BACKGROUND TO BYSSINOSIS IN ULSTER*

BY

JAMES A. SMILEY

From Queen's University, Belfast

(RECEIVED FOR PUBLICATION MAY 11, 1960)

The spinning and weaving of flax have been carried on as domestic arts all over Ireland for many centuries. In the late 18th century more efficient methods were introduced into the British Isles by refugee Huguenots. For historical, economic, and ecological reasons the manufacture of linen became concentrated in Ulster. There is no evidence of a respiratory hazard until mechanization of the processes took place.

Ramazzini (1705) described a severe respiratory affection amongst scutchers and hacklers aggregated for work in enclosed spaces. In 1831 Thackrah and Jesse Leach (1863) described similar cases occurring in Leeds and Heywood, and in 1860 Greenhow noted the enormous increase in the mortality from respiratory disease following the introduction of linen manufacture to the Pateley Bridge area of Yorkshire. He recognized also the Monday exacerbation. In 1856 Malcolm in Belfast suggested, in a statistical study, that the incidence of respiratory disease was directly related to the dustiness of the occupation and in a series of papers from 1873 onwards Purdon (C. D.) and a number of other Ulster doctors described the syndrome.

It is my view that, although the incidence of the disease has markedly decreased, cases still occur and that clinically these are indistinguishable from byssinosis in the cotton trade. Recent observations on byssinosis in Ulster, with some typical case histories, provide the evidence for this view.

The invitation to give the Scott-Heron Lecture has given me much pleasure because I regard it not only as a personal honour but also as a compliment to that growing group of doctors (of whom I am one) whose main concern is with the problems affecting the health of men and women in their working environment. The fragmentation of medicine into an increasing number of specialties is perhaps the inevitable consequence of the advances which have been made in technology in the 20th century. Francis Hugh Scott whose bequest led to the establishment of this lecture would probably have deplored it. He was a general practitioner, born in 1865 and bred in the county of Down. He practised for 50 years in Saintfield amongst people whom he knew and loved. Their traditions he cherished, the habits and the customs of the countryside were an open book to him, seed time and harvest meant as much to him as to them, and when the crises of life and death were at hand he was at their side as a friend. He was held not only in great affection by them but in great respect; he was a

good doctor. His undergraduate career was distinguished for he won, not only the Malcolm Exhibition but, in the winter session of 1890-91, the medal of the Belfast Hospital for Sick Children for distinguished answering on the diseases of infancy and childhood. His mother Caroline Scott, a daughter of Major Francis Heron of Killyleagh, was the great formative influence in his life and her memory is perpetuated in these lectures.

The History of Byssinosis

When first invited to give this lecture I planned to introduce the subject with some remarks on the beauty, the durability, the antiquity, and indeed some of the religious significance which surrounds the fabric "linen". I had hoped to refer to the huge output, probably by slave labour, in ancient Egypt; to the trade in the material across the Mediterranean Sea, to the introduction of flax to Britain by the Romans, to the encouragement of its culture in Ireland by the Brehon laws. Then we might have looked at the first definite reference early in the 13th century to a trade in linen in this country when it was said to be flourishing apparently in association

* The Scott-Heron Lecture delivered at the Royal Victoria Hospital, Belfast, on March 3, 1960.

with the abbeys of Bangor, Newtownards, and Armagh. As a matter of interest we could have considered the contribution of Strafford in Tudor times, his own private and unsuccessful venture into the trade, his suppression of piracy which was probably his chief contribution to trade in general and which, a generation later, led to the flight of more than 50,000 refugees from the Continent to these islands from France. It seemed for a moment that in this World Refugee Year one might well have loitered to consider in retrospect what we in Ulster owe to the Huguenot refugees and how it came about that although these foreigners, the majority of whom were acquainted with the arts of spinning and weaving, settled all over these islands, it was mainly in Ulster that the linen trade took root and developed. I would have liked to have examined the historical and economic causes which had this result; the nature of the crop, the terrain, the climate, the system of land tenure, the plantation of Ulster by the dour Presbyterian Scots, and then to have made a reference to William, Prince of Orange, who in 1698 invited a personal friend Louis Crommelin, a member of a wealthy Picardy family in the linen trade (another refugee), to become overseer of the Royal Linen Manufacture in Ireland.

For centuries the spinning and weaving of linen was a domestic industry and remained so until quite late in the 19th century. Indeed weaving as a cottage industry lingered on in a few areas until the First World War.

On some other occasion one might dwell on the romantic history of linen during the late 18th and 19th centuries, on the story of the Linen Board and the squabbles which ended it, of the drapers who travelled together from town to town to buy brown linen, in company, because of the disturbed state of the country and because of the large sums of money they carried; of the social consequences, the balls and the parties in the provincial towns, the erection of Linen Halls, the bargaining which went on between the weavers who brought their webs to market just as they brought their eggs and butter, the growth of the bleach greens, and the inevitable concentration of capital in the hands of the drapers which made the later industrialization of the whole linen trade possible, the theft of linen from the greens, the anecdotes connected with such exploits of thieving, the smuggling of stolen linen to the Isle of Man and elsewhere, the measures taken to stamp out all "these iniquities" and the reluctance of juries to bring in a verdict of "guilty" because the sentence meant transportation for life. One could, perhaps, with profit, examine the industrial unrest which was with us even in those days and its mani-

festations in strikes or "turn outs" as the weavers called them, not infrequently resulting in riots. In 1762 for example the weavers in and around Lisburn rose in revolt, formed riotous mobs, destroyed property, and defied Parliament because they resented the introduction of a Bill concerning the inspection of brown linen. It is reported (Irish Linen Trade Hand Book and Directory, 1876), however, that they "quickly came to a state of repentance for the acts of folly and wickedness committed" and they presented an address to the Irish Linen Board: "May it please your Honours, we should have been amongst the first to express our sincerest gratitude and thankfulness for the happy regulations you have made in our trade, had not grief and shame for the late enormities committed in and about this place withheld us from presuming to lift up our faces before you and the public". Here is a vein of our social history which remains to be worked out. For a period of about 40 years from 1784 until about 1828, when Mulholland's Mill in York Street was burned down, the main industry in Belfast was not the manufacture of linen but of cotton. It is virtually certain that conditions in the trade in those days were such that it seems inevitable that cases of byssinosis must have been frequent. In spite of that fact, although Ireland, its politics, its trade, and its agriculture was at that time under the almost continuous scrutiny of Government Commissions and committees, and a long stream of observant visitors from both England and the Continent, who amongst other things did comment on the health of the people, no remark seems to have been made of respiratory disorders amongst textile workers. Later in the century W. M. Thackeray (1843), who seems to have had an eye for a pretty girl, visited a spinning mill on a visit to Belfast and commented on the plumpness and rosy complexions of the girls he saw there. It must be remembered, however, that the Industrial Revolution had scarcely touched Ireland by the time it was reaching its crescendo in Lancashire, for the low wages paid to hand spinners made mechanization hardly worth while.

The first mention of the disease now known as byssinosis in an official document appears to have been made by E. H. Greenhow (1860). In 1863 Jesse Leach, certifying factory surgeon at Heywood, Lancashire, described the symptoms of the malady. "Mixers", he stated, "suffered from sneezing and coughing with much slaty expectoration, which was shown by the microscope to contain very fine short cotton fibres; their arms and hands were often affected with urticaria-like rashes". Similar symptoms were described in scutchers. Strippers and grinders were stated mostly to suffer from spasmodic

cough, bloody expectoration, asthma, and oppression of the chest. But 30 years earlier in 1831 Charles Turner Thackrah, the father of Industrial Medicine in this country, who lived in Leeds, then the thriving centre of a considerable linen trade, had recognized the malady: "Dressers of flax and persons in the dusty rooms of the mills, are generally unhealthy: The early stage of the malady which attacks flax men varies from that of ordinary bronchitis. The cough and difficulty of breathing are not so temporary: one precedes the other sometimes by months, more frequently by years. The cough is harsh; its invasion is generally confined to the morning and evening—and more to the latter than the former. In the early stage there is no mucous, pituitous or puriform expectoration and little even for years of cough". Thackrah then gave minute clinical details of 14 cases and incidentally commented on the diminution of the number of cases of drunkenness, attributing this result to a reduction in the wages of flax men. He noticed too that the air was exhaled at an effort even at the age of 18 but said explicitly that "The younger operatives, who are generally of the age of 7 to 12 were not examined". He continued: "The process of hackling flax is generally the most injurious to health. A large proportion of men in this department are young. Very few can bear it for 30 years and not one instance could we find of any individual who had been forty years either in this or any of the dusty rooms. There are indeed comparatively few old persons in any departments of the flax mills. On inquiry last year at one of the largest establishments in this neighbourhood, we found that of 1,079 operatives, the majority were children, but a considerable portion adults, there were only nine persons who had attained the age of 50; and besides these, only 22 who have reached even 40".

One of the things which impressed me most in reading through the writings of our 19th century predecessors in medicine and indeed their ancestors, is their readiness to prescribe practical measures affecting not only their patients but the environment in which they lived and worked. There was no distinction between clinical medicine and social medicine. It was all *Medicine*. Thackrah was no exception and his plan for creating a current of air directed downwards to a channel in the floor anticipated, in principle, the best of modern ventilation practice. But even Thackrah was anticipated. Ramazzini (1705) wrote: "... those who hackel the flax and hemp to prepare it for being spun and wove, afford frequent instances of the unwholesomeness of their trade; for there flies out of this matter a foul mischievous powder, that entering the lungs by the mouth and throat, causes continual coughs

and gradually makes way for an asthma. The *hemp-combers* and hacklers are wont to come in great companies from the adjacent borders of France to Lombardy about the beginning of winter: for the people of our country are not so well versed in that part of the manufacture. Now we always observe, that that sort of people are daubed over with hemp dust, pale faced, subject to coughs, asthma and bleary eyed. The winter being the season allotted for that work, they are obliged to work in close places, and considering that the hemp is very greasy and oily, upon that occasion they cannot but take it in at the mouth of these foul particles that pollute the spirits and stuff up the organs of respiration. Add to all this, that the hemp and flax being steeped in stagnating and putrid water and daubed over with clay to promote its readier maceration under water, the particles thus imbibed cannot but be virulent and open enemies to human nature. These work people complain that they suffer more in hackling flax than in hemp; and that perhaps, because of the powder or dust of the former is subtler and so making a smarter irruption into the organs of respiration, provokes them more sensibly to throw off the clog that galls them".

Ramazzini concluded "But at the long run if they find their affliction grows upon them they must look out for another trade; for 'tis a sordid profit that's accompanied with the destruction of Health".

In the latter half of the 19th century in Ulster there appears to have been an awareness not only amongst a group of doctors but also in the linen trade itself and beyond, that there was a severe respiratory hazard in all the dusty processes concerned with the manufacture of linen. Hamilton (1873), Medical Officer of the Cookstown Workhouse Hospital, after stating that he had the supervision of some 30 scutch mills and commenting on the very high rates of both fatal and serious non-fatal accidents in them, recorded: "These scutch mills being often mere hovels, with low roofs and very bad ventilation, were it not for the usual six months cessation between each season's crop of flax, the injury to the workers constitution would be very trying indeed; but getting work in the spring in the open fields helps to restore them. Chronic bronchitis, often ending in phthisis or asthma, frequently ends the days of the scutcher, his place always supplied by stout agricultural boys who in a year or two, show signs of the unhealthy trade by heaving chest and short breathing".

In the same year Newett of Ligonell (Newett, 1873) in an "Address to Millworkers" said "That employment in Flax Mills tends to bring about consumption and other diseases of the chest, does

not admit of doubt". So well was the risk recognized, he said, that the Army Surgeons forbade recruiting sergeants to enlist flax dressers to the Army.

In the absence of the diagnostic aids which are now available there may often have been a confusion between the various types of chronic pulmonary disease, tubercular and non-tubercular. A careful study of the investigations of two Belfast doctors disposes of any doubt, for the symptomatology and the epidemiology described by Purdon in numerous papers and by Malcolm (1856) are not those of tuberculosis. After describing in detail the various processes of hackling, preparing, carding, roving, spinning, and doffing, Malcolm remarked on the relative dustiness of the various departments and came to the conclusion that the smallest particles of dust were the most dangerous.

With the advantage of instrumentation for dust sampling and dust measurement Roach and Schilling (1960) confirmed this view. Their most recent work suggests that although the dangerous cotton particles are microscopic in size they are of the order of 7μ and larger, an important point in relation not only to the aetiology and pathogenesis but to the engineering problem of control.

Malcolm compared factory workers with non-factory workers drawn from the same social class and he emphasized the point. He showed in tabular form that amongst the preparers, the incidence of diseases of the chest amounted to 12.2%, in spinners 4.1%, in reelers, a relatively non-dusty process, 0.9%, and in weavers, another fairly clean occupation, 1%. He claimed that the more dusty the process, the greater the incidence of respiratory disorder.

In the returns from the six dispensary districts of Belfast from 1852 to 1855 there were 2,503 mill workers, 394 males and 2,109 females. The percentage with disease of the chest amongst these amounted to 18.7% compared with 6% amongst the total 35,039 attending the dispensaries during the same period. There were only 65 hacklers, 21 of whom had "pulmonary affections, though not of phthisis; pulmonary disease, generally bronchitis, is *par excellence* the hackler's malady" (Malcolm, 1856).

When this paper was read Charles Delacherois Purdon was 36 but it was not until another 20 years had elapsed that there began to issue from his pen a series of papers and reports describing the ravages wrought on workers by the inhalation of flax dust. The leaders of the industry were concerned by what they learned and helped Purdon in his inquiries, with the apparent result that the incidence of the disease was so reduced that, as Logan (1959) pointed

out, the leading physicians in Belfast at the end of the century barely mentioned it in their works.

Purdon (1877) wrote: "The different processes that flax has to go through before it is made ready for clothing our person or adorning our houses causes certain diseases in those that are employed in its manufacture, but one of the most injurious and in certain branches very fatal is the effect induced by the inhaling of flax dust, called by the workers 'pouce' which is produced when the fibre is cleansed by machinery from the decayed wood and earth that adhered to it in the steeping pools. This is largely given off in the Scutch Mills where it is inhaled by the scutchers and those employed at the rollers through which the straw is passed . . . not so with flax dressers (roughers and sorters) who are constantly inhaling the dust . . . The injurious effect that this inhalation of pouce produces on the lungs begins to manifest itself oftentimes in a few months, but more frequently in a few years . . . the worker seizes any article that he may be near in order to enable him to get over the attacks more easily—in which case he is said to be 'poucy'."

Purdon (1875) stated "a class to which I would draw especial attention is the carders whose life averages 45.7 years and the average length of time employed as such is only 16.8 years. I may mention that if a girl gets a card at 18 years, her life is generally terminated at 30 years. The next class that suffers greatly from the effects of the Pouce is the Preparers and the average time that they work is 28.7 years and the longest time any have been employed in the department is 48 years. With regard to weavers, winders and reelers, I may say that when workers that are employed in the unhealthy departments begin to feel that they are suffering from affections brought on by their employment in the same, they at once select (if they can) the healthier processes, begin to learn them, but the chest disease has already made too much progress and their lives are only prolonged for a short time. The departments generally selected are the Weaving, Winding and Reeling."

This group of 19th century physicians recognized little more than a respiratory hazard which was similar to bronchitis if not actually bronchitis, though they also mentioned asthmatic episodes. They recognized too that the more dusty the process the greater the risk, and indeed Malcolm was precise in identifying the smallest dust particles as being the most dangerous. There is little evidence that any of them recognized what we now believe to be the most characteristic feature of the disease namely the Monday exacerbation. True, Purdon (1875) did say "The spinners suffer from oedema of the legs and ankles, also from varicose veins, and on each

Monday morning after being in for a short time many of them become so faint and giddy that they are obliged to go out into the lobbies in order to recover themselves", though why varicose veins and oedema of the ankles should cause more acute symptoms on a Monday morning is not quite clear.

Greenhow (1860) produced a monumental report for the Privy Council which was presented to both Houses of Parliament and to which in subsequent reports he added much fresh data. It was he who first described in detail the disease in the cotton trade which we now know as byssinosis. The name *Byssinosis* was first used by Oliver (1908). It is derived from the Greek word "bussos" meaning "fine linen"; there was no classical Greek word for "cotton". Greenhow, although he visited Ireland, examined only the mortality rates for respiratory diseases in different districts of England. He visited Pateley Bridge in Yorkshire and after noting the enormous increase in the mortality from respiratory disease since linen manufacture came to the area, Greenhow continued "The effects of exposure to the dust of flax are manifest on the mucous membranes. The stomach is very apt to become deranged by the dust swallowed, and hence flax operatives more particularly hacklers often suffer from dyspepsia and are sallow and look sickly; the eyes often become sore, the margins of the eyelids being swollen and inflamed and the sight is said occasionally to become impaired. But the most serious effect is produced on the mucous membrane of the air passages; oppression of the chest, followed by dyspnoea, cough and eventually expectoration are ordinary results of inhaling air charged with the dust of flax. It is remarkable that dyspnoea sometimes of an asthmatic character often long precedes the accession of cough and expectoration or perhaps more properly speaking the cough and expectoration are in the beginning too slight to attract the notice of the sufferer, whilst the dyspnoea reminds him of its presence whenever he attempts brisk locomotion.

. . . Many of the flax operatives forsake the occupation at an early age on account of the injurious influence it exercises over the health but though this is true, the injury to health is commonly very gradual and constant discomfort and serious disease only become established towards middle life, men employed in any dusty department of the manufacture rarely attaining the age of 45-50 without suffering more or less severely from bronchial disease. So completely aware are the masters of the injurious nature of this occupation that some of them have endeavoured to introduce the use of respirators. . . . It was stated that operatives are more affected by the dust at the beginning than at the close of the week and that they always suffer

more on resuming the employment after an interval of cessation. . . . As life advances, the power of resisting the pernicious influence of their occupation diminishes and more or less permanent dyspnoea and other results of bronchial irritation, supervene."

Greenhow was a detached man, as befitted a civil servant and an able observer, and his first report penned 100 years ago is still worth detailed scrutiny. His work on cotton has long been accepted but we are only now beginning to rediscover it and realize its significance. In particular he recognized in flax workers the exacerbation which in the cotton trade is called "Monday fever". (This Monday exacerbation must be distinguished from three other conditions to which the name "Monday fever" is given, *i.e.* the fever and headache of metal fume fever or brassworker's ague, the mill fever which occurs or used to occur in youngsters when they first entered the spinning rooms, usually on a Monday and which lasted a few days, and the Monday headache of which workers with the aliphatic carbon compounds, *e.g.* dynamite and cordite often complain.)

Another observer of the linen trade was Osborn (1894) who pointed out that "workers with 'mechanical phthisis' or 'flax dressers' phthisis' always improve on withdrawing from the work for a period but immediately deteriorate on their return".

He communicated with 16 doctors, nine in Ireland and seven in Scotland, with experience of the linen trade. All of these recognized the hazard though not all believed that dust was the cause; one attributed it to the hot humid conditions, although Malcolm (1856) found that in the humid rooms the incidence was low, and another attributed the disease to the social conditions in which the workers lived. In general, the report of Dr. Alex D'Evelyn of Ballymena (quoted by Osborn, 1894) could be considered typical. He wrote "Hackling is the most deadly process. . . . The hacklers all die young and all suffer from chronic diseases of the lungs caused by the flax dust or 'pouce' as it is locally named. Many of these men succumb to cirrhosis of the liver or to disease of the kidneys but this is partly due to the amount of raw alcohol which they consume. The first thing a hackler does each morning is to drink a glass of raw whiskey to clear out his bronchial tubes otherwise he is unable to breathe. After a day off, the men often told me that their breathing is worse". Arlidge in his *Milroy Lectures* of 1889 and his textbook "Diseases of Occupations" (1892) accepted the evidence and described in similar terms the respiratory hazard to which workers in the early stages of processing flax were then exposed. Sir Thomas Oliver (1902) in his book "Dangerous Trades" included a chapter by H. S. Purdon in which was discussed the high incidence

of what is called "asthmatic bronchitis" in the dustier parts of the trade and commented on the relative absence of the condition in the damp humid spinning rooms.

After the close of the 19th century interest in the condition appears to have waned and as Logan (1959) pointed out there are few, if any, references to it in the literature. Sir Thomas Legge (1934) in his book "Industrial Maladies" said "the same evidence of bronchitis symptoms simulating asthma was forthcoming, from the inhalation of flax dust in scutching mills, in hackling and preparing"; and in her reminiscences, "From One Generation to Another, 1839-1944", Hilda Martindale (1944), who was a Factory Inspector in Ireland from 1905-1912, referred to the prevalence of asthmatic bronchitis in the mills. But it is not improbable that the evidence to which Legge referred was that which I have reviewed above and which was, by 1934, considerably out of date, and Hilda Martindale may have been observing the residuum of cases from a previous generation. Indeed, as I have already indicated, H. S. Purdon in 1902 appeared to be satisfied with the state of affairs then existing.

My interest in this subject dates from 1933 when I entered general practice in Belfast and soon became aware of the large number of women in the practice with chronic bronchitis and emphysema. At that time there was much unemployment in the mills and there appeared to be little that could be done to determine whether or not there was an association between the occupation and the malady, as was alleged. During the Second World War, however, it became increasingly clear that in a mill spinning hemp, to which I was adviser, card room operatives were exposed to a respiratory hazard (Smiley, 1951). At the same time it was obvious that similar cases were occurring in the early stages of processing flax for spinning. In 1947 I recognized the similarity of "pouce" as the Belfast workers continued to call it and "byssinosis" as it was being investigated by Schilling in Lancashire. Later Schilling and Hughes visited Belfast and to each independently were submitted a group of 14 cases of "pouce" in hemp workers, with a similar number of cases of other respiratory disorders, and 12 cases of "pouce" in flax workers and the same number of controls. Each picked out the cases, which they declared to be indistinguishable from byssinosis and the only conflict of opinion between them concerned the category of severity into which two cases might be classified. As a result of this visit Nelson (personal communication) has made an objective measurement of respiratory efficiency amongst card room workers handling hemp and measured the prevalence of symptoms of byssinosis

among the rope workers. This work has not yet been published.

Recent Observations on Byssinosis in Ulster

There appears to be some reluctance in Northern Ireland to accept the fact that under modern conditions cases of byssinosis, due to the inhalation of flax dust, still occur. It certainly seems true that the incidence of the condition has greatly declined since the turn of the century, but we know very little about its epidemiology. It was thought in 1947 that the disease in Lancashire had been almost eliminated. In the six years between 1942 and 1947 only 39 cotton workers out of some 60,000 at risk, were deemed to be disabled by the disease. But the size of the problem had been grossly underrated, "for in 1956 and 1957 when the scheme was expanded to include partially as well as totally disabled men and women, 408 cotton workers were awarded pensions for byssinosis" (Schilling, 1959). A field study of cardiovascular-renal disease in cotton workers with special reference to hypertension had been undertaken by the Department of Occupational Health in Manchester. A completely unexpected finding in the course of this survey was that 66 of the 131 card and blow-room workers complained of tightness of the chest on Mondays; moreover, 15 of those affected were permanently and severely disabled. As a result, a detailed and precise survey was begun in order to ascertain the prevalence of byssinosis. This survey confirmed the chance finding in the earlier one and revealed that 14% of the middle-aged men were in some degree disabled. (In the cotton trade men work at the dusty processes.) The nearer the operatives were to the carding engines, the higher was the prevalence of byssinosis amongst them (Schilling, 1956).

It has been known for a very long time (as I have shown above) that workers in the dusty rooms of flax spinning mills are exposed to a respiratory hazard and, recently, cases have been seen and described, which are clinically indistinguishable from cotton byssinosis. A survey is now needed to determine the prevalence of the condition. My impression is that the incidence of byssinosis in the linen trade is less than in the cotton, for two reasons: first, because of the suppression of dust by wet methods of spinning, and second, because many of the workers in the dusty processes are women. Women tend to be absent from work during their child-bearing period and as they are often not entirely dependent on their own earnings when they do return, they can leave the trade or change their occupation if their health deteriorates. It is probable that, compared with Victorian times, the shorter

working day, the improvement in working conditions, and the smaller number of workers employed in the spinning of flax fibres (as distinct from the man-made fibres) have all contributed to the fall in the number of cases of "poucey chests" seen nowadays. Many questions remain to be answered. What components have flax and cotton dust in common? What is the dangerous element? Is it found in flax dust of every particle size? Must all dust be suppressed or extracted or can the engineers concentrate their efforts on the removal only of dust of a certain range of size? Can the offending agent be neutralized by chemical or other means? Or can the workers exposed to risk be rendered immune? Is the action of dust on the lungs non-specific or a function only of particle size? Is the action perhaps due to contaminants, *i.e.* bacteriological or fungal?

Is byssinosis as rare in cotton mills in Holland and the United States as is often said? If so, why? In America it may be that workers do not remain long enough at the trade to develop the condition but that is not the case in Holland. Are our criteria of diagnosis different or are other factors concerned, such as climate or social environment?

Pharmacological studies are proceeding in this country and in Holland. The results are not yet available, but Bouhuys, Lindell, and Lundin (1960) found evidence that the offending fraction in cotton dust is not histamine as was once thought, but a substance which is capable of releasing histamine. They have also shown experimentally that inhalation of an extract of cotton dust can cause a delay in the clearance of nitrogen from the lungs during oxygen breathing.

The effect on medical students of inhaling cotton dust has produced interesting and occasionally alarming results which are being studied and two other investigations which may prove to be relevant are designed. The first should show the effect of breathing for a prolonged period an atmosphere laden with an inert dust such as calcium carbonate. The second is a comparison of the ventilatory capacity of coal-miners exposed to heavy concentrations of coal dust, who suffer no fall in ventilatory capacity during the course of a working shift, and mill workers exposed to cotton dust who do (McKerrow, McDermott, Gilson, and Schilling, 1958).

Clinical Observations and Typical Case Histories

Both men and women are affected and in those affected the condition is usually well established by the time complaint is made between the ages of 45 and 55. Cases occur outside these age limits. Commonly at the

onset the worker complains of "tightness of the chest" on resuming work after the summer holidays.

Case 1.—A hackler aged 37 played in a flute band as his hobby. On the day he returned to work after the holidays he felt "stuffed up" but attributed this in his own phrase to "the unusage". He felt tired at the end of the day and did not go to band practice on Monday evening. He was "chivied" by the bandmaster for his non-attendance and promised to attend on the following Monday. During the week he noticed nothing unusual. Shortly after returning to work the following Monday morning he again noticed the tightness of his chest and felt tired all day. After his evening meal he felt better and went to his band practice, but left early because the effort was too much for him. On Tuesday and the succeeding days of the week he worked as usual but thereafter on Mondays the "pouce got him" as he explained. He could play the flute on Saturdays but the effort was too much for him on Monday evenings. The following year he had to give up playing for he was not allowed to play on Saturdays if he did not attend the practices on Mondays.

Case 2.—A man aged 55 came to the Medical Department to have his finger dressed. As sister dealt with him he banged his chest and said "my oul chest". Inquiry elicited the story that for about seven years he had been short of breath usually on a Monday morning. At first he was better after lunch but later he was "bad all day Monday". Once or twice he stayed at home on Monday but when he returned on Tuesday the condition was, if anything, worse. Of late he had begun to wheeze and although he was free from symptoms at the week-end, he was affected on other days of the week as well as Mondays.

Case 3.—During the course of a pre-employment examination in an engineering works a man applying for a labouring job said that he had been employed for nearly 20 years in the preparing rooms of the flax spinning mills. When asked whether he was subject to colds, bronchitis, or other respiratory conditions he had said "No". In discussing his interests and hobbies, however, he said that he had given up attending his Lodge some years previously, because the meetings were held on Monday nights and he felt so tired on Mondays that he fell asleep by the fire in the evenings. It was only after a few loaded questions that he said that his "chest was always bad" on Mondays. He wanted a job away from the dust because his father had died of a "poucy chest" and he knew he was developing the same condition. He was subsequently employed in the engineering works and has had no further respiratory disability.

Case 4.—A middle-aged man who was employed in a country mill cycled to and from work. His first complaint had been some seven years previously, when on the day he returned to work after the summer holidays he felt great difficulty in breathing and continuing to work. He "soldiered on" feeling "not so bad". Later he noticed that on Mondays he was unable to cycle uphill to his home and he soon got into the habit of

getting his young son to meet him at "quitting time" each Monday, to wheel his bicycle home for him. As time went on the son was required to attend more and more evenings. After his summer holidays the patient had such extreme dyspnoea when he resumed work that he had to give it up. When I saw him some months later he remained seriously disabled. At rest he was symptom-free. He enjoyed fishing but any exertion caused him to wheeze and to cough. He said that he had greatly improved since he had left work. The only set-back he had had was on one morning when he was feeling better and he had visited the mill. When he returned home his chest felt tight and he had what he described as "the owl trouble back".

The women who are affected all give a similar history. Normally they leave their work and go home for lunch. Home is often only a few hundred yards away and they hurry there and back. Some notice that on Mondays they cannot hurry, and on that day they bring a "piece to work". On being asked why they cannot hurry the reply is often to the effect that their chest had been "stuffed up", that they felt their "chest tight", and occasionally wheezed. One woman said that at lunch time and at quitting time on Mondays she took a bus home but on the other days of the week she went on foot. Another said that, although she had been a heavy smoker, since she had returned to work after a lapse of 17 years she had never smoked on Mondays. "It was terrible" she said "I wanted to smoke but I knew I daren't because of my chest". Others are less specific about their earliest symptoms and a not unusual course of events is that for a period of months or years these middle-aged workers feel tired at their work on Mondays, and do not feel inclined to leave their hearth on Monday nights but accept this as part of the ageing process. The pattern of their Mondays imperceptibly changes until eventually they realize that the early part of the week at work is more exhausting than the latter part, that effort brings on wheezing and cough, and that the week-ends and holidays bring relief. The length of exposure to flax dust before this state is reached may be as little as five years but is more usually around 20 years. My impression is that a good many workers reach this stage but that relatively few progress beyond it. They are not seriously disabled so far as their work is concerned; they suffer from discomfort rather than disability. Schilling (1950) stated that in the cotton trade at this stage, bronchitis was not invariably present. My experience confirms that bronchitis is not *constantly* present. There seems, especially in those who progress to a further stage in the disease, a greater tendency to recurring attacks of acute bronchitis which leave no clinical signs except a few scattered rhonchi. Even at this stage a transfer or change of occupation ensures relief. In later work Schilling (1956) showed that a clear distinction could be made between bronchitis and byssinosis on the history alone, particularly in the early stages of the disease.

An important point in the differential diagnosis from asthma should be mentioned here. The asthmatic usually develops his attack immediately

he comes in contact with the allergen. The byssinotic worker usually does not experience his exacerbation until he has been at work for several hours. It looks almost as if the "build up" must reach a critical level before the trigger mechanism causing bronchospasm operates. Preliminary work (McKerrow *et al.*, 1958) has shown that the symptoms cannot be reversed by the use of anti-histaminic drugs. Also, the patient's difficulty in byssinosis is sometimes as much with inspiration as in expiration. This observation requires further elucidation.

If exposure to the hazard continues (and here I speak from experience with hemp as well as flax, for I believe the syndrome of each to be identical), the patients find that his colds are hard to "shake off" or that they settle on his chest and are slow to clear. Attacks of acute bronchitis may recur with increasing frequency, with the production of mucus, mucopurulent, and then purulent sputum, but between the attacks there persists the cough which is sometimes unproductive but often productive of mucus. The sense of constriction of the chest may not be severe and is taken for granted not only at the beginning of, but all through, the week.

If the disease develops further, cough increases with the production of tenacious sputum which is difficult to expel; a paroxysm of coughing often ends with vomiting. Dyspnoea becomes more and more marked. The chest becomes barrel-shaped and fixed in elevation by the accessory muscles of respiration and the full picture of chronic bronchitis and emphysema develops. It is generally believed that such patients are invariably emaciated but that is not my experience. Cases which reach this stage nowadays are much less common than in my early days in practice. There are no characteristic radiological signs at any stage of the disease and it is probable that even today many of these cases are diagnosed as chronic bronchitis with emphysema, as indeed at this stage they are. But the aetiology may be missed. The report of the Departmental Committee on Compensation for Card Room Workers (Home Office, 1939) stated "clinical and industrial histories taken in conjunction with the condition found on physical examination are sufficiently characteristic to enable a properly constituted Medical Board to arrive at a definite conclusion that the disease is industrial in origin". I believe that opinion is still valid and true of the linen industry as of the cotton trade.

Prevention of Byssinosis

Without delay, every available method should be used to *suppress* dust by whatever means are compatible with proper processing, and if these are

inefficient, to extract the dust from the atmosphere as close to its site of origin as possible. In the cotton trade it has been shown that the Shirley pressure point system substantially reduces the dust concentration in cardrooms with beneficial effects on the operatives (McKerrow *et al.*, 1958; Ministry of Labour and National Service, 1957). The adoption of this or a similar system seems to offer at least some hope of a solution of this problem. This, however, is a matter for decision by engineers. As doctors we are concerned with people and with the effects of environment on them. In this connexion there is a final word to be said. Workpeople will not and should not be expected to wear masks, except for short periods and in the presence of imminent risks. The fundamental solution of the dust problem is outside the control of the worker.

The preparation of this lecture has been a pleasant task and I wish to acknowledge the help of those who have made it so. I am especially grateful to my secretary Mrs. S. Stevenson who without complaint typed a number of drafts and helped me to revise and reduce to manageable size a large mass of material, to Miss Webster of the University Library, to Mr. J. W. Vitty of the Linenhall Library, to Mr. A. H. George of the Belfast Art Gallery for slides, to Mr. G. A. E. Roberts, O.B.E., Flax Spinners Association, for the loan of coloured transparencies, and to Mr. Victor Bell for projecting them. Most of all I am indebted to my wife without whose interest and encouragement the work would not have been possible.

REFERENCES

- Arlidge, J. T. (1892). *The Hygiene, Diseases and Mortality of Occupations*. Percival, London.
- Bouhuys, A., Lindell, S.-E., and Lundin, G. (1960). *Brit. med. J.*, 1, 324.
- D'Evelyn, A. (1894). In Osborn, E. H. (1894).
- Greenhow, E. H. (1860). In 3rd Report of Medical Officer of the Privy Council. H.M.S.O., London.
- Hamilton, D. (1873). Communications to Purdon, C. D., quoted by Purdon (1873).
- Home Office (1939). Report of Departmental Committee on Compensation for Card room workers. H.M.S.O., London.
- Irish Linen Trade Hand Book and Directory. (1876).
- Leach, J. (1863). *Lancet*, 2, 648.
- Legge, T. (1934). *Industrial Maladies*, ed. S. A. Henry. Oxford University Press, London.
- Logan, J. S. (1959). *Ulster med. J.*, 28, 164.
- McKerrow, C. B., McDermott, M., Gilson, J. C., and Schilling, R. S. F. (1958). *Brit. J. Industr. Med.*, 15, 75.
- Malcolm, A. G. (1856). *J. statist. Soc.*, 19, 170.
- Martindale, Hilda (1944). *From One Generation to Another 1839-1944*. Allen and Unwin, London.
- Ministry of Labour and National Service (1957). *Dust in Card Rooms*, 3rd Interim Report of Joint Advisory Committee of the Cotton Industries. H.M.S.O., London.
- Newett, R. H. (1873). Address to Mill Workers, Collected Papers, Linenhall Library.
- Oliver, T. (1902). *Dangerous Trades*. Murray, London.
- (1908). *Diseases of Occupations*. Methuen, London.
- Osborn, E. H. (1894). Reports made by direction of the Secretary of State upon the conditions of work in Flax Mills and Linen Factories in the United Kingdom. Parliamentary Papers 94, Vol. 17. C. 7287. H.M.S.O., London.
- Purdon, C. D. (1873). *The Mortality of Flax Mill and Factory Workers as Compared with Other Classes of Community*. Adair, Belfast.
- (1875). *Longevity of Flax Mill and Factory Operatives*. Adair, Belfast.
- (1877). *Sanitary State of Belfast Factory District*. Adair, Belfast.
- Purdon, H. S. (1902). Chapter in *Dangerous Trades*. By T. Oliver (1902).
- Ramazzini, B. (1705). *A Treatise of the Diseases of Tradesmen*. Bell, London.
- Roach, S. A., and Schilling, R. S. F. (1960). *Brit. J. industr. Med.*, 17, 1.
- Schilling, R. S. F. (1950). *Brit. med. Bull.*, 7, 52.
- (1956). *Lancet*, 2, 261.
- (1959). *J. occup. Med.*, 1, 33.
- Smiley, J. A. (1951). *Brit. J. industr. Med.*, 8, 265.
- (1956). *Trans. Ass. industr. med. Offrs*, 5, 103.
- Thackeray, W. M. (1843). *The Irish Sketch-Book*. Chapman and Hall, London.
- Thackrah, C. Turner (1831). *The Effects of Arts, Trades, and Professions, and of Civic States and Habits of Living on Health and Longevity*. Longman, London.