type the outstanding features are arterio sclerosis with high blood pressure and albuminuria, denoting a nephritis or Bright's disease.

Pyorrhea.

Of the total 26 cases of lead poisoning, 18 have pyorrhea. This is a fact of the very greatest importance, and suggests that pyorrhea may be a pre-disposing cause of lead poisoning. The causal relationship between pyorrhea and the onset of lead poisoning can only be definitely decided by a complete medical survey of the whole of the employees of the works. It could then be determined whether the incidence of lead poisoning was greater in those men with pyorrhea than in those without it. The necessity for a dental clinic is thus evident.

Table Showing Comparative Blood Picture in

1. Total lead cases.
2. Control lead workers.
3. Control office workers.
4. Control townspeople.

The haemoglobin percentage, red blood corpuscle count, number of red cells showing punctate basophilia in each million R.B.C.'s will be shown, and number of lymphocytes.

	Total lead cases. 26 cases.	Healthy lead workers. 16 cases.	Office workers. 5 cases.	Townspeople. 3 cases.
Haemoglobin percentage	82.6	84.9	95	97
R.B.Cs.	5,108,000	5,090,000	5,680,000	5,733,333
Punctate basophilia per million R.B.Cs.	761.5	583.1	8	—
Lymphocytes ..	32.5	31.9	29.6	28.7

The outstanding feature of this table is the presence of 583.1 cells in every million red blood corpuscles, showing punctate basophilia in the average healthy lead worker as against 761.5 in the average undoubted case of lead poisoning, whereas in average office workers or townspeople it is practically nil.

These figures definitely prove that the presence of punctate basophilia in the blood, even in a high degree (*e.g.*, 3,000 per million R.B.Cs. in one healthy lead worker) is not a diagnostic sign of lead poisoning, but is a diagnostic sign of lead absorption. It occupies the same position in summing up a lead case as do the presence of a blue line on the gums or a definite history of exposure to lead; that is to say, it is evidence of lead absorption. The fact that the average number of these punctate cells is higher in the definite lead cases than in the healthy lead workers suggests that after further prolonged investigation in this matter it may be possible to definitely establish a standard whereby a doubtful case could be determined to be either suffering from lead poisoning or from lead absorption. This would be most readily accomplished by the estimation of these punctate cells at frequent intervals in any case which showed signs of lead absorption and which was becoming progressively worse; that is, leading on to lead poisoning.

Another point of importance to be noted in the above table is that only four cases out of the total 26 cases of undoubted lead poisoning failed to show the presence of punctate basophilia, so that it is demonstrated that 84.6 per cent. of the total undoubted lead cases show this sign. In the case of healthy lead workers eight out of 19 failed to show this condition of these cells, thus 57.9 per cent. of these healthy lead workers have this blood condition present.

However, another most interesting fact has been noted from a study of the figures. The average number of punctate cells present in the healthy lead workers who *do* show the presence of this condition at all, is as high or higher than that of the total lead cases. This is a fact, to my mind, of very considerable importance, as it suggests that certain persons are undoubtedly more susceptible to the effects of lead on the circulating blood than are others. Further work on this point should be carried out. It may yield most important results.

CASES FOUND NOT SUFFERING FROM LEAD POISONING.

Of the 71 cases found to be not suffering from lead poisoning a large number were found to present a symptom complex of neurasthenia. It was a large group, and constituted 53 of the 71 cases. The whole of the men in this group were undoubtedly suffering from some disability of greater or lesser degree. In 25 of them dizziness whilst at work, with occasional nausea, was a prominent feature of the history. This suggested that the inhalation of carbon monoxide in small quantities may have been the causative factor (see appended Table C). From the industrial histories of these cases it was gathered that most of them came from the top floor, the bottom floor or the refinery. When this fact had been established investigations were made. The blood of fourteen men working on the top floor, bottom floor, D. and L. plant, and refinery was examined. In only one of these cases was carbon monoxide absent from the blood, and that was in a man on the bottom floor. Of the others, the highest amount of carbon monoxide haemoglobin found in the blood, viz., 27 per cent., was discovered in a man after working in the bag-house. The next highest, viz., 24 per cent. C.O.H.B., was found in the blood of a man working near No. 5 furnace on the top floor which had been down for barring and was ready for starting. The appended Table D gives a complete record of these tests for the presence of carbon monoxide in the blood.

I think it highly advisable that further work be done in this direction. I have little doubt that such investigation will result in the elucidation of the problem of this large group of cases of neurasthenia.

The other 28 cases of neurasthenia in which dizziness whilst at work was not a particularly prominent feature will possibly be explained when the above recommendation is carried into effect.

At the present stage I should prefer not to draw any definite conclusions on the subject of chronic carbon monoxide poisoning. However, it appears to me significant that in the above two groups Southern Europeans preponderate greatly.

Of the remaining 18 *cases*, six were found to be in good health and to have recovered from any disability which they may have had. The remaining 12 had other pathological conditions, viz., four cases of nephritis, one each of arterio sclerosis, arthritis, lumbago, appendicitis, myxoedema, whilst there were three cases of an indefinite nature—gastric ulcer (?), enlargement of the liver (?), neuritis (?).

RECOMMENDATIONS FOR PREVENTION OF ILL-HEALTH AMONGST WORKERS.

1. The institution of a medical service at the works is necessary. Its specific functions, apart from all other matters concerning industrial hygiene, should be:—
   - (*a*) A rigorous examination of all men before employment.
   - (*b*) A regular periodic examination of all employees for the detection and prevention of lead poisoning.
   - (*c*) Close observation of all men who have been suffering from lead poisoning and who have been certified as fit and have returned to work. If any of these cases again contract lead poisoning, it will be detected early, and these cases should be eliminated at once, being susceptible persons.
2. Further investigations should be carried out for the purposes of determining the lead and carbon monoxide hazards in every part of the works.
3. According to the results of the above investigations further steps should be taken to diminish the amount of dust and noxious gases in the air which is breathed by the men.
4. The institution of a dental clinic.

RECOMMENDATION AS REGARDS THE METHOD OF DEALING WITH SUPPOSED CASES OF LEAD POISONING.

Legislation different from that at present existing for dealing with persons suffering from lead poisoning is indicated. The new legislation should be on the lines of that existing in Broken Hill, adapted to local conditions. It should specifically cover this point—that all cases certified by the authority under the Act, whether it be a medical referee or a medical board, should be liable to re-examination at any time by the said medical referee or medical board at their discretion. In this way those men suffering from lead poisoning would have more intensive treatment for the cure of their disability than exists at present.

SUMMARY.

1. Lead poisoning exists to a greater extent in Southern Europeans than in Northern Europeans.
2. Lead poisoning occurs at an earlier age in Southern Europeans than in Northern Europeans.
3. Southern Europeans are more susceptible to lead poisoning than Northern Europeans.
4. Southern Europeans are physically inferior to Northern Europeans.
5. The H. and H. plant is the most toxic; the refinery the least toxic.
6. The nervous type of lead poisoning is the predominating one.
7. Pyorrhea is present in a high proportion of all lead poisoning cases and may be a pre-disposing cause.
8. Punctate basophilia is diagnostic of lead absorption only, and not of lead poisoning.
9. Further investigations into the question of the presence of punctate basophilia should be carried out.
10. A large number of cases certified as suffering from lead poisoning are suffering from neurasthenia, possibly the result of repeated exposure to small quantities of carbon monoxide.
11. Carbon monoxide has been found in the blood of men in the top floor, bottom floor, refinery, D. and L. plant and bag-house.
12. Further investigations into the presence of carbon monoxide in the air breathed in different sections of the works is indicated.
13. Twelve cases were found suffering from other diseases.
14. Six cases were found to be in normal health.
15. Recommendations for prevention of industrial illnesses.
16. Recommendation as regards legislation.

[Signed] OWEN M. MOULDEN.

TABLE B.—DEFINITE LEAD POISONING CASES.

Total Months Exposure.	Last Section Worked in.	Months in Last Section.	History Previous Lead Attacks.	Colic.	Pallor.	Blue Line.	Tremor.	Paresis.	Anaemia.	H.B. %	R.B.Cs.	Punctate Basophilia per mil. R.B.Cs.
GASTRO INTESTINAL TYPE.												
132	B.R.S*	14	+	+	+	+	+	—	+	70	48	4,100
8	B.	2	—	+	+	+	+	—	—	90	57	300
3	H.	2	—	+	+	+	+	—	—	88	53	250
NERVOUS TYPE.												
Northern Europeans.												
144	D	48	+	—	+	+	+	+	+	76	50	300
276	O.(H)	276	+	—	+	—	+	—	—	90	52	300
87	B.R.S.	5	+	+	+	+	+	+	—	84	47	140
34	O (T)	34	—	+	+	+	+	+	+	70	46	900
180	R	22	+	—	+	—	+	+	+	74	47	2,000
210	H	7	—	+	+	+	+	+	—	84	53	500
183	D	30	+	—	—	—	+	+	—	83	58	0
150	B	3	+	—	—	—	+	+	—	85	53	70
324	B	24	+	+	+	—	+	+	—	90	47	600
48	D	10	—	+	+	+	+	+	—	88	46	3,200
Southern Europeans.												
126	D	42	+	+	+	—	+	+	—	86	49	400
56	R	26	+	+	+	+	+	+	+	78	53	30
24	R	22	+	—	+	—	+	+	—	90	56	0
19	B	16	—	+	+	+	+	+	+	72	56	1,700
15	H	15	—	—	+	+	+	+	—	95	53	70
12	T	12	—	—	—	+	+	+	—	88	49	2,300
8	O (T)	6	—	—	+	—	+	+	—	90	51	140
13	H	11	—	—	—	—	+	+	—	82	50	1,400
7	S.P.	3	—	—	+	—	+	+	—	93	52	0
30	B	24	—	—	+	+	+	+	—	88	60	400
ARTERIO-RENAL TYPE.												
207	R	180	+	—	+	—	—	—	+	67	45	0
204	O	30	+	+	+	+	+	—	—	82	53	200
300	B	45	—	—	—	+	+	+	+	64	44	500

Each of these three cases has Arterio-sclerosis and high blood pressure—two have Albuminuria.

* B represents bottom floor; T, top floor; R, refinery, D. Dwight and Lloyd plant; H, Huntington Heberlein plant; B.R.S., Barrier roaster and Skinner furnaces; S.P., slag pit; O, service departments.

TABLE C.—SEQUELAE OF CHRONIC CARBON MONOXIDE POISONING.

This table deals with those cases suffering from the sequelae of repeated inhalations of small quantities of Carbon Monoxide. The history of their present illness shows that in every one of these cases dizziness whilst at work was a prominent feature. The other most *prominent symptoms* are those of neurasthenia, viz. :—General weakness, indigestion, headaches, insomnia, pains in the limbs.

Last Section.	Months in Last Section.	General Weakness.	Dizziness.	Pyorrhoea.	H.B. %	R.B.Cs.	Punctate Basphiles per mil. R.B.Cs.
SOUTHERN EUROPEANS.							
*T	16	+	+	+	72	54	2,500
D	16	+	+	—	83	48	2,600
R	37	+	+	+	92	—	—
R	120	+	+	+	88	58	15
B	6	+	+	+	72	43	900
T	12	+	+	+	77	50	100
B	4	+	+	+	80	49	—
B	30	+	+	+	75	46	700
T	3	+	+	+	80	51	140
R	7	+	+	—	90	56	140
R	8	+	+	—	80	51	700
R	16	+	+	+	108	60	600
T	3	+	+	+	92	53	700
B	17	+	+	—	80	54	70
R	—	+	+	+	86	56	800
B	16	+	+	+	93	55	400
B	8	+	+	—	83	54	500
B	28	+	+	—	90	53	—
R	24	+	+	+	78	60	70
NORTHERN EUROPEANS.							
D	16	+	+	—	80	43	1,140
T	9	+	+	+	86	49	300
B	4	+	+	+	79	48	—
R	10	+	+	+	88	55	—
T	6	+	+	+	88	52	200
T	12	+	+	+	82	53	500

* B represents bottom floor; T, top floor; R, refinery; D, Dwight & Lloyd plant; H. Huntington Heberlein plant; B.R.S., Barrier roaster and Skinner furnaces; S.P., slag pit; O, service departments.

TABLE D.—BLOOD TESTS FOR CARBON MONOXIDE.
PYRO-TANNIC ACID METHOD.

Date.	Location where Sample was taken.	C.O. H.B.	C.O.	Remarks.
		%	%	
12/5/25	Bottom floor smelters	10 12	·0077 ·0095	Shift boss. Sample taken at bungalow ½hr. after leaving work, where he had been for 7½hrs.
12/5/25	Top floor smelters	3 4	·0021 ·0029	Shift boss. Sample taken at bungalow ½hr. after leaving work, where he had been for 8 hours.
27/5/25	Bottom floor smelters	4 6 3	·0029 ·0044 ·0021	Shift boss. Sample taken from man after standing for 10mins. in path of fumes coming away from bullion mould and slag tap hole. This man had been working 6½hrs. when sample taken.
27/5/25	Bottom floor smelters	10 11 8	·0077 ·0086 ·0061	Foreman. Same conditions as last man, except this man had been working for 7hrs.

TABLE D.—BLOOD TESTS FOR CARBON MONOXIDE..*continued.*
Pyro-Tannic Acid Method.

Date.	Location where Sample was taken.	C.O. H.B.	C.O.	Remarks.
		%	%	
27/5/25	Smelter Office	2 0	·0014 Nil	Smelter Supt. Same conditions as above, but sample taken 5min. after leaving furnace.
28/5/25	Top floor smelters	15 13	·0123 ·0104	Shift boss. Sample taken near No. 2 Fce., which was down for barring. This man had been working about the furnaces 2½hrs., then stood by No. 5 furnace for 15 minutes before sample was taken
28/5/25	Top floor smelters	24 23	·022 ·0208	Asst. shift boss. Sample taken near No. 5 Fce. which had been down for barring, and was ready for starting up. This man had been working for 3 hours about the furnaces, then stood by No. 5 Fce. for 15 minutes before sample was taken.
28/5/25	Smelter baghouse	27 25	·0258 ·0232	Baghouse Attendant. Sample taken from man in attendants' change house 4 minutes after leaving the baghouse. This man had been working for 3¾ hours. The last 20 minutes were spent inside No. 5 chamber, before the sample was taken.
28/5/25	"A" section D. L. plant	4 5	·0029 ·0036	Shift boss. Sample taken after standing near No. 4 firebox for 15 minutes. This man had been working for 6½ hours before sample was taken.
28/5/25	"A" section D. L. plant	4 4	·0028 ·0029	Asst. Supt. Sample taken under same conditions as previous test.
29/5/25	Near gas producers at retort furnace refinery	8 4	·006 ·0029	Supt. Sample taken after standing near producer for 15 minutes.
29/5/25	Near gas producer refinery	10 8	·0077 ·006	Foreman. Sample taken after standing near producer for 15 minutes. No coal smoke about. This man had been working 2 hours before sample taken.
29/5/25	Near No. 8 refining furnace refinery	11 9	·0086 ·0069	Shift boss. Sample taken after standing near furnace for ¼ hour. Fair amount of coal smoke about. This man had been working 2¾ hours prior to the sample being taken.
29/5/25	Near antimony dross refinery	10 10	·0077 ·0077	Shift boss. Sample taken after standing near furnace for 15 minutes. The atmosphere was fairly free from smoke. This man had been working 3½ hours before the sample was taken.

2245. *By Mr. Gepp*—Do you mean that in one of the men 27 per cent. of the haemoglobin of the blood was useless—that one-quarter of the blood was out of action?—Yes.

2246. *By Mr. Robinette*—What is the exact meaning of neurasthenia?—Weakness of the nervous system. Roughly, the symptoms are general weakness, indigestion of an indefinite character, headaches of an indefinite type, inability to sleep, irritability of temper, and indefinite pains in the limbs. The most graphic description of neurasthenia I get is that they feel "crook" without knowing exactly where.

2247. *By Mr. Gepp*—Will you describe briefly the operation covering the tests for carbon monoxide in the men on the job, as previously mentioned by you?—The technique consists of pricking a man's finger with a haemospast, which is a mechanical pricker, and which is absolutely painless. You do not know that it is being done. It is a thing that looks like a cigarette-holder. It is put on the finger, and a little trigger is pulled. I had it done on myself, and did not know when it was done. I shut my eyes. That causes about one or two minims of blood to appear at the site of the puncture, which is sucked up into a small glass tube, with a piece of rubber attached, blown into a small test tube, and mixed with a certain amount of distilled water, and a pyro-tannic acid reagent is added. These are then shaken together, and allowed to stand for 15 minutes, and then compared with a series of tubes representing such and such a percentage of carbon monoxide haemoglobin in the blood.

2248. That is a colorimetric estimation?—Yes.

2249. And the difference in the color is due to what?—To the varying amounts of carbon monoxide which have combined with the haemoglobin in the blood.

2250. When the carbon monoxide so combines what effect has it on the color of the blood in the presence of the pyro-tannic reagent?—It causes an increase of a certain shade of redness—cherry redness almost.

2251. And the amount of change in the color is indicative of the percentage of haemoglobin combined with carbon monoxide?—Yes.

2252. You said "two or three minims." What is a minim?—A small drop.

2253. The amount used is how many drops?—Not more than two.

2254. This table D shows the results of these tests for carbon monoxide, and covers shift bosses, foremen, assistant shift bosses, and other men on the staff. I have one here mentioned who is apparently the only person not a staff man. He is marked "bag-house attendant." Please explain that particular case?—During the course of these examinations the man in question offered himself for a blood test, saying that he wished to help the investigation. The test was done, and it was afterwards found that he was not a staff man.

2255. How long was this man actually in the bag-house before the sample of his blood was taken?—He had been 20 minutes inside No. 5 chamber.

2256. The report mentions that he had been working for three and three-quarter hours. You cannot say for how much of that period he had actually been inside the chamber?—Only 20 minutes.

2257. What was he doing for the rest of the time?—He was in charge of the bag-house.

2258. So that exposure for only 20 minutes to the atmosphere of a chamber of the bag-house, shut off from the other chambers, gave him 27 per cent. of saturation?—Yes.

2259. *By the Chairman*—The presence of carbon monoxide haemoglobin in the blood requires a considerable time to entirely disappear?—Yes.

2260. So that in the case of this man, if he had been employed intermittently, or if his employment required his entering the bag-house at intervals, a gradual accumulation of carbon monoxide haemoglobin would probably result?—Yes.

2261. You did not mean to infer that one single exposure of 20 minutes in the bag-house would produce 27 per cent. of carbon monoxide haemoglobin in the man's blood?—Without knowing his actual employment I should say it is probable that that was only one of other exposures during the shift. It may be of interest to say that carbon monoxide haemoglobin disappears from the blood in a person removed from exposure to carbon monoxide at the rate of approximately 30 per cent. per hour.

2262. Of its total, or actually 30 per cent.?—Thirty per cent. of the carbon monoxide haemoglobin formed disappears each hour roughly.

2263. *By Mr. Pearson*—It takes three hours for a man to be free from its effects?—Yes.

2264. *By Mr. Gepp*—Please explain the general conditions under which you took the samples?—The primary object in taking them was to establish, or otherwise, the fact of the existence of carbon monoxide in the air which may be breathed by the workmen. Consequently many of the tests were taken in such places as were thought to be the most likely where carbon monoxide would be found.

2265. Were the staff men stood there for periods to get the effect on them?—Certain cases were deliberately stood for a period of some minutes in a particular spot.

2266. It is, of course, undesirable that this Commission's work should cause alarm in regard to the general conditions. Is it your opinion that there is probably chronic carbon monoxide poisoning, but not acute carbon monoxide poisoning, at Port Pirie?—Yes.

2267. Will you explain what you mean by chronic as compared with acute carbon monoxide poisoning?—It will be better to describe the effects of carbon monoxide poisoning under three headings:—1, acute carbon monoxide poisoning; 2, chronic; and 3, the sequelae of chronic carbon monoxide poisoning. In acute carbon monoxide poisoning it is usual for a person to fall down unconscious. He may die while unconscious, or he may recover and gradually get well, or he may get well temporarily and then within 48 hours suddenly die from delayed poisoning. In chronic carbon monoxide poisoning dizziness is a common symptom with headache and nausea; on cessation of exposure to carbon monoxide the symptoms disappear. In the sequelae of carbon monoxide poisoning a condition exists which is apparently the result of the absorption of small quantities of carbon monoxide repeatedly over a comparatively long period. The pathology of this condition is not at present clearly understood.

2268. For the purpose of further investigation by the Commission would you define the minimum time that a man should be on shift before a test is made?—I think half a shift should have elapsed before a test is taken.

2269. You were not able to make any progressive tests over a shift?—No.

2270. Is it necessary that samples should be taken whilst a man is at work or immediately he knocks off?—For preference, within a minute or two after he leaves the position in which he works.

2271. Are there any other places than those you mentioned in table D where you think tests might be taken?—The table includes the top floor, bottom floor, D. and L. plant, refinery, and bag-house. I think every section should be tested where the combustion of carbon containing materials is proceeding.

2272. Can you give the Commission any references to literature which might help us to consider for ourselves this subject of carbon monoxide poisoning?—Yes, I would refer you to the following:—Kober and Hayhurst's "Industrial Health" and Kober and Hanson on "Industrial Hygiene." Then there is the Journal of Industrial Hygiene, vol. 3, No. 1, May, 1921, pages 11 to 15; vol. 3, No. 7, November, 1921, page 213; vol. 4, No. 11, March, page 463; vol. 5, No. 4, August, page 109; vol. 5, No. 7, November, page 253; vol. 6, No. 3, July, page 102.

2273. *By Mr. Pearson*—In describing a phase of lead poisoning you mentioned the words "over a long period." What period do you mean?—By the term "over a long period" I infer a minimum of 17 years in the cases which I examined.

2274. In earlier evidence given before the Commission it was

stated that the men employed in the lead processes are employed seven shifts, equal to 56 hours, per week. Do you consider the strain of continuous employment under the conditions as you know them would have a tendency to increase the risk of lead poisoning?—All other things being equal it would.

2275. We can take it that you consider that shorter hours would be advisable?—You cannot infer that from what I say, because I modified my statement by saying "All other things being equal." The susceptibility of each individual comes into the picture. It is only after long investigation that you could get any definite knowledge on this question.

2276. There would be extra exposure to the hazard with the seven shifts as compared with the six?—Yes.

2277. And harm would result to the susceptible person?—Yes.

2278. In an industry of this description do you consider six or seven shifts per week preferable from the standpoint of the health of the workmen?—I cannot say.

2279. *By Mr. Robinette*—You stated that you were associated with the Technical Commission in Broken Hill, and followed the results closely. Were the results you followed interim reports?—There was one interim report published.

2280. It was on that that you followed the results?—Yes.

2281. During the 11 years you were in Broken Hill how many cases of lead poisoning did you examine?—Roughly, between 150 and 200 of suspected lead poisoning.

2282. You stated that you examined 97 men at Port Pirie who were beneficiaries under the Act. How did you know they were beneficiaries?—By a statement from the company which employed me. A number of men were compounded within a week or two after I examined them.

2283. You did not examine any men other than beneficiaries under the Act?—Yes, I did.

2284. Were they working men or staff men?—Staff men.

2285. Did you find any of them showing symptoms of lead poisoning?—No.

2286. Do you attach any importance to a blood test in determining lead poisoning?—As a result of my investigations, no.

2287. Some of the men you examined were suffering from gout. Does not lead cause gout in some cases?—No.

2288. Have you heard of men's disabilities being diagnosed as lead gout?—Yes.

2289. What does that term mean?—Gout is a metabolic disease; that is, it is due to certain foreign substances existing in the blood-stream. These substances commonly attack the joints. They also frequently attack the kidneys. In a lead worker, who is excreting lead by the kidneys, if he gets gout his excretion of lead by the kidneys may be lessened, and symptoms of lead poisoning could be precipitated. If he, at the same time, had gout in his joints, that would constitute what is called lead gout.

2290. *By the Chairman*—Do you recognise a condition of arthritis caused directly by lead which may simulate gout?—No. I do not think there is such a condition.

2291. *By Mr. Robinette*—Who conducted the blood tests for carbon monoxide?—I was responsible.

2292. You had some assistance?—Yes.

2293. Did you go through the whole process yourself?—I did not personally supervise every result.

2294. Then you do not know whether all those tests are correct?—I am satisfied that they are.

2295. How do you know they are?—Because I have sufficient knowledge of my assistant to place complete confidence in his findings.

2296. Apart from that confidence you do not know whether they were correct?—No.

2297. You said the tests should be taken within one or two minutes after leaving work. Why should they, in the face of your evidence that the rate of diminution in the blood was 30 per cent. per hour?—So that none of it would be lost.

2298. Not much would be lost in five or ten minutes, and the amount could be calculated?—No. The colorimetric test is not sufficiently delicate to differentiate between small variations.

2299. You assisted Drs. Chapman and Smith at the laboratory in examining the beneficiaries?—I was present during their examination.

2300. Did you consider that it was proper to be there while the men were being examined, seeing that you were employed by the company?—Yes, decidedly.

2301. Who invited you to be present?—Professor Chapman.

2302. *By Mr. Gepp*—Who was your assistant in carrying out the carbon monoxide tests?—Mr. Hemingway and Mr. McDonald.

2303. What are their positions at the works?—Mr. Hemingway is the chief chemist and Mr. McDonald head assistant.

2304. Mr. Hemingway carried the tests out first in your presence to satisfy you as to his manipulative methods?—Yes.

2305. You carried out a certain number of tests yourself?—Yes.

2306. It was only after you were satisfied with the tests carried out in your presence that you left the remainder to Mr. Hemingway?—Yes.

2307. Did you do any manipulation yourself in particular cases?—I did the assessing of the result myself in some cases.

2308. You made the judgment from the colorimetric test instead of Mr. Hemingway or Mr. McDonald?—Yes. To test the correctness of their color vision I checked their results and found them to be correct. That is a very important point. A person's color vision must be found to be normal before he is of any use in colorimetric estimations.

2309. When you say you are satisfied with the results from the tests of Mr. Hemingway and Mr. McDonald you mean that it was only after doing some of the tests yourself and seeing them do some that you left the rest to them?—Yes.

2310. Mr. Hemingway is a man of high calibre in his profession?—Yes.

2311. In connection with the cases dealt with by Professor Chapman, has your decision in regard to beneficiaries any statutory effect?—No.

2312. You are not the certifying officer under the Workmen's Compensation Act?—No.

2313. Therefore any decision you may make and any statement you may make to the company as the examining officer for the company does not affect the payment of compensation to the beneficiary?—No.

The witness withdrew.

The Commission adjourned.

Wednesday, June 17th, 1925, at 3 p.m.

[At the Town Hall, Port Pirie.]

Present—

Dr. K. R. Moore (Chairman).
Mr. H. W. Gepp.
Mr J. L. Pearson.
Mr. W. Robinette.

LESLIE GEMMEL TASSIE, medical practitioner, Port Pirie, was recalled and further examined:

2314. *By the Chairman*—In accordance with a proposal of Mr. Robinette, he and myself, as medical representative on the Commission, have, on behalf of the Commission, supervised a series of tests to estimate the presence or otherwise of carbon monoxide in the blood of men working at the smelters. These tests were made on volunteers under conditions which prevented the individual results from being known to any person, and I have no knowledge of the names of the persons tested. The

tests were made in accordance with the method described by Dr. Sayer, of the United States Health Service, and with his apparatus loaned by the Broken Hill South Company. This apparatus is believed to be the only one of its kind in Australia. During the test each of the local medical practitioners was present at some time, and checked certain readings of the results by Mr. McDonald, of the B.H.A.S. chemical staff. Other readings were checked by myself in their absence. The results are summarised in the following tabulation:—

Top floor—In 3 hours' work, 4 to 11 p.c.; in 7½ hours, 9 to 11 p.c.
Bottom floor—3½ hours, 2 to 8 p.c.; 8 hours, 3 to 8 p.c.
Barrier roaster—4 hours, nil.
Skinner process—4 hours, 3 p.c.
Bag-house—7 hours, 8 to 9 p.c. After 10 minutes inside a chamber of the bag-house, 15 p.c.
Refinery—2 hours, 3 p.c.; 7 hours, nil to 2 p.c.
H. and H. pots—3 hours, 1 to 12 p.c.; 7½ hours, 3 p.c. (Showed 12 p.c. in morning. There was south wind blowing in afternoon.)
Dwight and Lloyd "A" plant—3 hours, 4 to 6 p.c.; 7 hours, 10 p.c.
Dwight and Lloyd "B" plant—3 hours, 1 p.c.; 7½ hours, 5 p.c.
Power house—4 hours, nil.
Blacksmith's shop—4 hours, nil.
Sample plant—4 hours, 4 p.c.
Coke heap—4 hours, 4 p.c.

I may add that these results do not represent a survey of the work, but simply indicate to some degree the co-hazard under present weather conditions in certain places. With varying weather conditions and changes in working operations, variations in results would doubtless be obtained. You, I understand, have read the evidence of Professor Chapman and Dr. Smith recently, and you saw therein the reference or recommendation to the effect that a survey should be made in respect of carbon monoxide at the works?—Yes.

2315. You were present the other day, and checked the readings of certain results obtained by the Sayer method?—Yes.

2316. Can you make a statement as to any conclusions you draw from those results?—From my observation of those tests I am satisfied that certain men working at the smelters in certain places, which are unknown to me, as I am not aware where the tests were taken, are being exposed to the absorption of carbon monoxide gas, and are absorbing carbon monoxide gas.

2317. You are satisfied on that point?—Quite satisfied.

2318. Have you any further statement to make to the Commission in that connection?—I consider it emphasises what I have already indicated to this Commission, that is the necessity for compulsory notification of all industrial diseases, compulsory notification of suspected cases, and the examination of those cases, not by the general practitioner, who has neither the time nor the appliances to carry out research, but by men expert in matters of industrial hygiene.

2319. *By Mr. Robinette*—Have you had any experience of carbon monoxide poisoning?—No.

2320. Have you read much on that point?—I have read all the available literature I have on the subject; but, as I have remarked, we have had no professional experience of it up here, and no indication that it has been occurring. We have had suspicions that things other than lead poisoning were occurring, but we could not trace to what they were due, as we are only general practitioners, not chemists, nor have we had opportunities to go about the work and make investigations in such a direction. I have had no experience of carbon monoxide poisoning up to the present.

2321. Dr. O. M. Moulden made a statement that where a person has absorbed carbon monoxide, and has removed to the fresh air, the diminution of carbon monoxide in the blood was at the rate of 30 per cent. per hour. Have you any comment to make on that?—I am not prepared to offer any opinion. I presume that it could be worked out by tests.

2322. Do you consider that the eyes of a man making those tests should be thoroughly tested before doing so?—I think he ought to have normal and efficient eyesight.

2323. Would it be necessary for his eyesight to be tested?—It would certainly be necessary to ascertain that the man is not suffering from color blindness.

2324. Would it be possible for there to be a variation in respect of those tests in men of normal eyesight?—In tests where you have to compare with color standards, the personal factor would have to come in, and in the case of men of normal eyesight there might be a variation of 1 or 2 per cent., but not a great amount.

The witness withdrew.

CARL EMIL DORSCH, medical practitioner, Norman Street, Port Pirie, was recalled and further examined:

2325. *By the Chairman*—You have just heard the statement which I made concerning the result of tests as to the presence or otherwise of carbon monoxide in the blood of men working at the smelters, and I take it that you have read the evidence of Professor Chapman and Dr. Smith, in which they made certain statements relating to carbon monoxide?—Yes.

2326. You have been present at the smelters recently, and have seen some results of the carbon monoxide tests taken?—Yes.

2327. Will you give the Commission your opinion in relation to the presence or otherwise of carbon monoxide at the works, as a result of what you have seen and heard?—As a result of what I have seen I cannot very well offer an opinion, but as a result of what I have heard from you as to how the tests worked out it would appear that there must be a hazard there. The tests which I saw were not at all conclusive, but the figures you have read out are suggestive.

2328. You would say they represent a carbon monoxide hazard?—Yes.

2329. Do you desire to make any further statements to the Commission in that regard?—No.

2330. *By Mr. Robinette*—You say the tests you saw were not conclusive?—No; I only spent about an hour at the works. However, the figures read out seem to be conclusive.

2331. Were you satisfied with the tests?—It is my opinion that when made by men with strong color vision they would be very good. My own vision is not good enough in respect to slight variations in color to enable me to quibble over percentages.

2332. *By Mr. Gepp*—Dr. Tassie, in his evidence a few minutes ago, emphasised that this work seemed to him to support his previous contention that all cases of suspected industrial disease should be referred by the general practitioners to experts for final decision. Do you agree with that?—Yes; most emphatically.

2333. As a general practitioner you would prefer that?—Yes.

The witness withdrew.

CHARLETON YEATMAN, medical practitioner, Port Pirie, was recalled and further examined:

2334. *By the Chairman*—You have just heard the statement which I read out of results of tests at the works for carbon monoxide by the Sayer method. You have read the evidence of Professor Chapman and Dr. Smith, as given at Port Pirie recently, in which there were certain references to carbon monoxide as a possible hazard in connection with the smelters? Yes.

2335. In addition, you were present and read certain of the tests taken at the smelters?—Yes.

2336. What is your opinion now in relation to carbon monoxide as a hazard at the smelters?—I can merely say that there would seem to be a hazard in respect to carbon monoxide poisoning. I would not like to indicate its degree or prevalence.

2337. Is there any further statement you would care to make to the Commission in that respect?—No.

2338. *By Mr. Gepp*—Do you agree with Dr. Tassie in regard to the necessity of cases of industrial disease being compulsorily notifiable, and that suspected cases should be referred to experts for examination, as the general practitioner has neither the time

nor appliances to carry out research in respect to such diseases? —I quite agree that suspected cases of industrial disease should be notifiable, and that we should have the greatest assistance possible in coming to a correct diagnosis through the aid of special laboratory methods and so on.

2339. *By Mr. Robinette*—You have not had any experience in regard to carbon monoxide poisoning industrially?—I did not recognise it as such.

2340. You have read something of carbon monoxide poisoning?—Yes.

2341. Would you consider that a man, subject to 5 per cent. saturation over the bigger part of eight hours each day, would be likely to become incapacitated?—I could not answer that question with certainty.

2342. From your reading on the subject, what percentage would there have to be for a man to absorb before it would be likely to be injurious?—I cannot remember the actual figures.

2343. On the figures which have been indicated by the Chairman, do you think there would be a hazard?—Those figures certainly show that there is free carbon monoxide in the vicinity of the work those men are doing. Whether that particular saturation is sufficient to cause ill-health I have not the experience to say.

2344. *By Mr. Gepp*—You would except, of course, such a figure as 15 per cent. in the case of the bag-house?—From my very limited experience and limited reading I do no think I can answer that question definitely. I recognise there must be a carbon monoxide hazard. Beyond that I do not care to make any further remarks.

2345. *By the Chairman*—It would seem a logical deduction from the standpoint of physiology that a man who each day has 15 per cent. of his haemoglobin put out of commission by carbon monoxide over a long period, would get ill results from it?—Yes; I think he must, reasoning on physiological grounds.

2346. *By Mr. Robinette*—Are you satisfied from what you saw of those tests that they were carried out as nearly accurately as it was possible to get them?—They were, as far as I could tell.

2347. *By the Chairman*—Apart from actual color blindness, or loss of the faculty of distinguishing greens or reds, do you consider that individuals show variations in the power of discriminating between fine shades of the same color?—I know they do. I think it would need special training to take accurate readings by colorimetric methods.

2348. A part of the training in chemistry is color estimation? —Yes.

2349. *By Mr. Robinette*—Have you read Sayer's work on the testing of the blood?—I have read his small pamphlet.

2350. We had certain tests in which there was variation in the amount of pyrotannic acid used, and we were unable to read them. Do you think it is necessary that the amount of pyrotannic acid used should be strictly accurate, and that a slight variation would alter the tests?—There is a brown color developed by blood under pyrotannic acid, and when it contains carbon monoxide also a cherry red color is given to the mixture. It seems to me that the cherry color would still develop even if there were still slight variations in the amount of pyrotannic acid. No doubt it is advisable that the tests should be carried out with strict accuracy.

2351. There would be no great variation between the amount you would get in the small spoon used and what you would get on the end of the blade of a pocket knife?—I have so little experience of the tests that I could not say what the variations would be.

The witness withdrew.

The Commission adjourned.

No. 57.

Wednesday, June 24th, 1925, at 10 a.m.

[At Parliament House, Adelaide.]

Present—

Dr. K. R. Moore (Chairman.)
Mr. H. W. Gepp,
Mr. J. L. Pearson
Mr. W. Robinette.

BEDLINGTON HOWEL MORRIS, Inspector General of Hospitals, Adelaide, and a Medical Referee under the Workmen's Compensation Act, was recalled and further examined.

2352. *By Mr. Gepp*—Since you were previously before the Commission as a witness, the Commission has taken a considerable amount of evidence in New South Wales and later at Port Pirie, and has developed, as the result of its inquiries, a number of important and interesting facts. The evidence of the works' medical officers at the white lead manufacturing plants in New South Wales was, firstly, strongly in favor of careful entrance examinations; secondly, strongly in support of regular periodical examinations; and thirdly indicated the difficulty in many cases of correct diagnosis owing to the absence of specific criteria. Professor H. G. Chpaman and Dr. S. A. Smith of Sydney, who were the principal experts in charge of the Broken Hill investigation, gave much valuable evidence before the Commission in Sydney, and they both particularly emphasized their views that the clinical picture placed before them by the Commission, gathered from previous evidence, was not to them convincing that the industrial cases at Port Pirie were specifically caused by lead. When questioned regarding the possibility of carbon monoxide, they said that in the absence of lead colic in many cases as a predominant symptom and the presence in a large number of cases of symptoms and signs of neurasthenia, the cases might possibly be carbon monoxide instead of lead. They indicated that they could give no definite finding unless they were able, preferably on the spot, to examine a sufficient number of cases, and to make examinations also of the conditions under which the men worked. These two gentlemen who, I think, can be regarded as two of the leading experts on these matters in Australia, and who also have a world-wide reputation in connection with their knowledge of industrial diseases, had the opportunity of examining 29 men at Port Pirie, and of closely investigating conditions of work. Their evidence given at Port Pirie after the examinations had been made, was, firstly, that, in their opinion, only seven cases were undoubted cases of lead poisoning, that three were carbon monoxide poisoning cases, that three were doubtful and should be referred to hospital for further observation, that four were then free of any disease from which they might have been suffering, and that a number were suffering from diseases unconnected with their employment. Dr. O. M. Moulden, who has been examining all, or nearly all, the cases at present receiving compensation, and who has been doing this on behalf of the B.H.A.S. Proprietary, Limited, reported in his evidence given last week that of 97 cases examined 27 only were undoubted cases of lead poisoning, 53 cases were of neurasthenic type, of which the causation was, in his opinion, carbon monoxide, six were now well, having recovered from any disease from which they may have been suffering, and 12 were suffering from diseases unconnected with their employment. On the suggestion of Mr. Commissioner Robinette, agreed to unanimously by the other members of the Commission, further tests were carried out last week at Port Pirie by the Chairman as a medical man under the oversight of Mr. Commissioner Robinette, representing the employees, and in the presence of one or more of the local medical men, all of them being present at one time or another, and as the result of these tests, which were made in order to ascertain the percentage saturation of carbon monoxide in the blood of men working on the plant, evidence was educed of the presence of carbon monoxide in a number of working places, supporting the evidence of a similar character given by Dr. Moulden as the result of earlier tests. It seems to me that now we have an explanation, namely, carbon monoxide poisoning, for a considerable number of cases amongst

the men of comparatively short periods of employment, and further an explanation, at least partial, of the large number of cases occurring amongst foreigners, particularly Southern Europeans, of short periods of employment, which may be caused by the fact that they have not become in any way tolerant to the inhalation of small quantities of carbon monoxide during their eight hours of work each day. I would now like to read to you a very clear summing up of the clinical picture at Port Pirie as given by Dr. S. A. Smith in his evidence. [Dr. Smith's evidence read, qs. 2164—2168.]?—The clinical picture drawn in what you have read is one which might be got in any factory or institution where owing to defective ventilation the quantity of oxygen necessary for health is not provided. There is nothing specific, although there can be no doubt that carbon monoxide must occur where there is incomplete combustion; but according to such an authority as Sir Thomas Oliver very little is known of the effects of the inhalation of carbon monoxide in minute doses over a long period, and much more investigation is required before anything definite can be pronounced in that matter.

2353. I will read further extracts from the evidence of Dr. Smith. [Questions and answers 2169—2175 read.] That was the general clinical picture given by Dr. Smith. It would, of course, be possible to elaborate this brief summary of the investigations of the Commission since you gave your previous evidence, and perhaps my fellow Commissioners will later bring out other points which I may have missed or have not mentioned. The importance of the Commission's work to the future both of health of the employees at Port Pirie, and to the health of the industry itself is so great and so evident that it is unnecessary for me to more than mention it, but I have gone to some length in placing before you some of the facts which we have educed recently in order to enable me to ask you if you would give the Commission the benefit of your comments and views and suggestions. I should have mentioned earlier that after the recent examinations last week of men in their working places at the smelters local medical men were recalled. They all agreed that the evidence was clear proof of the presence of carbon monoxide in a number of working places, and that this undoubtedly, in their opinion, would have a definite influence upon the character of industrial disease being incurred at Port Pirie. Further, they were unanimously of opinion that expert assistance was most desirable to assist them as general practitioners in the diagnosis of the cases of industrial disease in such a centre as Port Pirie. Indeed, one of the senior men gave it as his strong opinion that the decision should be made by an expert body of medical men on all cases of suspected industrial disease in such a centre. It has occurred to me to be possibly better to have made a connected statement of this sort for your information, and I hand you herewith, a copy of this statement and should be glad if you would comment on it for the information of the Commission, or if you so wish I am prepared to ask specific questions on the subject matter of this statement. Realising, as the Commission does, the extreme importance of the subject to all concerned, and the responsibility resting upon yourself as the Medical Referee in many cases sent from Port Pirie, we are most anxious to have your further assistance in this matter, and would be glad if you will give us your views?—From the fact that carbon monoxide is one of the best known and most prolific sources of industrial poisoning, more particularly in mines and where blast furnaces are in operation, it is reasonable to assume that carbon monoxide in certain proportions would be present in the air of the smelting works at Port Pirie. It is difficult, however, to realise that if for many years cases of carbon monoxide poisoning have occurred there that they do not appear to have been recognised. I make that statement only on what is before me. I do not know whether cases of carbon monoxide poisoning have been recognised there or not.

2354. You may take it definitely that they have not been recognised or reported?—In regard to the diagnosis of carbon monoxide poisoning in acute cases there should be no difficulty whatever with a knowledge of the location. Such poisoning is very sudden in onset as a rule and the victim of it is rendered powerless. He falls down and he is not in many cases even able to call out. In sub-acute cases, if I may use a very loose term, one probably gets symptoms of lack of oxygen, such as dizziness, headache, vomiting, and possibly epigastric pain. These symptoms, however, are common to a great many other diseases and would not be pathognomonic of carbon monoxide poisoning. As to chronic cases, that is the absorption of very minute quantities of carbon monoxide over a long period, opinions amongst medical men differ very considerably in regard to the recognition of symptoms. Sir Thomas Oliver, as I already remarked, goes so far as to say very little is known, and much more investigation is required before anything definite can be pronounced in the matter. The 1923 edition of "Industrial Hygiene and Medicine," by Hope, Hanna, and Stallybrass, quotes him as saying "We are not yet sufficiently familiar with the effects of inhalation of carbon monoxide in minute doses carried on over a long period."

2355. From that would one gather that Sir Thomas Oliver considers there are probably some sequelae or that there are no sequelae?—I do not think Sir Thomas Oliver would hold that there are no sequelae, but that they are not definitely and absolutely pathognomonic. The picture of carbon monoxide poisoning which has been presented to you is really a picture of ill health. It is not like a case of lead poisoning. There you have a lead industry and the occurrence of lead colic and a lead line, which it would be very difficult to mistake. There is nothing in relation to chronic carbon monoxide poisoning from what you can say there are fixed symptoms by which you cannot mistake the general malaise and muscular weakness. They would apply to anybody living under unhygienic conditions.

2356. *By the Chairman*—With evidence of the repeated absorption of carbon monoxide the deduction would be more or less pointed?—Yes, though it is rather begging the question. What would be equally important would be evidence as to the condition of the men before they were exposed to carbon monoxide. In my opinion, medical examination is most essential where there is suspicion of carbon monoxide poisoning. From the authorities I have read, I could not state the signs and symptoms of poisoning by minute doses of carbon monoxide spread over a long period definitely enough to be sure that they are pathognomonic of carbon monoxide poisoning, because the picture presented by such poisoning is common to a great many other diseases.

2357. Are they also indicative of lead as well as of carbon monoxide?—Some of them. The picture as between lead and carbon monoxide, however, is like the difference between, for example, a water color and an oil painting. In lead you have colic, which you do not get as a result of carbon monoxide, as far as I know, nor do you get the blue line; but if a person's vital energy or power of resistance was lowered by the long breathing of impure air, more particularly carbon monoxide, he would be more susceptible in my opinion to the absorption of lead. In other words, if a person's vital energy generally and power of resistance to disease are lowered, he would be more likely to absorb lead.

2358. *By Mr. Pearson*—That means, broadly, that his toleration would be lessened by his condition of health?—I would have no hesitation in saying that.

2359. *By Mr. Gepp*—If there are definite places on the plant where, by regular observation, it is found that for eight hours there is up to 10 and more per cent. of saturation of the blood with carbon monoxide, if a man subject to that saturation came before you for examination and there is no specific evidence of lead poisoning, or the blood picture is not helpful, but you found a very definite neurasthenic type of case, knowing the man's history and having his blood picture before you, would you go so far as to say there is perhaps more proof of carbon monoxide poisoning than anything else you know?—I would not like to express an opinion on a supposititious case. The symptoms of chronic carbon monoxide poisoning are very vague, and would apply to a great many other diseases. There is one other observation I would like to make. It is that from experiments made on the lower animals in regard to carbon monoxide poisoning, it is clear that they become

tolerant after a while. Naismith and Graham experimented on guinea pigs, and it was shown that after absorbing carbon monoxide the guinea pig, after a long period, was able to produce more red blood cells for oxygen carrying purposes, and so increased its power of carrying oxygen. The Chief Inspector of Factories in England in 1923 had reported to him 56 cases of carbon monoxide poisoning, of which 18 were fatal. It would help very materially in giving evidence if one had statistics showing definitely what has happened at Port Pirie. It is reasonable to assume there is carbon monoxide there, as it is to be found in practically every factory which uses carbonaceous material for combustion. Colorimetric tests from a purely scientific standpoint are rough, as you are depending on the comparison of colors in various grades.

2360. Recent literature on the subject seems to show that the effects of small quantities of carbon monoxide over long periods may be worse than the effects of large quantities over a short period?—I would not agree with that, as the effect of large quantities over a short period is fatal. The first question which occurs to me in relation to Port Pirie is, why has carbon monoxide poisoning not been recognised in works that have been in existence so long, seeing that for so many years it has been recognised as such a prolific source of poisoning in different industries? The importance of inter-current disease on the question of carbon monoxide is very significant. If the vital energy and resistance of a workman is lowered he is more liable to inter-current diseases and toxaemias of various kinds, including lead; but because a particular patient, who may be suffering from lead, has unmistakably a picture of another disease, that is no evidence that he has not got lead poisoning or has not had it. A man might go before a referee who has more or less recovered from whatever he was suffering from, and the picture as got from his clinical history might be an unmistakable picture of lead. Further examination might show that he has not only got lead, but something else besides, but from the presence of the other symptoms it is not to be held in any shape or form that he was not suffering from lead. It is possible to be suffering from a multitude of ailments and to have lead as well. The greater the number of things a man is suffering from the more liability there is of his having lead as his resistance is lowered. If a man is suffering from some disease which lowers his vitality and he becomes leaded, it might be said that that man has never had lead, but that the symptoms are due to the other disease. In other words, a man might be leaded and suffering from other diseases at the same time.

2361. Supposing a man had had lead and did not have it when he came before you, what would you say about it?—If the workman has suffered from the effects of lead and is suffering from the sequelae I would uphold his appeal. If he has not suffered from the effects of lead I would turn him down.

2362. *By the Chairman*—In your opinion the effects of lead can be treated and cured without leaving permanent damage to the body?—Yes, provided that is has not gone too far.

2363. *By Mr. Gepp*—If in your opinion there is chronic carbon monoxide poisoning at the works, should it or should it not be a disease under the Workmen's Compensation Act?—If it is shown clearly to be a hazard, it should undoubtedly be made a disease under the Act.

2364. In that case what criteria would you define? Would you make it necessary before a certificate for carbon monoxide poisoning of the chronic type is given that some proof, such as a blood test, should be necessary?—I doubt whether any criteria could be made for the chronic type. It would be very loose. It might be opening the door. The difficulties at Port Pirie are apparently fairly great.

2365. *By Mr. Robinette*—By opening the door do you mean opening the door to the employers to dodge their responsibilities under the Workmen's Compensation Act?—No; opening the door to all kinds of difficulties.

2366. What I mentioned would be one of the difficulties?—The difficulty of definite and positive diagnosis is what I was referring to.

2367. *By Mr. Gepp*—Is it your opinion that, theoretically, there is no argument that chronic carbon monoxide poisoning should be a compensable disease?—Before that could be said, I think it is necessary to show first of all that there is a risk and a good deal of risk. If it can be shown that there is a certain quantity of carbon monoxide in the air the men breathe, and that as a result there have been a number of cases of carbon monoxide poisoning, then I think it should be a compensable disease. In the absence of those two factors I do not think that that could be said.

2368. Theoretically, if there is proof that carbon monoxide is inevitably there, the difficulty I foresee is the criteria by which these cases are going to be judged. How could the position possibly be protected from the point of view of the Company? Supposing this Commission says that in our opinion, chronic carbon monoxide poisoning should, under proper precautions, be compensable, what precautions would you suggest should be taken?—I am inclined to believe that more investigation on proper lines is necesary before there could be obtained definite criteria by which it could be certified beyond doubt that a man has suffered from chronic carbon monoxide poisoning.

2369. If it could be tied up specifically to a clear and logical statement by medical men that a person has suffered from chronic carbon monoxide poisoning, that should be acceptable both to the company and to the men?—It should be, but there would be a great many cases in which there would be doubt.

2370. Are there any other comments you wish to make?—I have been given to understand that the average service of foreigners at the Port Pirie smelters is somewhere about 12 months. The fact that a large percentage of the reported cases are foreigners is, to my mind, strong evidence that men do become tolerant, and in the first 12 months they probably have not become tolerant either to lead or carbon monoxide. In the case of lead they have not learned to take precautions which other men have, and in the case of carbon monoxide they have not become tolerant. If there has been carbon monoxide present in lethal quantities there should be evidence of gassing, of men falling off stages, and so on, as has taken place all over the world. If there have been acute cases and they have not been recognised it is rather extraordinary.

2371. Would it not be rather dangerous to look for such signs and symptoms in chronic cases—say after the effects of the gas have been going on for 12 months—as are diagnostic of acute cases of carbon monoxide poisoning?—The acute case is absolutely unmistakable.

2372. And the others may not be even of the same symptoms?—That is so, and in saying exactly what are the sequelae of carbon monoxide poisoning is where the medical profession generally comes, as it were, to the parting of the ways. A great deal more of experimental and research work must take place before a definite opinion can be given.

2373. We have consistent evidence from Professor H. G. Chapman, Dr. S. A. Smith, and Dr. O. M. Moulden, which indicates the unreliability of the results of blood tests as applied to lead diagnosis. They point out as a result of their experiments that the pictures are plus and minus all the time, and they feel that the blood tests are unreliable?—I think everyone would agree on that, but they are of great and distinct advantage if you come to making a comparison or differential diagnosis between carbon monoxide and lead. There is evidence that there are no basophiles in the case of carbon monoxide poisoning. If you have basophilia it is reasonable to assume in the absence of other symptoms that you have not got carbon monoxide poisoning.

2374. The Workmen's Compensation Act at present is designed to provide monetary compensation for persons injured in the ordinary course of their employment. In your opinion, would it be a good thing if the law took cognisance of the matter of supervising the treatment of people injured as well as of their compensation?—I should say it would be a distinct advantage in the interests of the men and the industry to make treatment compulsory.

2375. At Broken Hill the Medical Board has the power of calling up men who are being compensated from time to time for examination, also the power of supervising the treatment they are obtaining. There is at present no organisation of that kind at Port Pirie. Do you thnk it would be advisable if it could be arranged?—In principle, yes; but in detail it

would be difficult. I do not know what the relations are between the various medical men there, or who specialises in any particular thing. There might difficulty in a practitioner being supervised in his treatment of a patient by somebody else. If a medical man is recognised as qualified he is expected to have reasonable knowledge of his profession and to be able to treat an ordinary case, such as a case of lead poisoning, which is not difficult to treat. Intervention by somebody who would go there and say, "Do this, that, or the other," would have a tendency to create strained relations between the supervised and the supervisor.

2376. Personally I believe that the Broken Hill method of having an independent Government man, who is an expert in industrial hygiene and indstrial diseases, together with two others, one of whom is the representative of the employers and the other the representative of the workmen, who all become expert in the particular type or types of disease which may be incurred in a particular area, is undoubtedly a sound and good method of helping to fight against these troubles. When you previously gave evidence before this Commission you felt that there were certain difficulties in regard to that. We have since then asked quite a number of people, and I think they almost without exception favor an expert board. Have you had any further thought on that matter and do you think such a method at Port Pirie would be definitely an advantage to both sides in view of the unanimous statement of the medical men?—I would not care to express an opinion on the question. I have no knowledge of it, but if you have evidence that it is beneficial in other parts one would have to accept that in the absence of any evidence to the contrary.

2377. *By Mr. Robinette*—You have read the evidence of Professor Chapman and Dr. Smith?—I scanned it.

2378. Do you think they were competent to give diagnosis such as those produced as a result of spending only a few days at Port Pirie and having only the clinical histories obtained from the company's doctor, and not the histories from the patient's private doctors?—That is a difficult thing on which to express an opinion, yes, or no, without knowing the cases and the nature of them. I prefer not to criticise the work of other professional men, and it would not be of much help to you one way or the other.

2379. If you were sent up there do you think it would be competent for you to diagnose 29 cases in about two days on receiving only the clinical histories from the company's doctor and not from the men's doctors, who had probably treated them for five or six months?—Personally I do not work very quickly, and would probably take longer than very rapid experts to go through 29 cases, and there may be people who would take longer than I would.

2380. *By Mr. Gepp*—Professor Chapman and Dr. Smith have had most extensive experience in regard to industrial diseases? —I do not know how long they spent per man and various other details.

2381. *By Mr. Robinette*—In diagnosing cases are you guided to a large extent by the clinical histories you receive from other medical practitioners?—Yes, I always get all the information I can in the way of notes from the certifying practitioner, the man's medical attendant, and all the evidence I can from the man who has refused to give a certificate. I get evidence from the patient himself in the presence of a representative of the company and in the presence of a representative of the man, sometimes a lawyer and sometimes a union representative, in regard to where he has worked, how long, the nature of the occupation, and so on. After I have all that information, I make an independent examination and give an independent opinion as a result of such examination, and of urine tests and blood tests, made by an independent expert in such matters.

2382. If you had been conducting an examination such as that made by Professor Chapman and Dr. Smith at Port Pirie, would you have deemed it advisable to consult the private practitioners?—I would like to get all the information I could bearing on any case.

The witness withdrew.

The Commission adjourned.

Tuesday, June 30th, 1925, at 2.15 p.m.

[At Parliament House, Adelaide.]

Present—

Dr. K. R. Moore (Chairman.)
Mr. H. W. Gepp.
Mr. J. L. Pearson.
Mr. W. Robinette.

HENRY ST. JOHN SOMERSET was recalled and further examined.

2383. *By Mr. Gepp*—In committee this morning the question of the suppression or elimination of dust and methods in connection therewith were being discussed, and mention was made of the roads within the smelters. Will you tell the Commission the position with regard to those roads?—Some two or three years ago we considered the question of concreting the main arteries of traffic throughout the works. Owing to the nature of the traffic it would be necessary to heavily reinforce any concrete put in on the roads, and estimates made by Mr. Dibdin showed that the cost would be so excessively heavy that we gave up all idea at that time of doing it. Since then, in the endeavour to keep down dust, we have been going in for a regular system of watering down, and although I know the roads within the works, particularly in wet weather, look very bad, I am not, however, sure that from the dust point of view absolutely they are not equal when kept wetted to what concrete roads would be. In the summer time we have hot dry winds and it would be necessary, in the case of a concrete road, with carts constantly passing over it, to wet the road continually if dust suppression were to be obtained in respect to it. A smooth hard surface like concrete would dry under Port Pirie summer conditions in a few minutes, and on a windy day any dust which had fallen from the drays passing over would be immediately taken into the air. If the roads are wetted in the condition in which they are now they certainly hold the water, and with many fewer wettings it is possible to keep dust from rising badly. I do not think it is possible to keep it from rising entirely under our present system of transport. The condition of the roads at present is due to the exceedingly heavy dray traffic, particularly in the carriage of Risdon residues and coal, mainly the latter, from the wharf front to the reserve at the far side of the works. We are altering the wharf front at present, and in a comparatively short space of time we hope to do away entirely with the heavy carting of those materials from the wharf front, making our stock heaps on the wharf front rather than behind the works. When that happens we will be able to get much cleaner surfaces on the roads than we have now, and they hold the water sufficiently long to make it practicable to keep them wetted in summer time.

2384. Would it be possible to do a certain amount of road construction of an arterial nature, or is that not of much use on account of the amount of diversion of traffic which you have? —The main part of our traffic is along definite lines, but immediately alongside those main lines we have spaces that need watering down just as much as the roads need it. These spaces we do water down at present. If we were to concrete the roads and these open spaces the cost would be heavy indeed, so heavy, I think, as to put the idea out of court altogether. The roads at present do get metalled, but dray traffic is about the worst for cutting up metal roads, because of the slight movement of wheels from one piece of stone to another, which shakes the road as the dray goes along and gradually disintegrates it.

2385. *By Mr. Robinette*—Have you considered the question of macadamised roads?—Yes.

2386. Have you considered tarred macadamised roads?—No. I would be quite willing to consider tarring a section.

2387. Have you any estimate of the cost of procuring stone from Mount Ferguson?—No. You would probably know that from the town council's operations.

2388. It is 6s. 8d. a yard. Would you consider that expensive for roadmaking?—No.

2389. Would it be practicable to improve your roads considerably if it could be procured at 5s. a yard, which I think

it could be?—I think so. I have not had experience of Mount Ferguson stone on roads, but from its appearance it should be quite good stuff.

2390. You know some of the roads in Port Pirie are constructed of Mount Ferguson stone. From your observation are they better roads than those previously made in Piric?—I believe they are comparatively new yet.

2391. The piece of road from the Y.M.C.A. in David Street has been down for 10 years to my knowledge, and has never been repaired?—I know it is quite good. I think you will recognise that our traffic within the works is really more intense and much harder on road surfaces than what you would get outside.

2392. Do you not think there would be less likelihood of dust from macadam roads that are well made and tar paved?—There should be if the tar would stand all right. I am willing to put a trial section down.

2393. *By the Chairman*—Do you think a macadamised road without tar would be better than a macadam road with tar, if tar would present the same surface as concrete and dry more rapidly?—As a rule, in summer time tar gets almost sticky and would probably hold dust better than a concrete surface.

2394. *By Mr. Robinette*—In summer your roads require watering down three or four times in the middle of the day. Do you not think it would be easier to water down tarred macadamised roads and that it would be more effective?—It would take less water. If a road were tarred I think it would hold the dust better, but any surface which dries very rapidly would, in the winds we get up there, release dust immediately the surface dried. As a matter of fact our roads cost us a good deal in upkeep now owing to continual patching with metal, and if we could get a satisfactory road at a reasonable cost it would be worth our while to consider it. Our most difficult places are the narrow necks in the main route; for instance, past the corner of the refinery and through between the offices. If we had to shut up these in order to put a high class road down it would be extremely difficult to carry on operations while it was being done, as good roads take a considerable time to put down properly.

2395. *By Mr. Gepp*—With regard to the question of allowing men to relieve one another, say, 10 or 15 minutes before shifts, so as to relieve change house congestion, have you had any experience?—That system was followed at the smelters years ago, I am told, by Mr. Robertson, but the company had to put a stop to it because where so large a number of men are concerned it was impossible to see whether they observed the rules properly, and men used to leave their work before their reliefs came. What finally brought the matter to a head, I understand, was that during the last few minutes of a shift there was trouble at the blast furnaces due to a breakaway, and no men being there to cope with it. They had all gone irrespective of the fact that their reliefs had not turned up to take on their work. I understand also that the experiment was tried in the mills of Broken Hill companies and was given up for the same reason. At Cobar, on the other hand, where we had very few men on the smelters, it worked quite satisfactorily.

2396. *By the Chairman*—Whether it would work satisfactorily would depend to a great extent to the nature of the job the men were working on?—A thing like that is very difficult unless it applies universally to everybody, for as soon as you give a privilege to one section others quite naturally ask for it, and the fact that you point out the difficulty in the way of giving it to them does not affect the position from their point of view at all, so it means certain dissatisfaction if a rule like that is applied to one or several sections of the work and not universally.

2397. *By Mr. Gepp*—That might not be an insuperable difficulty if it were clearly understood between the company, the inspector, and the men's representatives that the system was being tried tentatively with the right of the company to withdraw it if there was any abuse?—From my experience of the men I am absolutely certain they would not be satisfied if one section had this privilege and they had not. They would not lie down under what they considered a disadvantage. They would demand the same privilege and it would lead to trouble. In the case of the power house, where there is a regular number of employees who are readily under observation at the change of shifts, it might work quite well, but if I were to give it to the power house men, and perhaps some other small section like the underfloor of the blast furnaces, the top floor of the blast furnaces, the Dwight & Lloyd plant, and the refinery sections would ask for it, and point out with a certain amount of justice that they had as much right to get the concession as others, and it would put us in a very difficult position. It is hardly practicable to do a thing like that unless it is done universally, and previous experience, both at Port Pirie and Broken Hill, has shown that it had to be stopped because it was so much abused.

2398. *By Mr. Robinette*—Supposing at the lead ring relief came along, there would be no objection to men going to change?—Theoretically there would not be, and we used to do it at Cobar, but where there a large number of men it is much more difficult to control. The shift bosses go towards the end of the shift to write up their records. The shift boss in charge of the lead ring would be away writing up his records during the last few minutes of the shift and there would be no direct control over the men. It would be necesary to trust to them to observe the rules, and while I think a great number of them would do it, there would be always some one who would not, and would take advantage of the opportunity to "duck off."

2399. If a man let his lead ring get cold before relief you would have your remedy, and that man would know what to expect?—It might not be necessary for them all to stay, and the watchman would not know who was legitimately leaving his work and who was illegitimately leaving it.

2400. But the position is not quite the same as before the advent of the change house. Now, if a man is clocked off for 4 o'clock he has naturally to stay on the job, whereas if there was no clock house it might be possible for him to knock off at any time and get away?—There are some who would stay in the change house if on the job. The experience at two mills at Broken Hill and at Port Pirie some years ago when it was tried, having shown that the system failed, would make me very careful indeed before introducing it again.

2401. If bathing and changing were made compulsory, I presume you will agree that the men should be allowed a certain amount of time, and not have to do it in their own time?—I presume that every man when he leaves his work washes either at the works or at home, and it would simply be washing in one specific place instead of at home or after work at one of the taps. It does not really call for any more time out of a man's day, presuming that he washes.

2402. With reference to the compensation of men who are eliminated from the industry on the ground that they are susceptible, you are aware of the conditions operating at Broken Hill?—Yes.

2403. Do you regard what is done there as unjust?—I think it would be unjust if applied to Port Pirie, because, as I have previously said, it is practically compensation for loss of employment, and in many cases men who have left our industry after lead poisoning have not actually lost employment, because they took work in other sections of industry at Port Pirie.

2404. Would not your point of view in regard to Port Pirie apply equally to Broken Hill in the case of the surface men, who would be in the same category as that in which you place smelter employees?—I have had no experience of Broken Hill. There would not be at Broken Hill the same avenues of employment which there are outside the lead business in and around Port Pirie.

2405. Have you read the Broken Hill legislation dealing with the matter?—Yes.

The witness withdrew.

The Commission adjourned.

APPENDICES.

APPENDIX A.

AUTHORITIES CONSULTED BY THE COMMISSION.

"Lead Poisoning and Lead Absorption," Legge and Goadby.
"Industrial Health," Kober and Hayhurst.
"Lead Poisoning, Medico-legal Aspect," Knocker.
Reports of the Technical Commission appointed to inquire into Industrial Diseases at Broken Hill, 1921 and 1922.
Report of New South Wales Board of Trade on use of White Lead, 1921.
Report of British Departmental Committee on Danger Attendant on Use of Lead Compounds, 1920.
Report on Methods of Dust Determination and Elimination in South African Mines, Western Australian Department of Mines, 1924.
Reports of Chief Inspector of Factories, England, 1914-1919.
Report into Causes and Occurrences of Lead Poisoning at Port Pirie, 1910, by W. Ramsay Smith, D.Sc., M.B., F.R.S., 1910.
Report of Royal Commission on Ventilation and Sanitation of Mines, Western Australia, 1905.
Report of British Departmental Commission on Use of Lead Paints, 1915.
"Laws and Regulations relating to Lead Poisoning," Stone, 1922.
International Labor Office Bulletins, Legislative series, 1923—Austria 1., "Lead and Lead Compounds."
"Recent Practice in Use of Self-contained Breathing Apparatus," Smart, 1921.
"Mine Gases and Ventilation," Beard, 1916.
Report of Miners' Phthisis Prevention Committee, South Africa, 1916.
Report of Inquiry into the Prevalence and Prevention of Lead Poisoning at Broken Hill Silver Lead Mines, 1903.
United States Bureau of Mines Bulletin 84, "Metallurgical Smoke."
United States Bureau of Mines Bulletin 150, "The Pyro tannic acid Method for the Prevention of Carbon Monoxide in the Blood and Air."
Monograph on Industrial Chemistry, "Lead," Smythe, 1923.
Mining Review No. 41, South Australian Department of Mines, Description of Broken Hill Associated Smelters Proprietary, Limited, Plant, 1924.
United States Public Health Bulletin No. 150, "Carbon Monoxide Literature."
United States Department of Labor, Monthly Labor Review, "Earliest Positive Signs of Lead Absorption."
United States Bureau of Labor, Bulletin 141, "Industrial Diseasease in Lead Smelting Plants"
Journal of Industrial Hygiene: Vol. I., Number 10, "Blood Changes in Lead Workers." Vol. II., Number 1, "Carbon Monoxide Poisoning in American Steel Works, &c." Vol. III., Numbers 3 and 4, "Physiological Effects of Automobile Gas, &c." Vol. VI., Number 3, "Carbon Monoxide Hazard in Public Garages." Vol. VI., Number 4, "Lead Studies." Vol. III., Number 3, "Industrial Poisoning by Inhalation." Vol. VII., Number 4. "The Study of Punctate Basophilia in Lead Workers."
Proceedings of Australasian Institute of Mining and Metallurgy, Vols. 42 and 43.

APPENDIX B.

[Referred to as Exhibit 1, q. 307.]

THE BROKEN HILL ASSOCIATED SMELTERS PTY., LTD., PORT PIRIE.

NOTICE TO EMPLOYEES.

For the information and guidance of those employees whose work brings them into contact with lead, or lead bearing materials, the following notes are set out:—

Lead does not enter the system through the pores of the skin. It can, in a great measure, be prevented by—

(1) Paying attention to cleanliness of hands, face, and teeth. The hands and face should be well cleaned before food is eaten, and it is a wise practice to wash out the mouth.
(2) Never roll cigarettes or tobacco with hands contaminated with lead bearing material.
(3) Taking once or twice per week an aperient medicine, such as is available to all employees at the various departmental shift bosses' offices and the first-aid room.
(4) Making full use of the bathing facilities provided in the change house, where hot and cold water systems are installed and lockers for storage of clothes.

H. ST. J. SOMERSET, General Superintendent.

Port Pirie, May 16th, 1924.

NOTE.—This notice was also printed in Italian, Greek, and Maltese.

APPENDIX C.

[Referred to as Exhibit 3, q. 452.]

THE BROKEN HILL ASSOCIATED SMELTERS PROPRIETARY LIMITED, PORT PIRIE.

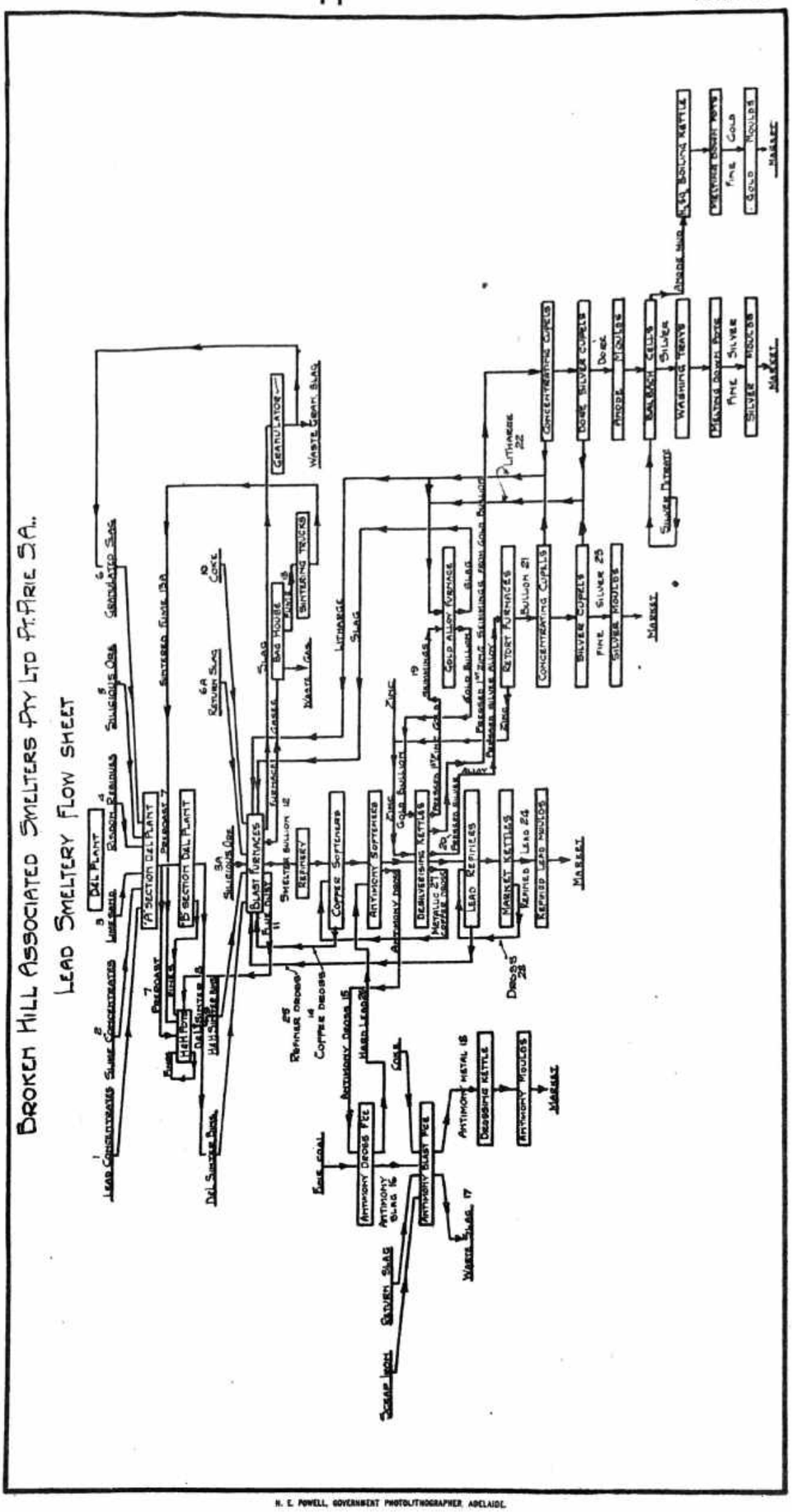
WORKMEN'S COMPENSATION ACTS (SOUTH AUSTRALIA).

Scale of Compensation.

Act	Benefit.		
	Permanent and Total Incapacity.	Death.	Weekly Rate during Total Incapacity.
	£	£	
1911	300	300	50% of average weekly earnings, with minimum of £1.
1918	400	400	50% of average weekly earnings with minimum of £1 10/- in the case of a married man, and £1 in the case of a single man.
1919	500	400	50% of average weekly earnings, with minimum of £2 in the case of a married man, and £1 10/- in the case of a single man.
1924 (15/1/25)	700	600	50% of average weekly earnings, plus 7/6 per week for each dependant child under the age of 14 years—Maximum payment, £5.

Appendix D.

PP No 57



H. E. POWELL, GOVERNMENT PHOTOLITHOGRAPHER, ADELAIDE.

APPENDIX E.

[Referred to as Exhibit 5, q. 605.]

THE BROKEN HILL ASSOCIATED SMELTERS PROPRIETARY LIMITED, PORT PIRIE.

ATTENDANCE BONUS—ANNUAL HOLIDAYS GRANTED ON FULL PAY.

The following graduated scale of attendance bonuses has been adopted to apply to the 12 months ending 8 a.m. September 3rd, 1919, and thereafter:—

	Not Absent More Than (Days).		Holidays on Full Pay (Days).
Six day a week men—			
Men employed 12 months	12	..	12
" 11 "	11	..	11
" 10 "	10	..	10
" 9 "	9	..	9
" 8 "	8	..	8
" 7 "	7	..	7
" 6 "	6	..	6
" under 6 months	—	..	Nil
Shiftmen employed 7 days per week—			
Men employed 12 months	16	..	14
" 11 "	14	..	13
" 10 "	13	..	12
" 9 "	12	..	11
" 8 "	10	..	9
" 7 "	9	..	8
" 6 "	8	..	7
" under 6 months	—	..	Nil

Employees failing to reach the above standard will be granted holiday leave on the above scale, less two days leave for every day's absence in addition to the number of days allowed by the above standards.

Employees discharged through no fault of their own will be paid attendance bonus for the period worked if such period is six months or over. If only part of a month is worked, it will not be counted.

Employees wishing to get time off must apply for leave of absence. All time taken off by employees without asking leave will be counted as time and a half—for the purposes only of the attendance bonus.

The holiday leave on full pay will not count as "absence."

Where overtime is worked the employee will be credited with the overtime hours worked, and the total overtime so worked by the employee during the bonus period will be divided by eight, and the resulting number of shifts credited to his attendance. All time worked by six day a week men on Sundays will be also credited in the same way. Absence through sickness or accident, if doctor's certificate is produced, is not counted against Attendance Bonus.

Men absent through sickness or accident must produce to the Time Office a doctor's certificate for the time away Dr. Leitch, where required, will supply the necessary certificate to employees free of charge. The duty rests upon the employee to produce these certificates, otherwise the time he is away will be counted against him as "absence." Absence representing Union or Arbitration Court or Compulsory Conference in any matter in which the Company has a direct interest is not counted against Attendance Bonus.

When leave is given in payment of the Attendance Bonus the employees must take his leave at a time arranged to suit the requirements of the works, but every effort will be made to suit his convenience. Any employee who fails to earn the Attendance Bonus, but thinks the special circumstances of his case justify granting him a concession, has the right to place the facts before the Superintendent of his department, and the Superintendent will submit the case to the General Manager for his personal decision.

APPENDIX F.

[Referred to as Exhibit 6, q. 829.]

THE BROKEN HILL ASSOCIATED SMELTERS ACCIDENT FUND, PORT PIRIE.

GENERAL INFORMATION.

The Fund was established at the end of September, 1917, and from that date until the 11th June, 1919, only accident claims were paid, the rate being £2 per week, and the subscription 6d. per member per week, with a pound for pound subsidy by the company.

In June, 1919, the trustees decided to recognise claims for disability due to sickness (including lead cases), and the first claims under this heading were passed for payment on 30/6/19, the rate of benefit being £1 per week.

The following sets out the various alterations made in benefits, &c., since the above date:—

30/3/20—Sick benefit raised to £1 5s. per week for 13 weeks' incapacity.

19/7/20—Sick benefit increased to 30s. per week.

21/3/21—Accident pay reduced to £1.

9/3/22—Sick benefit increased to £2 per week for 13 weeks and £1 per week for a further 13 weeks.

19/3/23—Payment of lead cases as a special section at £1 per week for total period of 52 weeks approved. If man compounded by company before 52 weeks expires, the remainder, which would have been paid to him if he were off 52 weeks, to be paid as a lump sum.

Payment to Fort Pirie Hospital of 30s. per week for maintenance of members whilst in that institution.

9/7/23—Contributions increased to 9d. per member per week, with pound for pound subsidy by the company.

26/3/24—Probationary period fixed so that members cannot receive sick benefit in respect of an illness, the commencing date of which is less than three months from the date of joining the Sick Fund.

Lump sum payments to lead cases cancelled, so that no further payment is made after a man is compounded by the company.

14/8/24—Payments to Port Pirie Hospital discontinued.

28/8/24—Accident pay reduced to 15s. per week. Sick pay (other than lead) reduced to £1 15s. per week.

2/10/24—Members' contributions raised to 1s. per week, the company's subscription remaining at 9d. per member per week.

Industrial sickness benefit reduced to 15s. per week.

11/3/25—The present contributions to the Fund by employees and the company are 1s. and 9d. per member per week respectively.

APPENDIX J.

[Referred to as Exhibit 12, q. 1124.]

RECORDS OF 300 BLOOD EXAMINATIONS OF MEN WHO ARE OR WERE EMPLOYEES OF THE BROKEN HILL ASSOCIATED SMELTERS.

The men were referred by their respective medical attendants to the Commonwealth Health Laboratory, Port Pirie, where the examinations were performed.

Of examinations performed—
- 92 were British
- 143 " Greeks.
- 21 " Maltese.
- 19 " Italians.
- 25 " of other nationalities.

Examinations performed were—
- Estimation of haemoglobin percentage.
- Red cell count.
- Examination of stained film.

TABLE I.—HAEMOGLOBIN.

	100 % and over.	90 % to 100 %	80 % to 90 %	70 % to 80 %.	60 % to 70 %.	50 % to 60 %.	40 % to 50 %.	Average.
								%
British (90 examined)	—	11	41	20	13	4	1	77·8
Greeks (138 examined) ...	5	17	69	34	12	1	—	79·7
Maltese (21 examined)	—	4	10	3	3	1	—	80·3
Italians (19 examined)	—	1	8	6	3	1	—	79·3
Others (24 examined)	—	3	9	9	2	1	—	79·1
	5	36	137	72	33	8	1	79·4

TABLE II.—RED CELL COUNT OF THOSE IN WHOSE BLOOD FILM EVIDENCE OF BASOPHILIC DEGENERATION WAS OBSERVED.

Nationality.	6,000,000 and over.	5,500,000 to 6,000,000.	5,000,000 to 5,500,000.	4,500,000 to 5,000,000.	4,000,000 to 4,500,000.	Average.
British	—	—	7	9	6	4,700,000
Greeks	1	7	15	23	3	5,000,000
Maltese	—	—	1	3	2	4,700,000
Italians	—	—	—	1	1	4,500,000
Other Nationalities	—	—	1	3	1	4,600,000
	1	7	24	39	13	

TABLE IIA.—RED CELL COUNT OF THOSE IN WHOSE BLOOD FILMS NO EVIDENCE OF BASOPHILIC DEGENERATION WAS OBSERVED.

Nationality.	6,000,000 and over.	5,500,000 to 6,000,000.	5,000,000 to 5,500,000.	4,500,000 to 5,000,000.	4,000,000 to 4,500,000.	Average.
British	2	8	32	20	7	5,200,000
Greeks	4	18	38	20	6	5,500,000
Maltese	—	6	4	6	—	5,100,000
Italian	—	3	5	6	2	5,000,000
Other Nationalities	1	4	6	3	1	5,200,000
	7	39	85	55	16	—

TABLE III.—EXAMINATION OF STAINED FILM.

Nationality.	Basophilic Degeneration.			Changes other than Basophilic Degeneration (Note 1).	No Abnormalities Observed.
	Slight.	Moderate.	Extreme.		
British	12	7	5 (Note 2)	22	46
Greek	33	10	7	28	65
Maltese	2	4	0	4	11
Italian	1	1	0	5	12
Other Nationalities	5	2	0	5	13
	53	24	12	64	147

Note 1.—This includes polychromatophilia, anisocytosis, and poikilocytosis, also proportional and morphological variation of leucocytes.

Note 2.—In one case numerous normoblasts were observed.

APPENDIX K.

[Referred to as Exhibit 16, qs. 1463 to 1554.]

CLINICAL CARD USED AT GOVERNMENT MEDICAL BUREAU, BROKEN HILL, N.S.W.

No...... *Date*..... *Age*..... *Birthplace*..... *Signature*.....

Distinguishing Marks—

Industrial History.							Social History.	Past Illnesses.
Locality employed in.	From Year	To Year	No. of Years.	Mining Work. Metal Mined.	Surface Job.	Undergrd. Job.	Non-Mining Work.	
							M.S.W. Children alive dead Wife died of Father " Mother " Brothers " Sisters " Exposure to T.B. Average tobacco " C_2H_5OH	

Present Health—Symptoms and Duration—

General—
Working cap. affected
Loss of weight
Night Sweats
" Rheumatism "
Frequent "Colds"

Respiratory—
Cough
Sputum
Dyspnœa
Blood
Hæmoptysis
Pain in chest
Husky voice

Circulatory—
Palpitation
Præcordial pain
Giddiness
Fainting
Swelling of legs

Alimentary—
Constipation
Indigestion
Vomiting
Colic
Diarrhœa
Appetite poor

Urinary—
Frequency
Blood
Pain
Neuro Muscular—
Headache
Pareses
Fits

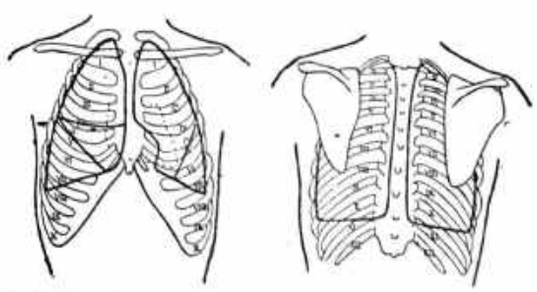
CLINICAL EXAMINATION—

General—
Unhealthy appear.
Alcoholic "
Pallor
Bad nutrition
" hearing
" sight
Pulse
Resp.
B.P. S. D.
Weight
Height
Expansion
Full inspir'n

Circul. and Alim. Systems—
Thick'd vessels
Cyanosis
Œdema face
" legs
Card. hypert.
" dilation
" arryth.
Bad teeth
Gingivitis
Pyorrhœa
Burton's line
False line
Nasoph. unhealthy
Liver
Spleen enlarged

Nervous System—
Pupils
L. reflex absent
A. " "
Pat. " "
" exaggd.
Elbow " "
Sup. " "
Babinski
Rhomberg
Abn. gait
Type of paresis
Type of paralysis
Type of wasting
Tremor

Abnormal Shape Thorax—



X-RAY EXAMINATION— Hilar fib. Hilar glds. L.M. P.B.M. Diaph. irreg. Thick'd pleura. Consol. Cav
Abnormal Pneumoconiosis T.B. Other conditions
Heart enlarged Central Aorta dilated

PATHOLOGICAL EXAMINATION— Sputum
Blood— R.B.C.'s. Hb. C.I. W.B.C.'s. Wasserman
Urine— Appearance Reaction S.G Alb. Sugar Pus Blood

FURTHER EXAMS.—

CLASS'N. DIAGNOSIS

APPENDIX L.

[Referred to as Exhibit 18, (q. 1612.]

INSTRUCTIONS ISSUED TO WORKMEN BY LEWIS BERGER & SONS (AUST.), LTD., WHITE LEAD, PAINT, AND VARNISH WORKS, RHODES, N.S.W.

NOTICE TO FACTORY OPERATIVES.

Before commencing work in the morning employees shall change into a suit of overalls provided by the company.

All employees must arrive at the works in time to commence duties immediately the whistle blows. Men arriving late will, in future, be required to stand aside for 15 minutes before starting.

Clothes.—It is imperative that employees make a complete change of clothing before starting work, and the overalls provided shall not be worn outside the factory grounds.

Men's own effects must be placed in lockers during working hours. The overalls must be hung outside on hooks provided for that purpose.

Respirators must be worn where there is dust, as in drawing stacks and in handling dry lead.

Baths.—All employees must take a bath before leaving work at night, and the company will allow time for this.

Meals.—Before entering the lunch room employees must scrub their hands, and particularly the finger nails.

Eating of any kind is forbidden on any part of the factory except the lunch room, and alcoholic liquor is forbidden on the premises.

Smoking is forbidden during working hours.

Medical Inspection.—All employees must be present at the weekly inspection, and report immediately to the doctor in the event of any ailment, no matter how slight. There is no charge upon employees for this.

The company has equipped the works with every facility for ensuring the health of the men, and any failure in the supply of respirators, sponges, nail brushes, soap, towels, &c., must be immediately communicated to the foreman in charge.

Drinking Water.—Use the bubbling fountains provided—all other water is dangerous.

Recommendations.—If the above conditions are carried out, there is no danger whatever.

Teeth and mouth should be cleaned regularly night and morning.

Keep your bowels regular; in case of difficulty, apply to the Works Foreman for corrective, supplied free of charge.

Avoid the use of alcohol.

A good breakfast before commencing work is recommended, and light food, such as milk, eggs, onions, is better for those who are in close contact with dry lead.

Above all—keep clean.

LEWIS BERGER & SONS (AUST.), LTD.,
H. J. SULLIVAN, Works Superintendent.

Rhodes, November 27th, 1917.

APPENDIX M.

[Referred to as Exhibit 12, q. 1612.]

LEAD-POISONING.

HINTS ON THE PREVENTION OF LEAD-POISONING FOR THOSE WHO WORK WITH LEAD.

The following advice is issued for the information and guidance of workmen at Lead-works, Silver-lead Mines, and in trades and occupations which involve risk of lead-poisoning. Proprietors are requested to be good enough to exhibit copies at conspicuous parts of their works.

Department of Public Health,
Sydney, 1923.

W. G. ARMSTRONG, M.B., D.Ph.,
Director-General of Public Health.

Lead and lead compounds cause injury to health unless great care is taken by those who are exposed to the risks of absorption of this metal into their body.

HOW LEAD ENTERS THE BODY.

The metal gains entry into the body through the air passages and the digestive canal and very occasionally through the skin. The breathing of lead-laden dust or eald fumes, the handling of food, cutting up tobacco or cigarette-making with hands soiled by lead, are the commonest ways by which the poison enters the system.

SIGNS AND SYMPTOMS OF LEAD-POISONING.

Workers in lead may show a blue line along the edges of the gums. This serves as a sign that the person is or has been exposed to the absorption of this metal, but is not a proof of lead-poisoning. The usual first symptoms which point to lead acting injuriously on the system are constipation, colicky pains in the stomach, headache, and definite paleness of the skin. In a certain number of persons nervous derangements occur, and in chronic cases of poisoning serious organic diseases and various forms of paralysis may appear.

PREVENTIVE MEASURES.

1. Lead fumes and lead-laden dust should be carried away from the point where they are produced, and not allowed to get into the air breathed by the work people.

2. Scrub the hands thoroughly and rinse the mouth before eating; rinse the mouth before drinking; keep the teeth clean and regularly brushed.

3. All food, including drinking water, as well as the utensils used for food or drinking, should be carefully protected from dust and fumes. A bubbling fountain is the safest method for supplying drinking water.

4. Food should never be eaten at the work bench, or in any other place where lead dust or fumes are present.

5. Never begin work on an empty stomach.

6. No workman should smoke whilst working with lead.

7. Workmen should change into overalls before beginning work. The home clothes should be kept where they will be protected from dust and fumes. A bath or shower should be taken after work to cleanse the hair and skin before putting on the home clothes again.

8. Experience has proved that persons who take alcohol are specially liable to be affected by lead.

9. Attention to general cleanliness of the body is very necessary. A bath should be taken daily.

10. The bowels should be regulated—use Epsom salts for this purpose. Take as much of it every day as will cause a single daily action of the bowels. The following is a good way to make up the medicine, and more or less of it should be taken daily as may be found necessary:—

Epsom salts	2 ounces.
Water	a wine-bottle full.
Red pepper	as much as is agreeable.

Take a wineglass full (or more or less as may be necessary to cause a single action of the bowels) in a tumbler of water on getting up after sleeping, once every day.

11. There are some people who get rid of any lead which is absorbed into the body and who do not suffer harm from it. There are others who feel ill or actually fall ill very soon after beginning to work with lead, and workmen who show this personal susceptibility to the poison should not continue to work with lead, but should seek some other occupation.

12. If any signs or symptoms of lead-poisoning appear medical advice should be sought at once.

In addition to the "Official" samples, eleven (11) grab samples of air were taken at various parts of the works. "Grab" samples yielded the following results:—

"GRAB" SAMPLES.

Date of Analysis.	Number and Location of Sample.	Carbon Monoxide
		%
16/6/25	No. 1. Over top of No. 3 blast furnace working under normal conditions. Sample taken where fumes were rising.	0·056
17/6/25	No. 2. Over slag tap hole of No. 2 furnace, working under normal conditions. North end of furnace. No wind.	0·004
18/6/25	No. 3. Top of Producer plant, about the height of a man above coal feed hopper on west side of No. 1 producer, a minute or two after charging with coal. Wind, south-east.	0·008
18/6/25	No. 4. H. & H. platform. Just after blast connected up to pot.	0·025
19/6/25	No. 5. Inside baghouse. Sample taken 9.30 a.m.—two hours after opening—at the extreme northern end, with fairly strong south-east wind blowing into the open door.	Nil.
29/6/25	No. 6. South side of antimony dross furnace in the refinery, close to fire door of melting pot in front of the furnace.	0·007
29/6/25	No. 7. D. & L. "A" machine floor. No. 1 machine working under normal conditions. Sample taken close to firebox. Smoke issuing from burning coke.	0·014
3/7/25	No. 8. Refinery. About 6in. above flue on the top of No. 4 antimony furnace. Smoke issuing from top of furnace.	0·002
4/7/25	No. 9. In baghouse. Man took sample at north end of baghouse 15 minutes after No. 6 chamber opened. South-west wind blowing into open door.	0·014
8/7/25	No. 10. Flue leading to smelter baghouse.	1·24
9/7/25	No. 11. Flue leading to smelter baghouse.	1·40

In my opinion one of the places on the works where men are likely to breathe air containing carbon monoxide is on the feeding platform, immediately above the blast furnaces. It was intended to analyse the air taken on the platform above one of the blast furnaces, but time did not permit of this being done.

In conclusion, I desire to thank the Broken Hill Associated Smelters Proprietary Limited, which rendered every assistance and facilitated my investigation, and in particular I wish to thank the Chief Chemist, Mr. A. J. Hemingway, and Mr. J. E. P. Murrie, for their assistance and valuable suggestions during the time I was engaged on this investigation.

I have, &c.,

C. E. CHAPMAN, F.I.C., F.A.C.I.

The Chairman, Royal Commission on Plumbism,
Parliament House, Adelaide.

APPENDIX Q.

Port Pirie, July 17th, 1925.

I, Walter Robinette, a member of the Royal Commission on Plumbism, and of the Committee of the Port Pirie Hospital, certify that I have from personal investigation of the records of the Port Pirie Hospital ascertained that the information supplied by the Secretary of that institution and published in paragraph 16, page viii., of the report of the Commission, is accurate.

(Signed) W. O. ROBINETTE.

GRAPH

Appendix R.

[Referred to as Exhibit 24.9.1926]

P.P. No 57

GRAPH of EMPLOYMENT & LEAD POISONING STATISTICS & MAIN PLANT ALTERATIONS DURING HALF YEARS.

Total turnover

British turnover

Average strength

Foreign turnover

Total lead cases

British lead cases

Foreign lead cases

Half year ending	29-12-19	29-6-20	25-12-20	22-6-21	21-12-21	21-6-22	20-12-22	20-6-23	19-12-23	2-7-24	31-12-24
Average strength & turnover											
Lead cases											
Plant idle with exception minor operations											
Plant idle with exception minor operations Mining operations and hygienic appointments installed.											
Gen. operations resumed Jan. 1921. Del. fire Jan 1922 closed the plant down except for minor operations. Further improvements installed (1) Skinner furnace started up.											
Gen. operations resumed Aug 19th.											
Extra Blast f/ce built & put into operation. 2 Roaster Roasters in operation roasting Zinc Conc.											
3 extra Del. machines installed & started up (12) Skinner f/ce started up.											
5 Downshaft Half pole put into operations Change house completed											
Barrier Roaster section operating											
17th Blast f/ce in commission											

H. E. POWELL, GOVERNMENT PHOTOLITHOGRAPHER, ADELAIDE.