South African Medical Journal : Suid-Afrikaanse Tydskrif vir Geneeskunde

Cape Town, 15 June 1963 Volume 37 No. 24 Deel 37 Kaapstad, 15 Junie 1963

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PULMONARY ASBESTOSIS

Of all the pneumoconioses or dust diseases, asbestosis would appear to be the most serious from many points of view. It can follow a relatively short exposure—months instead of years as in silicosis—and while the morbidity rate, as determined by radiological means, has been much reduced by measures to lessen the inhalation of asbestos dust in factories, it can still be very high—44·5% in asbestos workers with 20 or more years' exposure and 28% in those with 10 - 15 years' exposure.[1]

The reduction in frequency of pulmonary tuberculosis in the post-war era, and the equally striking increase in lung cancer in most countries, makes it difficult to assess the increased liability of present-day sufferers from asbestosis to these two complications. Clearly the data obtained 20 or more years ago have little validity now, while bronchial carcinoma has such a range of frequency in different countries that conclusions based on world averages are hardly acceptable. In the case of pulmonary tuberculosis, the British figure for the association of this disease with fatal cases of asbestosis in the years 1932 - 39 was 35·5%, while in the same period the figure was 57·1% in fatal cases of silicosis.[2] But in one part of Germany, Meissen, more recent findings published in 1960 show that tuberculosis as a complication of silicosis was still very significant—34·6%—while the association with asbestosis was only 4%, little more than twice the tuberculosis figure for the whole population in that region.[3]

The lung-cancer rate in silicosis is not appreciably higher than in the general population, but in asbestosis its frequency is estimated to be about ten times that of similar age groups, both in Britain[4] and in Germany.[3]

In recent years the matter has been extended by the tardy acceptance by most pathologists of malignant mesothelioma as an entity, and the even more tardy appreciation that mesothelioma of the pleura may be associated with asbestosis.[3,5-7]

In occupations where pneumoconiosis of mineral origin is a hazard, those affected are normally the miners and occasionally the workers handling the material in bulk. Thereafter there is no danger as a rule to those who deal with the manufactured goods containing the raw material concerned. With asbestos it is otherwise. In Canada, where almost three-quarters of the world's production of asbestos is mined, the miners would appear to suffer little asbestosis and show no significantly increased cancer of the lung,[8] but in South Africa at least, the miners, and even those living in the vicinity of the mines, may develop asbestosis and pleural mesothelioma.[7,9]

Most cases of asbestosis, however, result not from mining, but from employment in asbestos factories. Today asbestos is used in so many industries and is a constituent of so many manufactured goods that the occupations where asbestos is a potential hazard are too many to enumerate here. Workers at risk include such unlikely ones as the garage worker employed in under-body car spraying,[10] and more obvious ones such as those employed in lagging pipes with asbestos, or those concerned with the manufacture of asbestos cement, roof and floor tiles, ceiling boards, etc., or with the use of them, such as builders and builders' labourers.

While the modern use of asbestos expands the field of potential inhalers of asbestos fibres, the risk of asbestosis is limited, and it is unlikely that these occupations will lead to a marked increase in pulmonary asbestosis. The effect of the inhalation of a small quantity of asbestos fibres, insufficient to produce pulmonary asbestosis, but possible in many of the occupations indicated, has been put on quite a different footing by two recent papers by Thomson and his colleagues in this *Journal*.[11,12] In the first paper[11] Thomson described 6 cases of mesothelioma, pleural and peritoneal, where there was no diffuse pulmonary asbestosis of the ordinary type, but only a few small foci of asbestosis at the bases of the lower lobes. It was stressed that this limited basal asbestosis produced no signs or symptoms and was likely to be overlooked at autopsy, unless sections from the lung bases were examined microscopically. In only one of these cases was there a history of exposure to asbestos.

This paper was followed by what appears to be the first investigation into the extent to which urban dwellers are exposed to the inhalation of asbestos fibres. Thomson *et al.*[12] examined the bases of lungs for asbestos bodies by a simple smear technique, and found that more than a quarter of the subjects over the age of 15 years in the autopsy services of the Groote Schuur Hospital, Cape Town, showed asbestos bodies, supporting their contention that the inhalation of asbestos fibres was now an urban hazard. They did not find that it was a significant hazard today, and were more concerned with what might happen in the future. They emphasized that the world's production of asbestos is increasing at a staggering rate, and is now eight times what it was 35 years ago, and that today asbestos-containing products are ubiquitous, especially in urban areas.

Thomson *et al.*[12] also drew attention to a simple but important fact which seems to have been overlooked so far from the medical and public health points of view. This is that the very reason for the use of asbestos in industry—its resistance to heat, acid, alkali, oxidation and reduction; in fact, its virtual indestructibility—is the reason why it may become progressively more dangerous to man. Wind and water may disperse asbestos fibres, but they cannot destroy them. Asbestos is now accumulating on the surface of the earth, mainly in the cities, at the rate of 2,400,000 long tons per annum; motor vehicles are discharging asbestos dust from brake drums, clutches, silencers and under-body coatings, and modern buildings may contain asbestos products from the roof to the basement. The indestructibility of asbestos makes this to some extent cumulative, and in effect we may be creating such

an asbestos environment in cities that in the future basal asbestosis may become almost universal in urban dwellers and mesothelioma of the pleura and peritoneum may become common tumours.[12]

These observations and opinions are new and we await confirmation of these findings from other countries; they may well be confirmed as regards the frequency of asbestos bodies in the lungs of urban dwellers. It would seem a hard turn of fate that the avoidance of ordinary pulmonary asbestosis might lead to an increased frequency of mesothelioma of the pleura or peritoneum, presumably because the patient lives longer and the carcinogenic action of asbestos has a longer time to act. We hope the fears for the future expressed by Thomson *et al.*[12] are unjustified, but it may be desirable to pay heed to their warnings, at least to the extent of restricting some unnecessary and possibly dangerous uses of asbestos.

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11. Thomson, J. G. (1962): S. Afr. Med. J., **36**, 759.
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BAKTERIËLE GENETIKA

Daar was 'n tyd toe dit aanvaar was dat die klassieke genetiese wette en beginsels nie op mikro-organismes, en veral bakterieë, van toepassing was nie. Bakterieë reproduseer vegetatief en hul mikroskopiese grootte het hulle ongeskik vir sitologiese studies gemaak. Vir baie jare was dit aanvaar dat daar fundamentele verskille, beide geneties en fisiologies, tussen hoër diere en mikro-organismes bestaan en dat die wette wat op die een van toepassing is, nie vir die ander geld nie. Maar, gesien in die lig van die moderne fundamentele eenvormigheid tussen alle biologiese wetenskappe, is dit duidelik dat hierdie opvatting verkeerd was. Gemeenskaplike grond is gevind deur die intensiewe studie van bakteriële genetika wat slegs in die laaste twee dekades op die voorgrond getree het. Vandag is hierdie vak die brandpunt van die biologiese wetenskappe en het al selfs sovér gevorder dat dit amper die tergende vraag „wat is lewe?", kan verklaar.

Jacob en Wollman[1] verdeel die historiese ontwikkeling van bakteriële genetika in sekere tydvakke: Gedurende die laaste helfte van die 19de eeu is mikrobiologie as eksperimentele wetenskap ingestel en aandag is hoofsaaklik bestee aan die isolasie en morfologiese beskrywing van nuwe spesies. Van 1900 tot 1940 is 'n groot aantal variasies van bakterieë geïdentifiseer, bestudeer en beskrywe, en hieruit is die vak bakteriële genetika gebore. In die laaste tydvak, beginnende 1940, word bakteriële oorerwing ontleed en gekoördineer in die lig van die klassieke genetiese teorieë. Klassieke genetika ontleed die aard van komplekse, dikwels nie-essensiële, eienskappe. In teenstelling daarmee analiseer bakteriële genetika op die molekulêre vlak en gee 'n beter begrip van basiese sellulêre meganismes. Ook dien dit as 'n handige instrument waarmee die struktuur en funksie van biologiese sisteme bepaal kan word. Treffende bewys, dat daar 'n chemiese basis vir oorerwing bestaan, is gelewer toe 'n bakteriële eienskap omvorm is deur desoksieribonukleïensuur (D.N.S.), wat uit 'n pneumokokkale mutant[2] berei is. Soortgelyke ingrypende waarnemings is in die afgelope 20 jaar met bakterië gedoen waarvoor verskeie faktore verantwoordelik is. Om slegs 'n paar te noem: Bakterië kan, weens hulle ongeëwenaarde voortplantingsnelheid in 'n kort tyd tot enorme getalle aangroei. Die bakteriële sel se oorerwingsfaktore is vasgelê deur 'n enkele liniêre struktuur, die bakteriële chromosoom, bestaande uit D.N.S. wat die makromolekulêre patroon van die bakterium beheer. Bakterië se genetiese materiaal is relatief onstabiel. Mutasies kom spontaan voor in 'n gegewe gene in een uit elke honderd miljoen sel-verdelings. Eksperimentele metodes in bakteriële genetika tref deur hul eenvoud, akkuraatheid en berekenbaarheid waarmee analiese uitgevoer kan word.

Die fundamentele probleme van genetika het hierdeur binne die bestek van die nie-genetikus geval. Van die merkwaardigste bydraes op hierdie gebied is inderdaad gemaak deur fisici en biochemici. In 1953 beskrywe Watson en Crick,[3] Nobelpryswenners van 1962, die struktuur van D.N.S., gebaseer op chemiese analiese en kristallografiese studies, wat allerweë as 'n biochemiese triomf aanvaar is. Hiervolgens sou D.N.S. bestaan uit twee polinukleotied-kettings wat spiraalsgewyse rondom 'n sentrale as gedraai is. Die ruggraat van elke spiraal bestaan uit fosfodiester-bande. Die basisse, op 'n gegewe vlak van die een ketting, word met behulp van waterstofbande gebind aan basisse op die ooreenstemmende vlak van die ander ketting. Waterstofbindings kan, weens strukturele redes, net plaasvind tussen die basis-pare adenien-timien en guaniensitosien sodat die een ketting dan die spieëlbeeld van die ander is. Dit is verbasend watter belangrike biologiese gevolgtrekkinge van hierdie model gemaak kan word: Dit lewer bewys van D.N.S. se molekulêre replikasie; die aaneenlopende liniêre volgorde van basis-pare gee aanleiding tot 'n bepaalde genetiese kode en spesifisiteit, terwyl dit ook 'n verklaring vir mutasies aan die hand gee. Hierdie model dien verder as voorbeeld van 'n nuwe studierigting, naamlik *molekulêre biologie*, wat daargestel is hoofsaaklik deur die toedoen van bakteriële en virus-genetika. Hoe ver ons reeds vandag gevorder het van die klassieke sitologie blyk uit die feit dat as die genetika van dierlike somatiese selle op hierdie grondslag ontwikkel moet word, dit dan 'n direkte uitvloeisel van bakteriële en virus-genetika is, wat weer op hulle beurt hulle ontstaan aan weefselkulture te danke het.

Die sentrale posisie wat atoomfisika vandag in die fisiese wetenskappe beklee, kan ons vergelyk met molekulêre biologie in die biologiese wetenskappe. Vandag se teorie is die praktyk van môre. In hoeverre bakteriële genetika die natuurwette gaan beïnvloed, hang af van die sukses waarmee die teorieë, wat sodanig verkry is, op ander biologiese sisteme toegepas kan word.

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