Other therapeutic applications in treating arterial emboli, reflex anuria, abdominal distension, and vascular insufficiency have been described.

Continuous caudal analgesia has been determined of great value in the prognosis of sympathectomy for essential hypertension.

It opens a new avenue for the prolonged control of post-operative and intractable pain in terminal carcinomatosis.

Finally, the medical profession and I personally express our gratitude to our European colleagues who in 1901, after careful researches, made possible this medical technique which it has been my privilege to extend into these various applications.

SOME OBSERVATIONS ON PULMONARY TUBERCULOSIS IN THE NIGERIAN AFRICAN

BY

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Pulmonary tuberculosis is moderately common amongst the Nigerians, but, though cases now report more often to the hospitals for treatment, there is no conclusive evidence that its incidence is rising significantly. Anticipated measures for the control of the disease in Nigeria are likely to meet with little success unless close account is taken of its particular characteristics in the African, and it is hoped that the following observations may serve to stress some of its features. The series of cases, though consecutive, is admittedly very small, but supports the conclusions drawn from a large number of additional cases seen during the last eleven years, but in which observations and investigations were less complete.

The peculiarly virulent nature of pulmonary tuberculosis in the African is still sometimes attributed to a relatively recent introduction of the infection by the European to a country and people not hitherto exposed to it—a so-called virgin soil. It is probable, however, that the disease was introduced long before the advent of Europeans in significant numbers, possibly from the North and Near East by the old trans-Sahara trade routes. Conceptions of the importance of a virgin soil seem to imply that an inherited immunity can be established as a result of several generations of exposure to infection, but the example of the American negro furnishes no evidence in support of this supposition or in favour of a possible progressive genetic elimination of the highly susceptible. Though improvement in education, economic status, and standard of living may do much to mitigate the severity of the disease amongst the population as a whole, it seems that the violence of the disease in the African must be explained on a basis of his inborn constitutional peculiarities.

The common impression in Nigeria is that pulmonary tuberculosis in the African is not amenable to treatment and is invariably fatal. That the outlook is not so hopeless as this Davies (1946) has shown as a result of twenty years' work in Tanganyika. He points out that by the time a patient presents himself voluntarily for treatment his disease, so rapid is its advance in the African, is already hopeless of cure, and such indeed is the experience in Nigeria. Apart from the obvious necessity for education of the public and for improved living conditions, isolation of the open case is a prime essential. Davies stresses that for this purpose, and for the detection of cases early enough for effective treatment, sanatoria working as isolated units

are no more effective than the existing general hospitals, for both are dependent on the voluntary attendance of patients. Only by the institution of travelling teams equipped for clinical examination, mass skin tests, and miniature radiography, designed to detect the early case and the susceptible individual, and of spaced bush dispensaries based on regional sanatoria, can satisfactory results be anticipated.

Incidence of Tuberculous Infection

Skin Tests.—Table I shows the results of Mantoux tests with 1 in 5,000 old tuberculin on 93 hospital in-patients, chiefly Northern Nigerians, not exhibiting any demonstrable

TABLE I

Age Group	0-9	10-19	20-29	30-39	40-49	50 and Over
Positive	0	6	13	7	13	8
Negative	3	3	9	7	9	5
Proportion positive ..	0%	32%	59%	50%	59%	61%

TABLE II

Age Group	0-4	5-9	10-14	15-19	20-29	30-39	40-49	50 and over
Positive	1	2	2	3	8	3	4	4
Negative	4	5	1	1	2	1	1	1
Proportion positive ..	20%	29%	67%	75%	80%	75%	80%	80%

TABLE III

Negative	Weakly Positive	Strongly Positive	Total Positive
32	10	51	61 (65.6%)

tuberculous lesion. Table II gives the Mantoux results with 1 in 500 old tuberculin in 43 similar in-patients, while Table III shows the findings with 1 in 500 old tuberculin in 93 male scholars of a Government secondary school, all Southern Nigerians aged between 13 and 16 years. It is evident from these results that 65% of the more urban sections of the community in their mid-teens and 80% of those in the 20-29 age group and onwards have experienced a tuberculous infection.

Necropsy Evidence.—In a series of 90 consecutive routine necropsies carried out on the cadavers of patients who had died in one hospital of conditions other than tuberculous a search was made for latent or healed tuberculous foci. Almost all of the lesions so encountered were sent to the Lagos laboratory for microscopical confirmation. The results are given in Table IV.

TABLE IV

Age Group:	0-9	10-19	20-29	30-39	40-49	50 and over	Total
Pulmonary focus ..	0	0	0	1	1	1	19 (21.1%)
Hilar or broncho-mediastinal gland focus ..	0	0	3	1	2	1	
Pulmonary + hilar gland foci ..	0	0	0	1	1	1	
Abdominal gland focus ..	0	0	2	1	1	0	
Pulmonary, hilar gland, and abdominal gland foci ..	0	0	1	1	0	0	71 (78.9%)
No tuberculous focus ..	6	6	18	13	20	8	
Proportion with tuberculous foci ..	0%	0%	25%	28%	20%	27%	

It is observed that of these 90 cadavers 19 (21.1%) showed easily demonstrable healed or latent tuberculous foci. The employment of specialized methods would

undoubtedly have revealed a far higher percentage. The pulmonary lesions were usually subpleural and most commonly took the form of small gritty areas of fibrosis and anthracosis containing caseous foci from the size of a pinhead to $\frac{1}{8}$ in. (0.3 cm.) diameter. Larger encapsulated caseous foci were much less common. In the case of the hilar gland lesions the glands were usually a little enlarged, anthracotic, and contained similar pinhead, grey or yellow caseous foci. The abdominal glandular lesions are of some interest, as milk rarely enters into the dietary of these people, and in one or two cases the site of the lesions was not altogether suggestive of an intestinal portal of entry. Thus one cadaver with tiny caseous foci in the left upper lobe and associated broncho-mediastinal glands exhibited also gross enlargement and old caseation in glands at the root of the mesentery. A second showed tiny caseous foci in two of the right para-aortic abdominal glands as the only demonstrable tuberculous focus. Old pleural adhesions were encountered in 75% of the cadavers.

Clinical and Necropsy Observations in Cases of Pulmonary Tuberculosis

The clinical and post-mortem findings in 36 consecutive cases of tuberculosis with pulmonary lesions treated in one hospital have been analysed and summarized. Patients admitted during this period who absconded or on whom necropsy was refused have been excluded. The patients were Northern and Southern Nigerians, with a considerable preponderance of the former. Although the disease pursued an essentially similar course in the two races, it was the impression that the Northerners showed a rather lower resistance than the Southerners. Complicating factors are always common in these people, malaria being universal, intestinal helminths almost invariable, and filariasis, bilharziasis, dracontiasis, chronic amoebiasis, and malnutrition occasional. By clinical and necropsy criteria five types of case could be distinguished, the respective features of which are detailed below.

Type 1

This group comprised 23 cases, the extremes of age being 18 and 64, and the average age 36. Seven patients were over 45. All complained of productive cough, weakness, and weight loss, several of diarrhoea, six of hoarseness due to associated laryngitis, six of chest pain, and only three of haemoptysis. In all there were obvious physical signs in the chest, usually bilateral, and in all the sputum was profuse and acid-fast bacilli were easily found, often in large numbers. All cases showed a moderate to severe hypochromic anaemia, and in over half the cases there was a leucocytosis of 12,000 to 16,000, usually with a polymorphonuclear percentage of between 75 and 90, and no monocytosis. It should be mentioned that in 44 average healthy Africans the mean white cell count was found to be 6,807 (polymorphonuclear neutrophils 59%, lymphocytes 31%, monocytes 4.6%, eosinophils 4.4%).

In all cases in which it was determined the B.S.R. was between 50 and 70 mm. in one hour, except for one of 20 mm. and one of 2 mm. All showed some pyrexia, remittent or intermittent, with evening rises to 100–102° F. (37.8–38.9° C.). Weight loss varied between $\frac{1}{2}$ and 3 lb. (0.22 and 1.36 kg.) per week, and the average interval between the alleged onset of symptoms and death was seven months, the extremes being two and 13 months. Admittedly this estimate of the average duration of life excludes a few of the less severe cases, in which the patients, either because of lack of progress in hospital or because treatment had resulted in sufficient amelioration to induce in them undue optimism, absconded and were excluded from the series.

I have, apart from the present series, kept more favourable cases under observation and treatment for as long as two years before they defaulted in their attendance. Yet I have never, under existing conditions, encountered a case that had been

permanently cured or offered promise of being so. As regards treatment, I have during the last ten years employed collapse therapy, artificial pneumothorax, often bilateral and partial, alone or in combination with phrenic evulsion, in a considerable number of cases. The majority of the patients showed bilateral involvement, were too advanced to be truly suitable, and derived no significant benefit. However, the few less hopeless cases showed enough improvement to suggest the probable effectiveness of collapse therapy if cases could be detected and brought under treatment at an earlier stage. Suitable antibiotics have not been available.

At necropsy there was very extensive cavitation of one or both upper lobes. Often the whole of one upper lobe would be represented by a huge cavity bounded only by the greatly thickened and densely adherent pleura. Evidence of fibrosis limiting the cavities before the pleura was reached was very rare and never marked, except in one case which showed sufficient gross fibrosis to produce tracheal displacement. Exceptionally, cavitation was more extensive in a lower lobe. The condition of the remaining lobes was variable, but rarely were they normal and healthy. Very often there were more or less large areas of whitish caseous pneumonic infiltration, sometimes, when extensive, with central cavitation. Often there were isolated clean-cut spheroidal cavities about 1 in. (2.5 cm.) in diameter and containing fluid pus.

In most cases there were the scattered diffuse single and trefoil lesions of tuberculous bronchopneumonia. Occasionally a lobe might have an appearance of hepatization. The hilar glands were fibrotic and anthracotic, but rarely showed macroscopic tuberculous lesions. There were in the majority typical tuberculous ulcers of the ileum, with white thread-like infiltration of the associated lymphatics and caseous foci in the regional mesenteric glands. Apart from this latter, gross lympho-glandular lesions were absent, as also were miliary lesions. In only three instances were primary tuberculous foci detected. One showed a typical Ghon lesion at the left apex, and in the right upper lobe several old inspissated caseous foci, some partly calcified, varying in size from a pinhead to a peanut and surrounded by considerable fibrosis. Another showed old pinhead foci of caseation with surrounding fibrosis and anthracosis in an upper lobe, and the third two mesenteric glands converted to mere fibrous shells enclosing old inspissated caseous matter.

Type 2

Eight cases fell into this group; the ages ranged from 17 to 42, the average being 29. The invariable complaints were of productive cough, weakness, and weight loss. Obvious clinical chest signs were present in all, and acid-fast bacilli were always found in the sputum, usually in profusion. The blood count as a rule was characterized by a moderately severe hypochromic anaemia, and in five cases a leucocytosis of from 11,700 to 25,600 with polymorphonuclear percentages from 74 to 91 and no monocytosis. The B.S.R. lay between 60 and 70 mm. in one hour in all cases except one, in which it was only 3 mm. Pyrexia was remittent or intermittent, with rises to 101–103° F. (38.3–39.4° C.); the average weekly weight loss was 2½ lb. (1.13 kg.); and the average interval between the professed onset of symptoms and death 4½ months, the extremes being 1½ and eight months.

The common necropsy finding was very extensive areas of whitish tuberculous caseous pneumonia with small or moderate-sized central cavities where the caseous matter had broken down. The intervening lung might have an appearance of grey or gelatinous hepatization, while often the tiny diffuse lesions of tuberculous bronchopneumonia were found elsewhere. Tuberculous ileal ulcers with caseation of the associated mesenteric glands were usually present. There was always gross enlargement and caseation of broncho-mediastinal and/or cervical and abdominal lymphatic glands. Seven of the cases showed miliary lesions in one or more of the liver, spleen, and kidneys, and while the hepatic and renal lesions were typical milia the splenic foci were often larger, up to about $\frac{1}{4}$ in. (0.6 cm.) in diameter. Three cases showed primary tuberculous foci—one a caseous pulmonary area $\frac{1}{4}$ in. (1.25 cm.) in diameter with surrounding fibrosis and anthracosis, and the other two

small yellow caseous pulmonary foci from the size of a pinhead to $\frac{1}{4}$ in. diameter with surrounding fibrosis.

Type 3

There was only one case of this type, that of a man aged 34 who had complained of retrosternal pain and unproductive cough for two weeks. He was found to have a pericardial effusion and congestive cardiac failure, and died within a few days. At necropsy a grossly thickened parietal pericardium was found and an equally thickened and shaggy visceral pericardium, reported microscopically as tuberculous. The right lower lobe pleura was adherent and the upper lobe pleura opaque and markedly thickened. In the hilar zone of the right upper lobe were cavities the size of a peanut filled with old caseous matter; more peripherally were a few pinhead caseous foci and dense fibrosis of the whole area. This was reported by the pathologist as "a very chronic tuberculosis with great fibrosis and hyaline degeneration." In the right lower lobe and both left lobes were a few scattered pinhead caseous foci; in the left upper lobe there was an encapsulated caseous focus the size of a peanut. The hilar and broncho-mediastinal glands were a little enlarged and anthracotic, and contained small caseous foci. The mesenteric glands were enlarged and yellowish, and showed caseous areas.

Type 4

There were three patients in this group, aged 17, 19, and 27. The complaint in all cases was of weakness, weight loss, and cervical swellings. Clinically there were diffuse cervical and in one case also axillary lympho-glandular enlargements, retrosternal dullness, and intermittent pyrexia with evening rises to 100–102° F. (37.8–38.9° C.). There were a moderate or severe hypochromic anaemia, a slight leucocytosis of 10,000 to 12,000 with a relative polymorphonuclear preponderance, and a B.S.R. between 60 and 70 mm. in one hour. One case had thin purulent left pleural and peritoneal effusions, and necropsy showed many tiny subpleural tubercles. The salient post-mortem findings were diffuse enlargement with gross caseation, but no liquefaction, of broncho-mediastinal, cervical, abdominal, and possibly also axillary lymphatic glands, gross miliary tuberculosis of the lungs, and miliary tubercles in the spleen, and in one case also in the liver. Two cases showed coincident portal cirrhosis with splenic and hepatic enlargement.

Type 5

The one case of this type, that of a man aged 50, may represent a modification of type 4, but certain differences were apparent. The case had proved puzzling owing to an associated maculo-anaesthetic leprosy. At necropsy both lungs were riddled with tuberculous bronchopneumonia. Near the left apex was a caseous lesion 1 by $\frac{1}{2}$ in. (2.5 by 1.25 cm.), subpleural, without macroscopic limiting fibrosis but with an old overlying pleural adhesion. This was reported by the pathologist as "not a chronic lesion, but presumably the primary lesion of the recent infection, the pre-existing pleural adhesion being the determining factor of its site." Within one or two inches of this lesion were several zones of anthracosis and two small pinhead caseous foci reported as showing central scarring. The hilar glands were a little enlarged and contained caseous foci, and one, on section, was reported as "an old caseous encapsulated focus with some more recent tubercles." The more proximal broncho-mediastinal glands and the para-aortic glands in the abdomen were enlarged in lumpy masses, caseous and with liquefaction; splenic, pyloric, hepatic, and cystic glands were all moderately enlarged and grossly caseous. Cervical and axillary glands were greatly enlarged and confluent, and showed caseation and liquefaction. There was one tuberculous ileal ulcer, and the spleen and kidneys contained miliary tubercles.

Discussion and Conclusions

It is apparent that infection with the tubercle bacillus is now widespread, at any rate in the more populous areas of Nigeria, the primary infection being incurred usually in childhood or adolescence.

Progressive pulmonary lesions are rarely encountered in subjects under 17 years of age. It is recognized that such lesions can develop only if and when the lungs have acquired a high degree of sensitization to the products of the tubercle bacillus. It is thus evident that such allergy is not as a rule fully developed till after the age of approximately 17 years. The allergy responsible for the exhibition of a positive skin test, which is acquired as early as three months after the primary infection, must thus represent but one aspect of the process of sensitization. It seems that the attainment of sensitization to certain other fractions of the tubercle bacillus must extend over a period of years, its rate and degree varying possibly with the age incidence or dose of the primary infection or, more probably, with the number and frequency of early reinfections.

Further, the prevalence of tuberculosis of particular systems at particular age periods suggests that the various systems and tissues may attain maximum allergy at differing intervals from the primary infection. As an instance tuberculous adenitis in the European is most commonly seen in childhood, and is usually explained as a separate entity by postulating a distinct tonsillar or pharyngeal portal of entry, the result of a tendency on the part of young children to carry everything to their mouths. In the Nigerian I have most frequently encountered the disease among adolescents and young adults, while milk and milk products form no part of the dietary of the Southern Nigerian.

Though the communal eating-pot may provide a possible means of infection by ingestion, it seems equally possible that tubercle bacilli, entering by the usual method of inhalation of dust or droplets, may reach the cervical glands by lymphatic channels from the previously infected broncho-mediastinal glands. They there remain latent till later attainment of full allergy by the lympho-glandular system, possibly with the added precipitating factor of an inter-current non-tuberculous infection of teeth, tonsils, or pharynx causes the appearance of manifest cervical glandular lesions. It is thus suggested that glandular tuberculosis should be regarded, like pulmonary tuberculosis, as a possible milestone on the path of any tuberculous infection, and not necessarily as a separately determined entity, and that every subject of a primary infection subsequently, over a period of years, passes through a stage of lympho-glandular sensitization, a later stage of pulmonary sensitization, and a final stage of desensitization.

Despite the extreme virulence of pulmonary tuberculosis in the African, the vast majority, although exposed to tuberculous infection, do not develop cavitative lesions. Further, the disease is not exceptionally prevalent among the African nursing staffs of medical wards—an observation consistent with the relative infrequency of the disease among European sanatorium staffs and the marital partners of open cases. The possible inference that the majority of such adults have attained to a state of desensitization does not seem probable, for they fall within the age period at which clinical phthisis is most frequent and therefore pulmonary allergy presumably maximal. It seems more likely that they have been predestined by early reinfections, either very infrequent or of small dosage, to a low subthreshold peak allergy, the course of which later adult reinfections are powerless to influence.

The typical phthisis of the European, with its features of fibrosis and chronicity, is not encountered in the African. The counterpart in the Nigerian—the type 1 group described above—is a rapidly fatal cavitative disease in which rapid weight loss, high pyrexia, concurrent caseous pneumonic lesions, absence of fibrosis, and often a leucocytosis with

polymorphonuclear preponderance all indicate a far more acute process and an inherent failure on the part of the African to develop a degree of immunity comparable to that of the European. The absence of glandular lesions indicates that the lympho-glandular system has passed the stage of maximum allergy and is now desensitized, while the absence of miliary lesions implies some degree of general immunity.

The type 2 cases differ in showing a somewhat earlier age incidence, a rather shorter duration of life, pulmonary lesions of a preponderantly caseous pneumonic type, and more or less widespread lympho-glandular caseation and miliary lesions elsewhere. It is suggested that development of allergy has been more rapid, so that the glandular system is still in a state of sensitization when the lungs prematurely attain their full allergy, and any general immunity is of very low degree.

Should lymphoglandular sensitization be extremely rapid and of high degree the patient may succumb, as in the type 4 cases, to a generalized glandular caseous tuberculosis with miliary spread. The lungs, being still unsensitized, show no gross lesions other than miliary. The African's susceptibility to the type 2 and type 4 forms of disease implies a propensity on his part to the development of an unusually high degree of allergy.

Pulmonary reinfections occurring before the establishment of full pulmonary allergy might be expected to produce lesions essentially of the primary type characterized by localized caseation without liquefaction or cavitation, but possibly more extensive and, as some degree of immunity has been acquired, with more evident localizing fibrosis. The type 3 case probably illustrates this kind of lesion.

Summary

The characteristics of pulmonary tuberculosis in the African have been discussed, and certain conclusions suggested regarding the course of this disease, in the light of Mantoux tests carried out on 229 subjects, a search for latent and healed tuberculous foci in 90 consecutive routine necropsies, and an analysis of the clinical and post-mortem findings in 36 consecutive cases of tuberculosis showing pulmonary lesions.

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REFERENCE

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The Twenty-sixth Report of the Investigation of Atmospheric Pollution covering the five years ended March 31, 1944, has recently been issued by the Department of Scientific and Industrial Research (London: H.M.S.O. Price 2s. 6d.). During the war the restrictions on emitting pollution were partly relaxed, and for a period industrial concerns were encouraged to make smoke for camouflage purposes. Despite this, the records of this nation-wide investigation show no appreciable increase of smoke in the air of the country as a whole, though an increase in the deposition of ash has been observed. The main reason for local improvements in atmospheric pollution was fuel economy. In rural areas the effect of ploughing grassland and of intensive cultivation was to increase the tendency for wind-blown dust to be collected in deposit gauges. The invisible pollution of the atmosphere by sulphur gases is almost directly proportional to the quantity of coal burned, irrespective of the size or type of the combustion appliance used, and from the summer of 1940 onwards the rapid increase in the consumption of coal due to great industrial activity caused an inevitable rise in sulphur dioxide pollution.

MYOIDEMA

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Myoidema was first described in 1830 by Robert Graves and William Stokes, of Dublin. When they percussed the chest they noticed that "a number of little tumours appeared answering exactly to the number and situation of the points of the fingers." They did not regard the phenomenon as peculiar to pulmonary tuberculosis. Cornet (1899), Denny-Brown and Pennybacker (1938), and Smart *et al.* (1948) mistakenly credit Schiff (1858) with priority in its discovery. Schiff made an elaborate physiological investigation of its occurrence in the lower animals. He described how "a localized knot of contraction immediately forms at the site of percussion and a series of small waves of contraction leave the knot on either side and travel to the ends of the muscle fibres, sometimes being reflected back again."

Tait (1872), a Birmingham surgeon who was presumably unfamiliar with Schiff's work, coined the word "myoidema." He separated the condition into two distinct components—the instantaneous formation of a sulcus, and the "nodule or intumescence of Stokes." He used the term for the nodular variety only, which he regarded as a significant sign of pulmonary tuberculosis. The sulcus formation, he said, may be "frequently met with in health." He agreed with the finding of Stokes that myoidema was more pronounced in the pectorals on the diseased side in unilateral pulmonary tuberculosis. Broadbent (1934) extended this observation further by pointing out that if both lungs were involved myoidema was more readily obtained on the more diseased side. In 12 cases of lung tuberculosis in our hospital, of which six were radiologically unilateral, we found myoidema to be equally marked in pectorals and biceps on the two sides.

West (1879) regarded the sign of little value in the diagnosis of any one disease, as it frequently occurred in a wide variety of conditions, and might be physiological. He thought the two kinds of contraction—the nodular and the fascicular—need not necessarily be associated, and that the term "myoidema" was not accurate as there was no oedema at all. He also pointed out the importance of subcutaneous fat in the production of the sign. The findings of Labbé (1881), Klippel (1903), Jeanselme and Lermoyez (1885), Curschmann (1905), Shively (1905), and Langley and Hashimoto (1918–19) supported West in showing the sign to be non-specific.

Féré and Papin (1901) drew attention to the presence of myoidema in the muscles of fatigued cyclists, of epileptics following a fit, and in muscles undergoing atrophy in general illnesses, general paralysis, and mental deficiency. They concluded that myoidema was a sign of muscular fatigue from any cause. Ebbecke (1935) considered the swelling of myoidema to be similar in nature to cathodal swelling. Debenedetti (1930) believed that myoidema ceased to appear when the individual put on weight, and suggested that this finding may be of prognostic importance in pulmonary tuberculosis.

Most of the English textbooks do not distinguish the two distinct components of muscular irritability, and the local lump (termed variously knot, ridging, nodule, intumescence, or nodular contraction) for which the word