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Cancer of the Lung in Gwanda

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During the period from 1948 to mid-1956, 22 cases of carcinoma of the lung in Africans were admitted to Gwanda Hospital; 20 of these came to autopsy, one was diagnosed by X-ray and a biopsy of a supraclavicular gland, and one on clinical features and X-ray.

Post-mortem statistics in adult males in Gwanda Hospital for all practical purposes tallied accurately with deaths in hospital from 1948 up to the end of 1953; subsequent to that year pressure of work allowed only a proportion of deaths at the hospital (25 out of 43 in 1955) to be autopsied. In the six years 1948 to 1953 inclusive a total of 242 post-mortem examinations were performed. There were 36 carcinomata. Two of these were in women (secondary carcinoma of the suprarenal ? origin, and an adenocarcinoma of the thyroid). The remaining 34 were in men, as follows:—

Carcinoma of bronchus	14
Carcinoma of prostate	5
Carcinoma of liver (primary)	5
Carcinoma of bladder	3
Carcinoma of stomach	3
Carcinoma of pancreas	1
Carcinoma of oesophagus	1
Carcinoma of suprarenal	1
Glioblastoma multiforme	1

Carcinoma of the bronchus is thus seen to have been nearly three times as frequent in the Africans dying in hospital in Gwanda in these six years as either of the two next most frequent cancers, cancer of the prostate and primary cancer of the liver. Its autopsy incidence (5.8 per cent.) is more than double the figure for Europeans in Johannesburg (2.6 per cent.) given by Professor B. J. P. Becker, and more than 14 times the non-European incidence in that city (0.4 per cent. according to Becker, 1956).

It is recognised, however, that such post-mortem figures are a very misleading way of getting a true estimate of the relative frequency of any disease. Higginson (1951), for instance, has written, " . . . patients with incurable tumours are frequently sent home to die once the diagnosis has been made, causing so much selection in the necropsy group as to render it valueless for statistical purposes." Certainly the only completely accurate method for comparing

Table I

COMPARISON OF AGES BETWEEN GWANDA CASES OF LUNG CANCER AND DAVIDSON'S AND PIRCHAU AND SIKL'S SERIES

Ages	*All Lung Cancer Cases in Gwanda*	*Twelve Lung Cancer Cases from Mines*	*Brompton Hospital Series Reduced to Twelve*	*Joachimstal Series Proportionately Altered to Twelve*
0—10	—	—	—	—
10—19	—	—	0.24	—
20—29	—	—	0.67	—
30—39	2	2	2.24	—
40—49	4	4	4.6	5.3
50—59	10	5	3.36	4
60—69	5	1	0.67	2.3
70 plus	1	—	—	—

the frequency of diseases in different populations is by working out their incidence per unit population divided up into sex and age groups.

A sample census taken by the Native Department in 1953 gave the total population of the Gwanda-Beit Bridge districts, the "pool" from which Gwanda Hospital draws its patients, as 61,944 persons, of whom 14,340 were adult males. The incidence of cancer of the lung in males could therefore be expressed as 22 cases in 14,340 multiplied by 8½ man-years, which is equivalent to 18 cases per 100,000 of population. This is only very slightly less than the incidence in European males in the United States in 1950, i.e., 19.5 per 100,000 (as given by Hammond and quoted by Becker).

Out of the 22 patients with lunger cancer, 13 were working on mines (12 on gold mines, one on an asbestos mine) at the time of their admission to hospital. Such mine workers on the Gwanda gold belt form a smaller sub-division of the total population of Gwanda district with special features; thus practically all the mine workers sick enough for hospital treatment come to Gwanda Hospital, in contrast with the kraals in the more outlying parts of the district, where patients often attend mission clinics; they are at the same time more easily available for follow-up studies than the widely scattered population in the reserve. The average yearly employment figures for these miners obtained from the employers' labour register were 3,442 in 1948, 3,145 in 1949, 3,090 in 1950, 2,427 in 1951, 2,222 in 1952, 2,170 in 1953, 2,602 in 1954 and 1,293 in 1956 up to June. The number of man-years for the total eight and a half year period is thus 22,903; and from this it can be worked out that the incidence of cancer of the lung over the whole male mining population is 56.8 per 100,000.

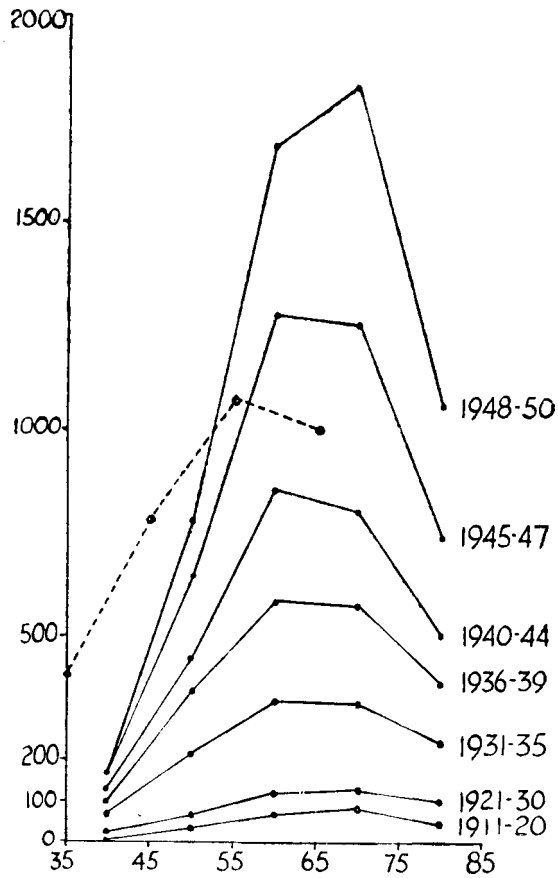

Fig. 1—Incidence of cancer of lung in Gwanda miners, by age groups (stippled line), superimposed on graphs of mortality statistics for men of different ages in England (after Doll).

Table II

AGE GROUPING OF GWANDA MINERS

Ages	*Numbers out of Three Hundred*	*Percentage*
0—10	—	—
10—19	11	3.7
20—29	64	21.3
30—39	69	23
40—49	73	24.3
50—59	66	22
60—69	14	4.7
70 plus	5	1.7

In order to get the incidences in the various age groups, an unselected sample of 300 miners from three mines had their ages estimated by the writer (table 2). The ages of 12 of the 13 lung cancer cases from mines are set out in table 1 and, taking this as a basis for calculation, the incidence of lung cancer per 100,000 in the various age groups of the Gwanda mining population may be estimated and are tabulated in table 3; in Fig. 1 a curve constructed from these figures is superimposed upon that given by Doll (1953) for mortality among the different ages for the years 1948-50.

The above calculations are of necessity based on numbers too small to allow completely accurate conclusions to be drawn. They indicate, however, that cancer of the lung among African males in the Gwanda district is almost as common as it is among European males in America, while in the smaller group of African mine

workers it is three times as common. The latter finding is particularly unexpected in view of the fact that cancer of the lung was until recently regarded as being for all intents and purposes non-existent in the Bantu. Strachan (1934), for instance, in 1,901 autopsies at Johannesburg General Hospital in 1924-33, had no case among 73 cancers in Africans; while others, such as des Ligneris, Berman and Vint, who have written on malignancy in the African, were not able to recall a single instance.

In an attempt to get some idea of the situation in other parts of Southern Rhodesia, eight government medical officers were questioned in 1952; five had seen cases of cancer of the lung among Africans in their districts, although only one (Dr. H. Knight, of Gatooma) had records of as many as three, while in only a minority of cases had there been actual histological confirmation. Dr. Brain kindly let me have the post-mortem records of Shabanie Mine Hospital between August, 1944, and November, 1952. Among 261 post-mortems there were 28 carcinomata, of which three were primary lung cancers. Dr. Rosset, of Elim Hospital in the Northern Transvaal, across the Limpopo from Gwanda district, has seen five cases in five years (four in men and one in a woman) among 25,481 in-patients, with an estimated population served by the hospital of 150,000 persons.

POSSIBLE CAUSES OF A LOCAL HIGH INCIDENCE OF LUNG CANCER

1. Smoking

Unfortunately, enquiries into smoking habits were made in only 11 out of the 22 cases of cancer of the lung, the possible significance of such a history not having been realised in the earlier cases. All 11 cases smoked. Nine smoked mainly the cheaper brands of bought cigarettes, three of these also smoked home-rolled cigarettes and three on occasion a pipe:

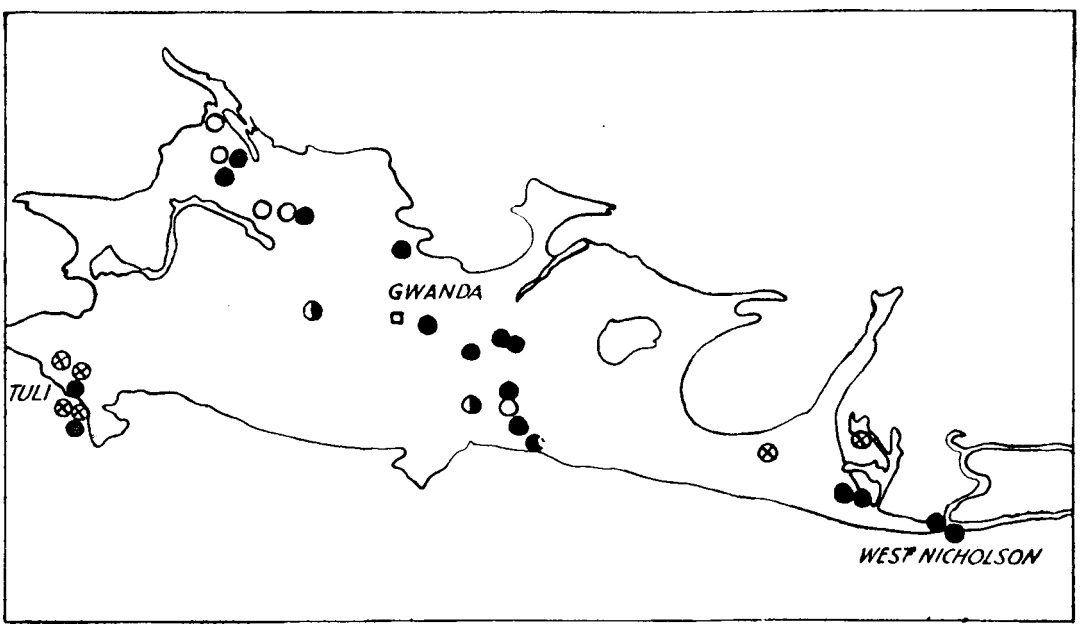

Fig. 2—Map of Gwanda gold belt, showing mines at which 16 lung cancer cases had worked.

Key to Fig. 2

Recent (for a period of more than 5 years) ⊗

Recent (exact duration unknown) ○

Not recent (more than 5 years previously) ●

Not recent (not known how long previously) ◑

one smoked home-made cigarettes only, and one a pipe only. Of those smoking cigarettes, only two smoked more than ten per day (Case No. 16, sometimes 16 per day; and Case No. 21, 12 to 14 per day).

Table III

INCIDENCE OF CANCER OF THE LUNG IN GWANDA MINERS ACCORDING TO AGE GROUPS

Ages	*Incidence of Cancer of the Lung per* 100,000 *Population*
30—39	41.13
40—49	77.9
50—59	107.5
60—69	100.6
70 plus	—

These 11 smokers were all either miners or had worked in mines at varying times previous to coming into hospital.

The question naturally arose as to whether miners from the nature of their work might smoke more than Africans in other occupations. In order to investigate this possibility a total of 358 African patients, not selected in any way, were questioned on admission to hospital about their smoking habits. One hundred and sixty of the 358 were employed on mines, 198 were non-miners. Of those mining, 103 (or 64 per cent.) were smokers, 57 (or 36 per cent.) non-smokers); while of the non-mining group, the figures were respectively 119 (60 per cent.) and 79 (40 per cent.).

In table 4 the smoking habits of miners and non-miners are compared in more detail. Nothing emerges to suggest that the smokers among the mining population, while not relatively more numerous than among the non-mining, at least smoke more heavily when they do so indulge. In fact, the two groups show no significant difference from each other.

II. Mining

Besides the 13 cancer cases admitted to hospital directly from Gwanda mines, four of the remaining cases ((13, (14), (15) and (19)) had worked for periods of from one and a half to more than 30 years in mines in the past; while two (Nos. (17) and (18)), although denying previous mine work, were found at autopsy to have silicotic and tuberculo-silicotic lesions respectively that could only have resulted from underground mining. Of the remaining three, occupational histories had not been taken from two (Nos. (1) and (6)), while the case notes of No. (7) were mislaid.

Apart then from finding such a high incidence of cancer among the relatively small group of Africans at present employed on Gwanda mines, the frequency of a history of mining in all the cancer cases taken together makes a strong case for the existence of a specific causative factor connected with mining.

The possible etiological factors which have been investigated in mines showing a high incidence of cancer in the mine workers—as, for example, in the Schneeburg and Joachimstal mines—are silica dust, arsenical fumes and radium emanations. Only the first two will be touched on, as there is no information available on the presence or absence of radio-active material in the Gwanda ores.

(a) *Silica Dust.*—Although Hueper (1951) states that there are some 50 cases on record of cancer of lung or larynx and silicosis co-existing, the majority of investigators are agreed that silicosis is not of any importance in the etiology of lung cancer. Among the 23 Gwanda cases two ((3) and (17)) were found at autopsy to have associated silicosis, and three ((10), (18) and (19)) had an associated tuberculo-silicosis, i.e., five out of the 19 cancer cases (approximately one-quarter) who had worked in mines had either silicosis or tuberculo-silicosis. Among a series of 80 Gwanda miners with a more than five-year history of underground mining admitted for chest investigation, 25 showed X-ray evidence of silicosis, five having an associated tuberculous infection, i.e., approximately one-third. The incidence of silicosis among those cancer cases from mines was thus actually slightly less than among a parallel group from mines investigated for chest symptoms.

(b) *Arsenic.*—It seems fairly definitely proved that arsenic can cause cancer of the lung, when used medicinally, in the form of arsenical pesticides or sheep dip, in their manufacture or use, or as smelter fumes (Hueper, 1951). It is thought, in association with radium emanations, to be the most probable cause of the extremely high death rate from cancer of the lung among the workers in the Joachimstal and Schneeburg mines.

In Gwanda the high content of arsenopyrite in the gold-bearing rock of the western portion of the gold belt, west of the twenty-ninth meri-

dian, which passes approximately through the site of Gwanda village, contrasts with its relative paucity east of the twenty-ninth meridian. A map is given showing the situation of the various mines at which 16 lung cancer cases had worked for periods of a year or longer. It will be noted that the distribution is more or less even over the whole district. Nor, in fact, had all the 16 lung cancer cases worked at mines in the western area; five gave histories of having been employed only on mines east of Gwanda. It would be unwise, however, to attach too much significance to this point in view of the possible incompleteness of many of the mining histories.

Another point which seems to weigh against arsenic as the main cause of lung cancer in the 22 Gwanda cases is the absence of any record of arsenical skin lesions among them. The importance of this negative evidence is dependant on whether one unreservedly accepts Hueper's opinion that "such manifestations rather regularly accompany the cancers of the lung in arsenic workers and thus represent a part of the environmental arsenic lung cancer pattern." It is possible to conceive of arsenic acting as a summation factor with other carcinogenic agents in amounts insufficient to lead to marked skin changes; in fact, it has been suggested that it acts in this manner, in association with radium emanations, to cause cancer of the lung in the Schneeburg and Joachimstal mines, where arsenical skin changes are not found, except for palmar hyperkeratoses in the men washing cobalt ores in the form of arsenides (Currie, 1917). However, since the only direct proof that can be obtained of the intake of arsenic in toxic amounts at some period in the past is the development and persistence of arsenical skin changes such as keratoses or pigmentation, coexistence of such skin lesions with cancer of the lung in the same patient is of particular value in helping to establish the position of arsenic as a causative factor of the cancer.

Fig. 3—Hand of patient Misiyamo.

It is for this reason that the writer considers the following case, not included among the 22 patients so far referred to, has particular significance.

The patient, Misiyamo, a male African aged about 60 years, was admitted to Gwanda Hospital from the Freda Mine on 13th August, 1956. He stated that he originally came from Mazimba, in Northern Nyasaland, but that he had worked on mines in Southern Rhodesia since 1930, these being (not in strict chronological order) the Jessie Mine (one year underground as a "lasher-boy"); the Abercorn Mine (one and a half years as jackhammer boy); the Bena Mine (one year as "hammer boy"); Sabiwa Mine (? time and nature of work); Blanket Mine (eight years as "jackhammer boy"); Horn Reef Mine (one year as "lasher boy"); Lone Hand Mine (five years surface work); and the Freda Mine (eight years as "jackhammer boy"). Thus he had worked for more than 23 years in mines in the western part of the Gwanda gold belt.

Complaint.—He complained of coughing since January, 1956, and of pain in the left axilla with the cough since June. Sputum was scanty and normal in appearance. Other symptoms were shortness of breath on hard work since the beginning of the year, more recently also after coughing, and loss of weight.

Habits.—He took snuff, but had never smoked.

Condition on Examination.—He was an adult male of spare build, able to walk around in comfort and without noticeable respiratory distress. There were two small and hard enlarged glands above the inner end of the right clavicle. The first chest examination showed the cardiac apex impulse in the nipple line and the trachea central: there was dullness and greatly decreased air entry over the left infra-clavicular region and the left apex behind, and a coarse pleural rub in the left axilla.

His fingernails showed early clubbing, but the feature most noticeable about his hands was a marked hyperkeratosis of the skin of both palms, extending as an unbroken thickened layer from the distal wrist crease to the distal interphalangeal joints, encroaching to some extent on to the finger pads (more so on the left hand), but leaving the dorsa of the hands and fingers clear except for some wart like keratoses at the

Table IV

THE SMOKING HABITS OF 222 GWANDA HOSPITAL PATIENTS

	Mining	*Non-Mining*
Home-made cigarettes	53	56
Number of this group smoking more than two packets (3 ozs.) per week	3	4
Cheap bought brands of cigarettes	38	50
Number of this group smoking more than 24 per week	16	23
More expensive European type of cigarette	3	8
Pipe	9	5

sides of the proximal interphalangeal joints of the left index and ring fingers. The keratotic layer on the palms was broken up by deep fissures to give a rough verrucous appearance, chiefly apparent over the fingers of the left hand and along the outer edges of the palms, on the left side especially. The nails, apart from the clubbing, were normal, though pale. The feet also showed hyperkeratotic changes, but not so extensive or so thick as on the hands. In addition, there was on the skin of his chest a scattering of hyperpigmented spots, most of them pinpoint or pinhead in size, but others up to half a centimetre in diameter and irregular in contour.

The patient gave the information that he had first noticed the keratosis of his hands in 1935, at the Blanket Mine, after he had been working there for two years as a "jackhammer boy." He said he did not at the time work with any chemical solutions and that the only liquid touching his hands was the oil used for lubricating the jackhammer.

Investigations.—Six sputa were negative for tubercle bacilli.

The blood Wassermann was strongly positive.

The blood sedimentation rate was 125 mm. in one hour: Hb. 70 per cent.: white cell count 14,600/cu. mm.; differential blood count: neutrophils 58 per cent., lymphocytes 31 per cent., monocytes 11 per cent.

The urine contained a one plus of white cells; otherwise quite negative.

The stool revealed no ova or cysts.

Chest X-ray showed a left hilar mass spreading outwards in a fanlike manner into the adjacent lung tissue.

A right supraclavicular gland excised and sent to the Bulawayo Public Health Laboratory proved to contain metastases of an anaplastic squamous celled carcinoma.

Progress.—During the next six weeks the trachea became deviated to the left, the apex impulse shifted one and a half inches outwards, and the whole of the left chest was dull on percussion. An enlarged hard gland appeared in the left supraclavicular fossa. The patient complained fairly persistently of a pain in the back of the left chest near the scapular angle, and was tender over the upper thoracic spines. In the first week of March it was found that he could no longer walk on account of weakness and trembling of his legs, and the occurrence of a carcinomatous metastasis seemed probable in the region of D 3 and 4, the spines of which were now more prominent as well as tender. In the next week he became completely paralysed in the lower extremities, with retention overflow of urine, and his condition deteriorated rapidly. He died on 16th October, 1956.

At autopsy a carcinoma of the left lung was found, which appeared to originate at the bifurcation of the main bronchus and radiate peripherally along the peribronchial lymphatics; it formed a carcinomatous plaque in the posterior pleura which was adherent to the upper six ribs and thoracic vertebrae. The hilar glands of both lungs were silicotic.

The aorta was dilated and the seat of a well-marked syphilitic mesaortitis. The liver was fatty; the spleen

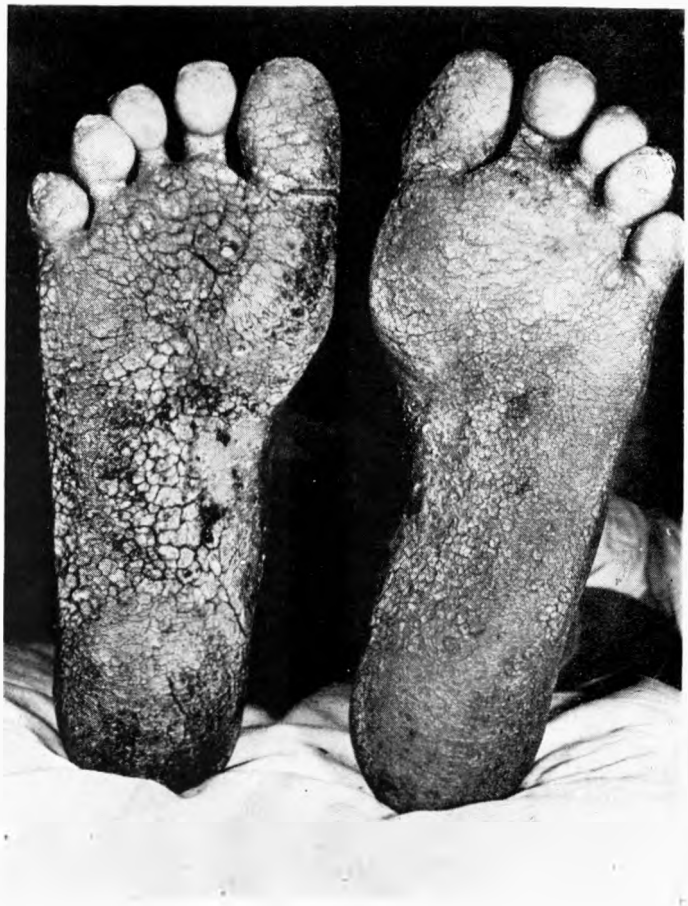

Fig. 4—Feet of patient Misiyamo.

large, with a thickened patch of perisplenitis. No visceral metastases were found except for a nodule of carcinoma in each of the kidneys. The bladder mucous membrane showed some chamois-leather coloured patches, probably bilharzial. All the other organs appeared normal. Histological examination of tissues by Dr. B. Tulloch, of the Public Health Laboratory, Bulawayo, confirmed the presence of a bronchial carcinoma and silicosis, and also of syphilitic mesaortitis. *Bilharzia ova were found in the liver sections.*

COMMENT

In view of the fact that the skin changes in the patient just described had started at the Blanket Mine, all the underground workers at that mine (at present 21 in number) were examined for similar signs of arsenic poisoning.

Only one showed possible arsenical keratoses. He was a man about 40 years of age who had worked 12 years underground at the Blanket, most of the time as boss boy supervising a variety of work, including that of the jackhammer gang, but for the last six months chipping rock samples with a hammer. He showed a scattering of keratotic spots none larger than a millet seed over the palms of both hands, most profuse at the proximal ends of the sulcus between the thenar and hypothenar eminences, and also distal to the proximal horizontal crease on the palm. On the web between the right ring and middle fingers was in addition a small wart-like keratotic growth.

It appears from the above rather limited investigation that the arsenic hazard for underground workers is not a high one. No doubt all kinds of factors enter into the matter, both degree and kind of exposure, and individual susceptibility. It is conceivable that the arsenical ores exert their main action on the bronchial mucous membrane as an inhaled dust, and that some occasional factor, such as hyperidrosis, may cause the localised appearance of keratoses on the palms and soles. Reference has already been made to the fact that in the Schneeburg and Joachimstal mines, where arsenic is thought to be a possible cause, with radium emanations, of lung cancer, palmar hyperkeratoses are only found in the men washing arsenical cobalt ores.

The question arises as to whether the Gwanda lung cancers in their clinical features bear the stamp of an occupational origin.

Various characteristics have been put forward as suggestive of such an origin, such as a shift to a younger age group and a multicentric

PARTICULARS OF CANCER CASES

No.	*Name*	*Age*	*Address Whence Admitted*	*Local Pathology*	*Metastases*	*Histology*
1	Mzegi	60 plus	Gwanda Reserve	Mass size of orange at right hilum. Second mass further out in region of axillary segment. Third mass left lower lobe extending through fissure into upper lobe.	Pleura. Liver.	Cylindrical cell (bronchogenic) adeno-carcinoma.
2	Zamailo	45	Abe Mine	Rounded mass 1 in. diam. in right lower lobe. Separate right hilar mass. Mediastinal involvement.	Liver.	Oat cell carcinoma of bronchial origin.
3	Tupa	50	Smiler Mine	Carcinomatous mass size of tangerine orange at the right hilum.	Spleen. Brain.	—
4	Beaton	—	Long John Mine	Carcinoma infiltrating lower lobe of right lung and adjacent middle lobe.	Liver. Left kidney.	—
5	Maviya	50	Farvic Mine	Nodule of carcinoma size of walnut in left lower lobe. Deposits in hilar glands.	Liver. Spine.	Bronchogenic carcinoma of oat cell type.
6	Masiku	60 plus	Gwanda Reserve	Carcinoma at right hilum. Right lung collapsed, effusion present.	Liver.	Anaplastic squamous celled carcinoma of bronchogenic origin.
7	Sabalo	55	—	Right lower lobe with seedlings peripherally and in middle lobe.	Liver.	Bronchogenic carcinoma of oat cell variety.

No.	*Name*	*Age*	*Address Whence Admitted*	*Local Pathology*	*Metastases*	*Histology*
8	Fekani	55	Horn Reef Mine	Rounded carcinomatous mass alongside right main bronchus.	Brain.	Primary oat cell carcinoma of bronchus.
9	Karenga	55	Vubachikwe Mine	Abscess of right upper lobe: nodules of cancer recognisable.	?	——
10	Libikani	38	Alpha Asbestos Mine	Carcinoma of right lower lobe bronchus: numerous masses throughout lung, together with miliary tuberculous nodules.	?	Squamous celled carcinoma plus tuberculosis.
11	Elisia	35	Blanket Mine	Carcinoma with abscess formation left upper lobe. Large mass at hilum infiltrates mediastinum.	Liver.	Primary bronchogenic squamous celled carcinoma.
12	Laija @ Radiyo	65	Blanket Mine	Carcinoma of left upper lobe bronchus.	Left kidney. Left adrenal. Pleura.	Primary bronchial carcinoma with the structure of an anaplastic adenocarcinoma.
13	Thom	50	Rhodesia Cement Factory	Carcinoma of left upper lobe bronchus.	Brain.	Bronchogenic carcinoma of oat cell type.
14	Juwawa	55	Rhodesia Cement Factory	Post-mortem examination done in Bulawayo.	—	Bronchogenic carcinoma of oat cell type.
15	Mdaka	60	Gwanda district	Post-mortem examination not done.	Thoracic and lumbar vertebrae. Clavicle, sternum and ribs.	Excised supraclavicular gland the seat of a metastatic anaplastic squamous celled carcinoma.
16	Sikutai	48-50	Freda Mine	Carcinoma at left hilum	Somatic muscles. Rib and vertebra. Heart. Left adrenal. Kidneys.	Primary squamous celled carcinoma of bronchus.
17	Bwale	50	?	A well-defined mass of carcinoma at hilum around bronchus going to upper lobe.	—	Bronchogenic carcinoma of oat cell type.
18	Manwele	58-60	Gwanda district	Carcinomatous mass in right upper lobe forming abscess. Associated tuberculo-silicosis.	Ribs.	Anaplastic squamous celled carcinoma.
19	Matambo	70 plus	Rhodesia Cement Factory	Carcinoma at left hilum. Associated tuberculo-silicosis.	Pericardium. Both adrenals.	Undifferentiated growth showing evidence of origin from a bronchus.
20	Habgwaza	55	Sally Mine	Carcinomatous mass spreading out from left hilum.	Ribs. Adrenal.	Primary bronchogenic carcinoma of epidermoid type.
21	Mwanza	45	Geelong Mine	Carcinoma of left lower lobe bronchus with excavation to form abscess.	Liver.	Primary bronchogenic carcinoma mainly of oat cell type, but in places having epidermoid structure.
22	Anosi	40-45	Horn Mine	No post-mortem examination performed.	—	——

origin of the tumour. Pirchau and Sikl also draw attention to the exclusive appearance of two types of cancer in their small series of nine autopsy cases from Joachimstal—an unripe small cell sarcoma and a squamous epidermoid cancer (one case, however, was a polymorphous pleural carcinoma).

The Gwanda cases do not conform to any of these criteria. The age grouping has already been shown to be slightly higher, if anything, than in an English series (table 1). In no case was multiple origin of primary tumours found. Of the 18 tumours which were histologically examined at the Bulawayo Public Health Laboratory, two were adenocarcinomata, one a carcinoma of epidermoid type, six squamous carcinoma and nine oat-celled carcinoma. These are roughly the same proportions as have been generally found to occur in European non-mining series, e.g., Becker quotes the figures as being columnar celled adenocarcinoma in 12 per cent., malignant adenoma in 6 per cent. squamous carcinoma in 33 per cent. and undifferentiated tumour (small cell and large cell carcinoma) in 46 per cent.

There is, nevertheless, a distinct doubt as to how essential the suggested criteria for the diagnosis of occupational lung cancer in fact are. Taking as an example the age groupings of the nine cases from Joachimstal autopsied by Pirchau and Sikl (table 1), they are found to be actually higher than those in Davidson's Brompton Hospital series, and in fact to differ not very greatly from the Gwanda Hospital series. Also only one of the nine Joachimstal cases had a multicentric origin (two primary foci, of different histology, in the right lower and left upper lobes). Admittedly the Gwanda cancer cases conform as regards histological variety rather to the European non-mining cases than to the Joachimstal series, but the existence of a somewhat diverse histology has not apparently been considered any bar by many investigators to attributing the increase of cancer of the lung in the present century almost exclusively to a single cause, i.e., cigarette smoking.

Arsenic may be one of the factors in town dust which supplements the action of tobacco smoke and is responsible for the higher incidence of cancer of the lung in towns than in the country (Goulden *et al.*, 1952). In the case of Gwanda district it is likely to be the chief carcinogenic substance and tobacco smoke a subsidiary one, since relatively few cigarettes, by European standards of consumption, were smoked by those cancer cases from whom a smoking history was taken—in only two cases more than ten per day. The fact that all the 11 lung cancer cases questioned on the matter smoked, compared with 62 per cent. of 358 unselected hospital patients, is suggestive of tobacco playing a part, even if a relatively minor one.

SUMMARY

The incidence of cancer of the lung in Gwanda district is only slightly less than that in European males in the U.S.A. in 1950; in the case of the smaller group of mining Africans, the incidence is three times that in males in the U.S.A.

Nineteen out of 22 lung cancer cases (in the remaining three histories were not available) had worked at some time in mines or were at present employed there, and the inference is that the cancer is an occupational disease associated with mining.

The most likely specific cause is thought to be arsenic, which occurs in large quantities as arsenopyrite (mispickel) in the gold-bearing ores of the part of Gwanda gold belt west of the twenty-ninth meridian.

Tobacco smoking possibly plays a subsidiary role as a summation factor. All eleven Gwanda cases of lung cancer questioned in the matter smoked (in the series seen up to June, 1956). The case of a patient seen subsequent to that date, who had hyperkeratoses of hands and feet and a pigmented rash on the trunk, and who did not smoke, is also reported.

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