

A FIVE YEAR FOLLOWUP OF A SILICOSIS CLINIC

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In 1955, a silicosis clinic was started for the cases of silicosis discovered in the Singapore Granite Quarry and reported elsewhere (Khoo 1956, Khoo and D'Souza 1961). Since then other cases have been seen from other quarries in Singapore. However it seems worthwhile to report on the progress of the cases after following them up for five years. The method of investigation and treatment has already been mentioned.

Out of the original 62 workers of the Singapore Granite Quarry at the 8½ milestone Bukit Timah Road, it was possible to follow up 52 workers. The remaining 10 workers either did not attend the clinic or could not be reached, but two had died during this period from causes related to silicosis; one stone-breaker died of Carcinoma of liver and the clerk died during an accidental explosion of gelignite at the quarry.

One case (case 15), a crusher stone trucker, returned to China in 1958 because of his illness. His progressive massive fibrosis* had considerably worsened in the 3 years and was furthermore complicated by tuberculous endobronchitis. No news have been received from him, but his purpose in returning was to die in China. Two cases of progressive massive fibrosis, one a crusher trucker, the other a crusher feeder died in 1958 and have been written up elsewhere (Khoo and D'Souza 1961).

RESULTS

A list of workers that were followed up is drawn up in Table I which also compares it with the previous list. It can be seen that the defaulters do not come from any one or two groups (classified by the type of work) but are spread throughout most of the groups so that the two lists are in fact comparable. Thus in the largest representative group viz. the eighteen stone breakers, only two workers did not subsequently return for followup.

Table 2 gives the results comparing the incidence of silicosis and silico-tuberculosis in the different types of work at the quarry in the years 1960 and 1955 (bracketed figures).

Table 3 shows the individual followup of each case over the five years and relates the character

of the clinical and radiological changes to the nature or type of work.

In Table 4 the overall incidence in the beginning and the end of the five year followup is shown and compared.

The relationship between length of service (and therefore duration of exposure to dust) and the incidence of silicosis is shown in Table 5, again with figures of the first examination to compare with.

Three case reports are appended which will in effect give a representative picture of the natural history of the silicosis in the local quarry worker.

TABLE I

Nature of work	Number of workers	
	First seen in 1955	followed up to 1960
1. Drillers	6	5
2. Crusher Stone Trucker	11	8
3. Crusher-Feeder	4	4
4. Block-Trucker	11	9
5. Stone-Breaker	18	16
6. Excavation Worker	2	2
7. Blasterer	2	1
8. Blacksmith	2	2
9. Oiler	1	1
10. Kepala	3	3
11. Clerk at Crusher	1	— (died at explosion)
12. General Worker	1	1
Total	62	52

* In the rest of the paper, progressive massive fibrosis shall be abbreviated to P.M.F. and simple pneumoconiosis to S.P.

TABLE II

INCIDENCE OF SILICOSIS AND SILICO-TUBERCULOSIS

Nature of work	No. of workers +	No. of workers with normal X-rays	No. of workers with S.P.	No. with P.M.F.	Died	Silico-T.B.
1. Driller	5 (6)	0 (0)	4 (5)	1 (1)	—	2 (0)
2. Crusher Stone Trucker	8 (11)	0 (1) [*]	3 (6)	3 [†] (4)	2	3 (5) [∅]
3. Crusher Feeder	4 (4)	0 (1)	1 (2)	1 (2)	1	[1*] (1) [§]
4. Block-Trucker	9 (11)	0 (2)	7 (9)	3 (0)	—	5 (2)
5. Stone-Breaker	16 (18)	0 (5)	15 (12)	0 (1)	1	3 (3)
6. Excavation Worker	2 (2)	0 (0)	2 (2)	0 (0)	—	1 (1)
7. Blasterer	1 (2)	0 (0)	0 (1)	1 (1)	—	1 (0)
8. Block-Smith	2 (2)	0 (1)	2 (1)	0 (0)	—	0 (0)
9. Oiler	1 (1)	0 (0)	1 (1)	0 (0)	—	0 (1) [^]
10. Kepala	3 (3)	0 (0)	3 (2)	0 (1) [°]	—	0 (2) [^]
11. Clerk at Crusher	0 (1)	Died (1) at explosion	—	—	—	—
12. General Worker	1 (1)	0 (1)	—	—	—	—
Total	52 (62)	Nil (12)	37 (41)	9 (10)	4 [†]	15 (15)

*Not followed

•Emphysema

†great improvement
regarded as S.P.

‡one of the 3 died in 1961.

°Previously all P.M.F.

^Pure P.T.B. resected.

^Arrested.

§Died of P.M.F.

∅1 case died of P.M.F.

1 case returned to China.

1955 figures are bracketed

TABLE III
CHANGE IN CLINICAL AND RADIOLOGICAL STATE IN 5 YEAR PERIOD

Progression of Clinical and Radiological changes in 5-year period 1955 to 1960.	Number of cases	Nature of work work
1. Normal to normal.	nil	—
2. Normal to significant X-ray change (not silicosis).	1 (emphysema)	general
3. Normal to simple pneumoconiosis.	6	5. Stone-breakers 1. Black-smith
4. Simple pneumoconiosis unchanged.	17	2. Drillers 2. C.S. Truckers 5. B. Truckers 4. S. Breakers 1. Excavation 1. Black-smith 1. Oiler 1. Kepala
5. S.P. to more advanced S.P.	13	2. Drillers 1. C.S. Trucker 1. B. Trucker 6. S. Breakers 1. Kepala 1. C. Feeder 1. Excavation Worker
6. Normal to progressive massive fibrosis.	1	1. Block Trucker
7. S.P. to P.M.F.	4	2. C.S. Truckers 1. C. Feeder 2. B. Trucker
8. P.M.F. to advanced P.M.F.	3	1. Driller 1. C.S. Trucker 1. Blasterer
9. P.M.F. to death.	4	2. C.S. Truckers 1. C. Feeder 1. S. Breaker
10. P.M.F. to S.P.	1	Kepala
11. S.P. to Silico-tuberculosis.	5	1. Driller 3. B. Truckers 1. S. Breaker
12. Normal to tuberculosis.	1 *	1. C. Feeder
13. Silico-tuberculosis to more advanced silico-tuberculosis.	6	1. Driller 3. C.S. Truckers 1. B. Trucker 1. Blasterer
14. Silico-tuberculosis unchanged.	3	1. B. Trucker 2. S. Breakers
15. Silico-tuberculosis improved.	1	C.S. Trucker
16. Silico-tuberculosis arrested.	3	2. Kepala 1. Oiler

*Tuberculous round lesion resected successfully.
C.S. Truckers=Crusher stone truckers.

B. Truckers=Block truckers.
S. Breaker=Stone breaker.
C. Feeder=Crusher feeder.

TABLE IV

Comparison of incidence of silicosis in the years 1955 and 1960

	No. of cases	Normal	Simple Silicosis	Complicated Pneumoconiosis	Total Incidence
1955	62	12 (20%)	41 (66.12%)	9 (14.51%)	80.69%
1960	52	—	37 (71.11%)	13* (24.99%)	96%

*including 4 deaths

TABLE V

Showing relationship between length of service and incidence of silicosis
(1955 figures are bracketed)

Years of Service	No. of cases	Simple Pneumoconiosis		Complicated Pneumoconiosis*	
		Number	Percentage	Number	Percentage
0 - 9	5 (23)	5 (17)	100% (73.9%)	— (1)	— (4.3%)
10 - 19	25 (26)	21 (15)	84% (57.6%)	4 (5)	16% (19.2%)
20 - 29	20 (13)**	10 (9)**	50% (69.5%)**	8 (3)**	40% (23%)**
30 - 39	2	1	50%	1	50%

*including deaths **for a period 20-34 years (1955)

ILLUSTRATIVE CASE REPORTS

Case 10. Chinese male aged 42.

He was first seen in 1955 and apart from the X-ray findings, he was physically fit. He had

worked approximately 25 years in the quarry, latterly as a crusher stone trucker. His condition was reviewed again 5 years later and the comparative findings are as follows :

	Weight	B.S.R.	Vital capacity	Sputum Culture for M. tuberculosis	X-ray grading
1955	103 lbs.	21	3.1 L	—	3 n
1960	102½ lbs.	87	1.6 L	—	3 m B2/3

He had been attending Tan Tock Seng Hospital early in 1960 under the care of Dr. J. Supramaniam. He became worse in 1961 and was readmitted for dyspnoea and severe haemoptysis on 17.4.61. He died on 6.5.61. The following report was prepared by Dr. Lim Hock Siew of

Tan Tock Seng Hospital. The X-rays of 1955 and 1960 are Figs. 1 and 2 respectively.

This patient was first referred to Tan Tock Seng Hospital on 4.4.60 by a general practitioner as a case of bilateral pulmonary tuberculosis. He complained of chest discomfort, cough and loss

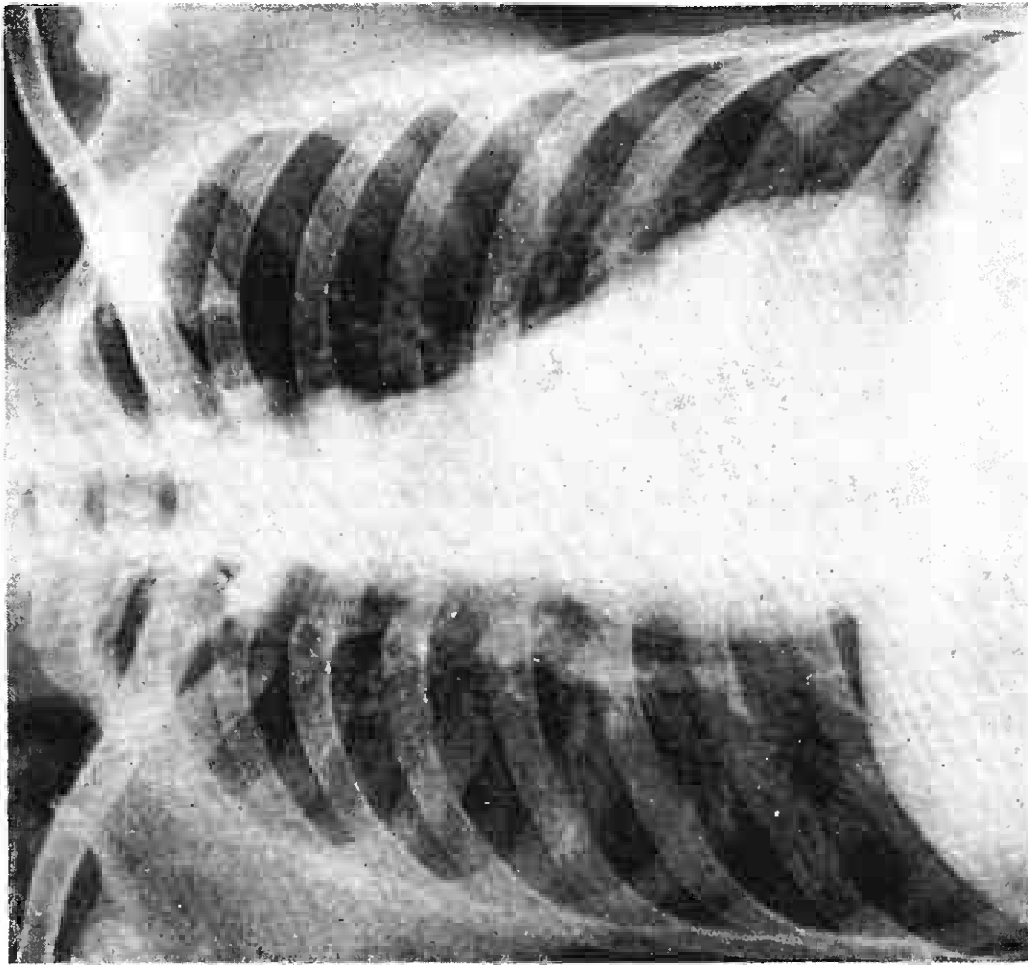


Fig. 1. Case 10. Chinese male, aged 42, has worked in granite quarry for 25 years, latterly as crusher-stone trucker.

Chest X-ray film taken in 1955 shows nodular discrete opacities scattered throughout all lung fields.

Classified as simple pneumoconiosis, category 3 n.

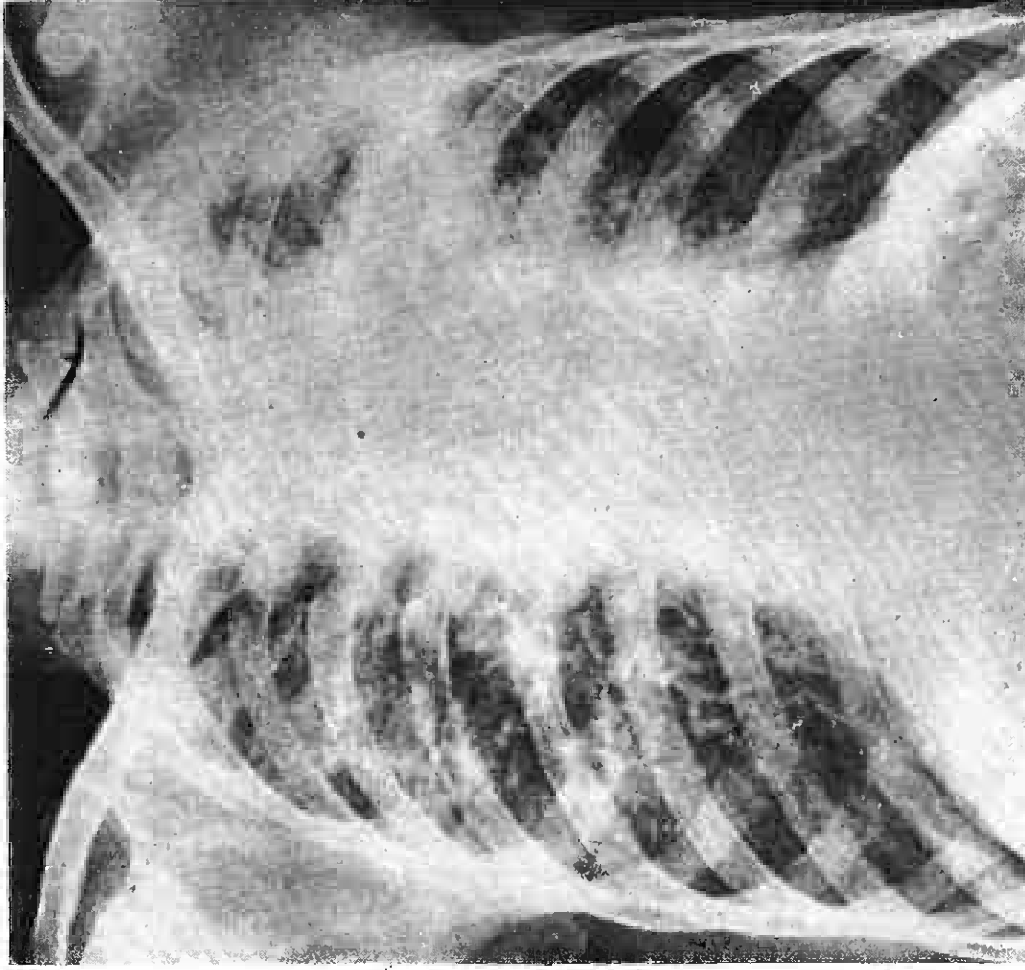


Fig. 2. Case 10. Chest X-ray film taken on 22nd October 1960. He had begun treatment in Tan Tock Seng Hospital in April 1960 as a case of Silico-tuberculosis and by 13th October 1960 had completed 150 Gm. of Streptomycin. X-ray shows progressive massive fibrosis extending 3 anterior rib spaces on the left and 2 on the right against a background of mixed type of simple pneumoconiosis. Coded as 3 m. B2/3.

of weight for 2 weeks; there was no fever or night sweats. He gave an occupational history of having worked as a labourer in a quarry for over 10 years. On examination he was thin and wasted; heart N.A.D.; lungs — fine crepitations scattered over upper and mid zones of both sides.

X-ray chest showed bilateral opacities in both upper and mid zones with translucency left upper zone due to cavitation. Sputum examinations showed presence of acid-fast bacilli in one specimen of antiformin concentration, but direct smear and laryngeal swab cultures were negative. B.S.R. was 63/93. Diagnosis: Silico-tuberculosis.

He was started on injection streptomycin gm. 1 daily (6 times weekly) with I.N.H. 150 mgm. b.d. on 19.4.60 as an outpatient.

On 28.4.60 patient was admitted to Tan Tock Seng Hospital for blood stained sputum and discharged on 8.5.60 when sputum cleared.

By 13.10.60 he had completed 150 gms. streptomycin and was continued on P.A.S. gms. 10 and I.N.H. 300 mgms. daily. There was however no radiological improvement and X-ray on 27.10.60 showed more opacities and more obvious cavitation in the left lung. Sputum was however repeatedly negative for tubercle bacilli on direct smears, concentration tests and laryngeal swab cultures. He was gradually losing weight and began to have dyspnoea on exertion.

On 22.12.60 he was started on Prednisolone 10 mgms. b.d. together with P.A.S. and I.N.H.

From February 1961 he began to have blood stained sputum off and on and on 13.4.61 Prednisolone was reduced to 5 mgms. t.d.s. There was no radiological change.

On 17.4.61 patient was admitted to Tan Tock Seng Hospital with fever, dyspnoea on exertion and blood stained sputum. On examination — general condition fair, temperature 99.8°F. Lungs — no crepitations present. T.W. 12,800, D.C.: P 94%, L 6%, M 0% E 0%. He was treated with a course of Achromycin together with P.A.S. and I.N.H. and Prednisolone 5 mgms. t.d.s. Sputum for A.F.B. was repeatedly negative.

He improved slightly but one week after admission his temperature increased and was swinging and he became more dyspnoeic and slightly cyanosed. He did not respond to Chloromycetin and steadily went downhill. Temperature remained high and swinging. He became more dyspnoeic and cyanosed and had to be in Oxygen tent throughout. Crepitations were present all over both lungs. T.W. increased to 15,600.

On 3.5.61 sputum cultures results showed growth of *P. pyocyaneus* sensitive to only Streptomycin and Trisulphonamide. He was put on injection Streptomycin gm. 1 b.d. and Sulphatriad gm. 1 4 hourly, and taken off Prednisolone completely. There was however no improvement and on 5.5.61 he was changed to Sigmamycin.

Patient died on 6.5.61. Cause of death: Respiratory failure resulting from secondary infection of extensive silico-tuberculosis.

Patient's relatives refused consent for autopsy.

Case 9: Chinese female aged 52. When first seen in 1955 she had worked in the quarry for 21 years, in the last 4 years at the crusher plant. Her earlier job was loading stone into lorry. During the past year she was using a handkerchief mask. Her chest film showed simple pneumoconiosis grade 1/-. In early 1959 the quarry closed down and she lost her job and drew social welfare aid, for herself and four children (two others were married). Her husband died of progressive massive fibrosis of lung in 1959. In 1960 she was examined again and her silicosis reassessed.

	Weight	B.S.R.	Vital capacity	X-ray Grade
1955	101 $\frac{1}{4}$ lbs.	27	2.1 L	1/-/-
1960	96 $\frac{3}{4}$ lbs.	60	2.4 L	2 m C3/3

She was treated as a silico-tuberculosis from November 1960. Given injection Streptomycin, Isoniazid, Anabolic hormone, Casilan and Multivitamins she improved. In January 1961 her B.S.R. fell to 21, weight increased to 104 lbs. but she was still short of breath. The X-rays of 1955 and 1960 are Figs. 3 and 4 respectively. It had taken approximately 5 years for the Silicosis to progress to massive fibrosis despite the fact that latterly she had not been working more than a year. Her case was of interest because i) she was one of the few female workers of the quarry; ii) her husband died of progressive massive fibrosis working in the same quarry as a stone breaker, iii) her silicosis progressed although she had stopped working at the crushing plant.

Case 26: T. C. Chinese male aged 44 — Block Trucker.

When he was first seen in 1955, he had been a crusher stone trucker for the past 10 years. He had no symptoms, except an occasional cough. He attended Tan Tock Seng Hospital as a patient

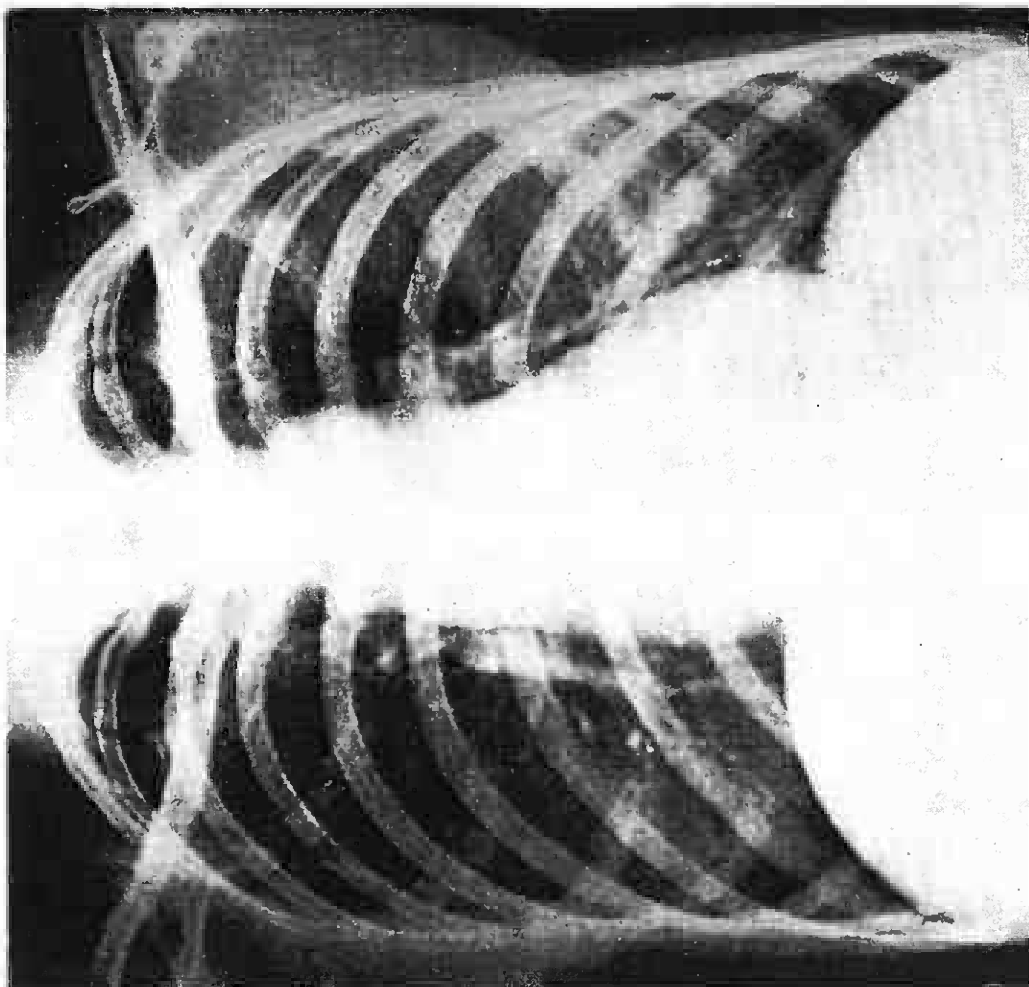


Fig. 3. Case 9. Chinese female, aged 52 years. She had worked in the granite quarry for more than 21 years in the last 4 years as crusher-stone trucker. Chest X-ray film taken in 1955 shows discrete opacities extending within the medial 2/3 of the lung field — interpreted as simple pneumoconiosis. Category 1/.

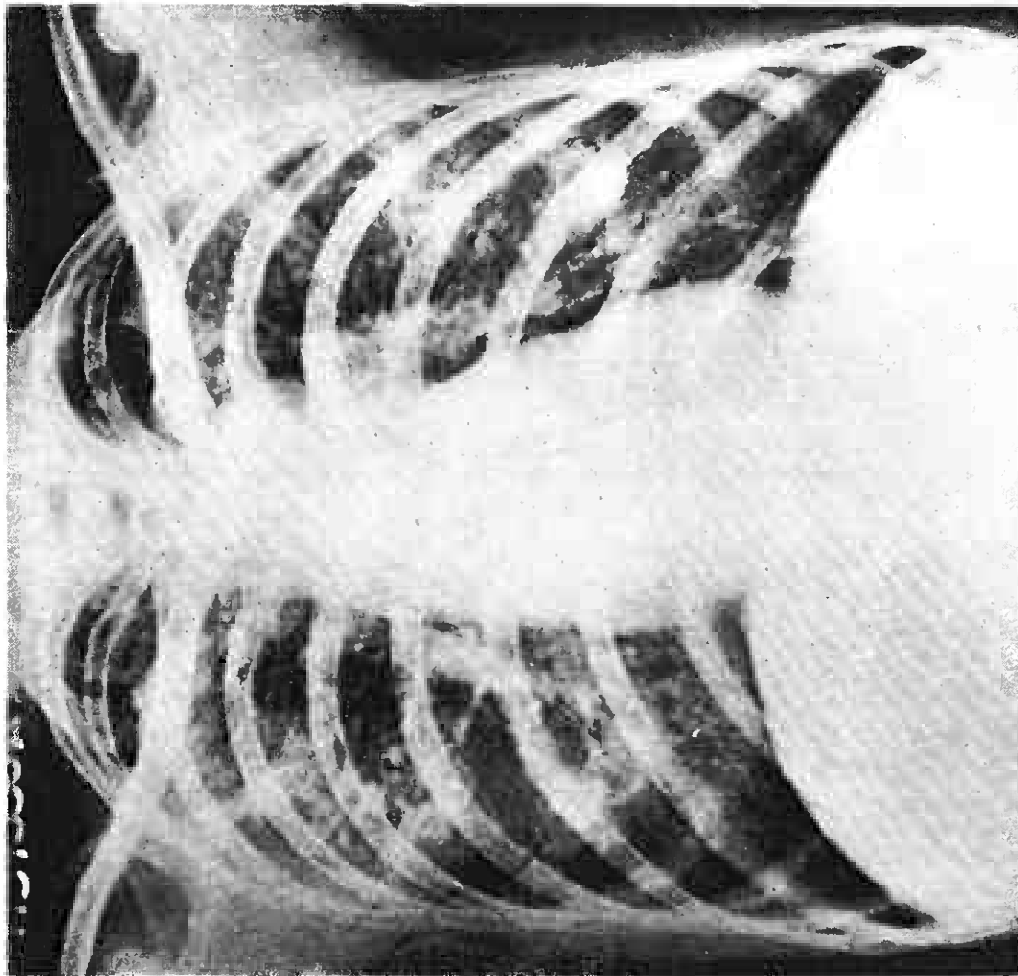


Fig. 4. Case 9. Chest film taken in 1960 shows progressive massive fibrosis, with massive shadows extending 3 anterior rib spaces on either side against a background of simple pneumoconiosis of a mixed type not quite involving the lateral 1/3 of the lung field. Classification 2 m. C3/3.

in November 1959 and was under the care of Dr. S. A. Yeoh. He was treated with a course of Streptomycin with Isoniazid from November 1959 to April 1960 and since then on PAS and Isoniazid. In November 1959 his X-ray was

graded by Dr. S. A. Yeoh as 2 m D 4/2. His sputum had been consistently negative on smear and cultures, and serial X-ray in Tan Tock Seng Hospital had revealed no change on treatment. His case was reviewed again in November 1960.

	Weight (lbs.)	B.S.R.	Vital Capacity	Sputum Culture for M. Tuberculosis	X-ray grading
1955	112	11	2.5 litres	negative	3 m
1960	95	59	1.0 litres	negative	3 m D4/4

He was breathless on walking and coughing badly. There was bronchial breathing over the left lobe and diminished breath sounds over the right lung. The X-rays of 1955 and 1960 are seen in Figs. 5 and 6 respectively.

DISCUSSION

Thus of the original 62 workers examined, 52 workers were followed up or traced in 1960 and reexamined. The quarry closed down in 1959 due to poor returns. Many of the workers could not find other types of work. A few were transferred to another quarry of the same company in the 12 mile-stone Bukit Timah. This quarry was largely mechanised and required fewer workers. Most of the workers did not move away from the quarry's 'quarters' but were allowed to stay on although the quarry was no longer functioning. In 1961 the quarry reopened and the long time workers were recalled. Those attending clinics for active treatment of silico-tuberculosis were not accepted. But particularly among former crusher-stone truckers, there were only a few who were able to return. Thus out of 8 crusher stone truckers followed up, 3 had since died of progressive massive fibrosis, four had progressive massive fibrosis and were in poor health, two had evidence of silicosis (simple variety), none of the eight had normal chest films and three were receiving active treatment for tuberculosis. There was a general reluctance of workers to sign on as crusher stone truckers which is not surprising in view of the high morbidity and mortality attached to this job.

It will be seen that in the 5 year followup no normal X-rays were seen in 1960, while six new cases of simple pneumoconiosis and five new cases of progressive massive fibrosis were detected. By far the largest group, 17 cases of simple pneumoconiosis had not shown significant changes, while 13 had progressed to a more advanced type of simple pneumoconiosis. 3 cases of P.M.F. had worsened, and 4 cases of P.M.F. had died

all as a result of the disease. 5 cases of simple pneumoconiosis had now developed silico-tuberculosis and 6 cases of silico-tuberculosis followed up had become worse. 3 cases of silico-tuberculosis showed no change, 1 improved and 3 were definitely arrested. One case was diagnosed as pure tuberculosis of the lung without silicosis; this patient had the 'round' lesion resected successfully. It was found that one case of P.M.F. improved so much that his 1960 X-ray was read as simple pneumoconiosis. This patient, a kepala, had been treated as Silico-tuberculosis for a long period and much of the 'massive shadows' must have been tuberculous in origin. Among the 52 workers, there were 15 cases of silico-tuberculosis which were being treated and 3 arrested cases where treatment had ceased. The incidence of silico-tuberculosis has therefore increased in proportion from 24.2% in 1955 to 28.8% in 1960. This is a true increase because although the actual numbers of 15 cases are the same on both occasions, there were latterly four deaths from P.M.F. cases who had been treated as silico-tuberculosis since 1955 and were not included in the 1960 figures.

It has been clearly shown that the overall incidence of silicosis increased during the space of 5 years between the examination from 80.69% to 96%. The increase was greater in the P.M.F. group (10.48%) than in the S.P. group (4.99%). In the breakdown into 10 year service groups among those within the first decade of service 73.9% were found to have simple pneumoconiosis in 1955 but 100% were affected when seen in 1960. Keeping in mind the fact that no new workers had been included in the series, the increase is a real one. In the second decade of service there is again a significant increase in incidence in simple pneumoconiosis of 26.4% in the past 5 years but it was the reverse for progressive massive fibrosis where the incidence fell 3.2% in that period. Among workers with more than 20 years service, the incidence of simple pneumoconiosis fell from 69.5% in 1955

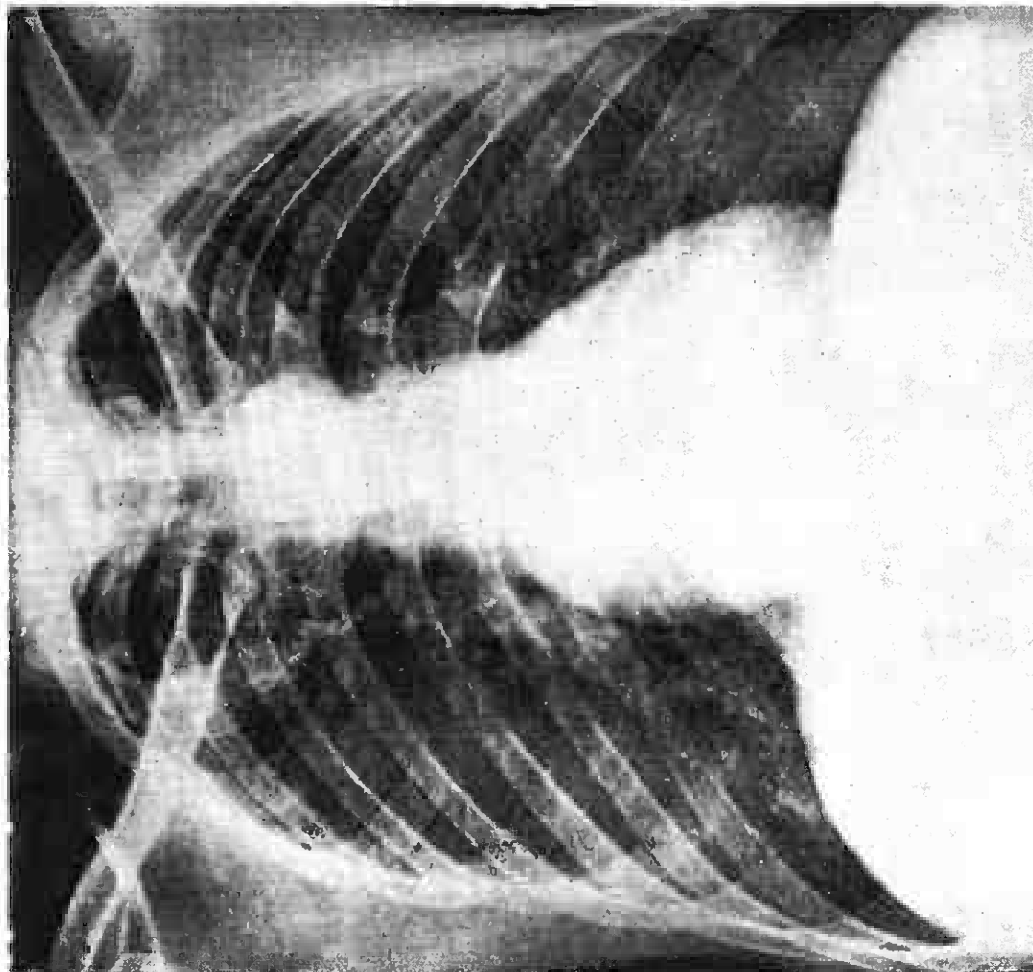


Fig. 5. Case 26. Chinese male, aged 44 — Block Trucker in granite quarry. Chest film taken in July 1955 shows discrete opacities of "mixed" type extending throughout all lung fields. Category 3 m.

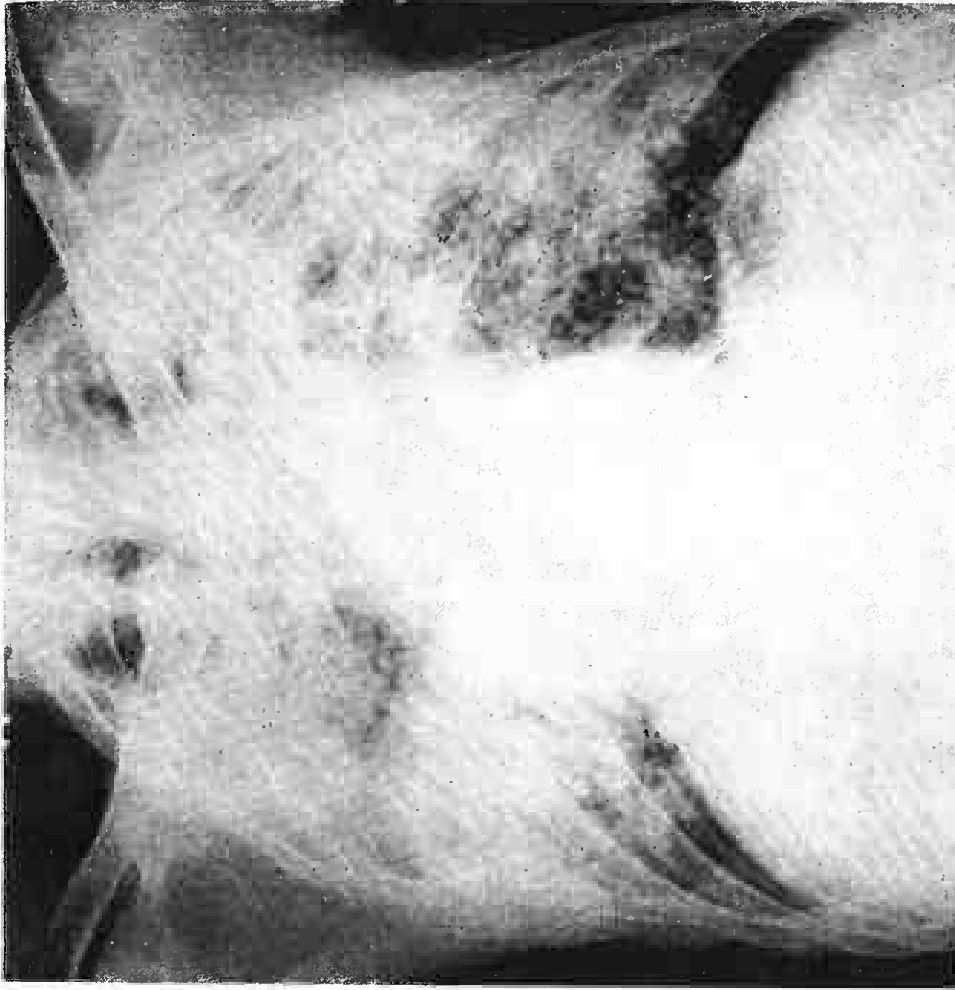


Fig. 6. Case 26. Chest film taken in November 1960 shows extensive progressive massive fibrosis of uniform density involving all lung fields and associated with traction of the heart to the right and peaking of left diaphragm. There is a background of mixed type of simple pneumoconiosis. Classification 3 m. D4/4. Patient is undergoing treatment for silico-tuberculosis.

to 50% in 1960, but the incidence of progressive massive fibrosis was higher by far in 1960 — 40.9% — as against 23% in 1955 (Deaths from P.M.F. have been included in the calculation of incidence of P.M.F.). One can surmise that the disparity in the two groups was due to the conversion of simple pneumoconiosis to P.M.F. (see Table V) among workers with longer service i.e. above 20 years.

SUMMARY

1. 52 workers out of an original number of 62 workers were followed up for 5 years (1955 to 1960) in a Silicosis Clinic.
2. The overall incidence of silicosis had increased in the five year period from 80.69% in 1955 to 96% in 1960. The increase was proportionally higher in the P.M.F. group (10.48%) than in the S.P. group (4.99%).
3. No normal X-rays were seen in 1960 as against 12 normal films in 1955.
4. Six new cases of S.P. and 5 new cases of P.M.F. were detected.
5. Of the cases of S.P. seen in 1955, 17 cases remained unchanged in 1960 whilst 13 had progressed to more severe types of S.P. and 4 cases had become P.M.F.
6. Three cases of P.M.F. seen in 1955 had worsened and 4 cases had died from the disease during the 5 year period.
7. Five cases of S.P. had developed silico-tuberculosis by 1960. Six cases of silico-tuberculosis followed up had deteriorated.

The incidence of silico-tuberculosis had increased from 24.2% in 1955 to 28.8% in 1960.

8. It is significant that among workers of less than 10 years service 73.9% were found to have S.P. in 1955 whilst 100% had S.P. in 1960. Amongst workers with 10 - 20 years of service there was an increase of 26.4% in the incidence of S.P. but the incidence of P.M.F. fell by 3.2%.

Among workers with more than 20 years service, the incidence of S.P. increased by 17.9%. This is due to the conversion of S.P. to P.M.F. with increase in service.

9. Three illustrative case reports are given to show the progression of S.P. to P.M.F.

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REFERENCES

- Khoo Oon Teik (1956) Silico-tuberculosis in Singapore. *Proc. Al. Ass.* 10, 117.
 Khoo Oon Teik and D'Souza, E. J. (1961) Granite Quarrying and Silicosis. *Malayan Medical Journal*. In print.