children belonging to larger families reflects, we believe, an inadequate standard of living among at least a proportion of those composing these groups.

Our grateful thanks are due to the teachers, particularly to the heads of the three sections of the school—Mr. J. A. Richardson, Mr. H. S. Jones, and Miss G. Ellis—for their generous co-operation in this investigation with all the extra work it threw upon them. We are indebted to the Medical Officer of Health for Surrey, Dr. J. Ferguson, for permission to carry out the work, to the medical students and others who gave up several days to assist us, and to Dr. W. J. Martin for advice on statistical methods.

REFERENCES

Committee on Haemoglobin Surveys (1945). Med. Res. Cncl. Spec. Rep. Ser. No. 252, p. 125, H.M.S.O., London.
Dobbs, R. H., Mackay, H. M. M., and Bingham, K. (1944). *British Medical Journal*, **2**, 748.
Fullerton, H. W. (1936). Ibid., **2**, 523.
McCance, R. A., Widdowson, E. M., and Verdon-Roe, C. M. (1938). *J. Hyg., Camb.*, **38**, 596.
Mackay, H. M. M., Bingham, K., and Dobbs, R. H. (awaiting publication in *Arch. Dis. Childh.*).
Reid, W. J. S., and Mackintosh, J. M. (1937). *Lancet*, **1**, 43.
Ross, J. R., and Summerfeldt, P. (1936). *Canad. med. Ass. J.*, **34**, 155.
Spence, J. C. (1934). *Investigation into the Health and Nutrition of Certain of the Children of Newcastle-upon-Tyne between the Ages o 1 and 5 years*, Newcastle-upon-Tyne.
Yudkin, J. (1944a). *British Medical Journal*, **2**, 201.
—— (1944b). *Lancet*, **2**, 384.

WEIL'S DISEASE

OCCURRENCE AMONG WORKERS IN WELSH AND SCOTTISH COAL-MINES

BY

T. H. JENKINS, M.B., B.S., B.Sc.

AND

Wm. C. SHARP, M.B., Ch.B., D.P.H.

Regional Mines Medical Officers in Wales and Scotland (Ministry of Fuel and Power)

During recent years numerous articles have been published on Weil's disease (synonyms—spirochaetal jaundice, acute infective jaundice, leptospiral jaundice, spirochaetosis icterohaemorrhagica, and possibly Nanukayami or 7-day fever of Japan, and slime fever of Eastern and Central Europe). The present paper is the result of inquiries conducted during the past few years into its incidence among mine workers in the Scottish and South Wales coalfields. Cases of Weil's disease among miners occurring during the past three years have been followed from mine to home or hospital into convalescence and return to work. During the past year a number of miners suffering from the disease have been treated with penicillin with most promising results. In this paper the incidence and prevention of the disease are dealt with, and the features referred to are mainly those peculiar or of special interest to coal-mining.

From April 1, 1940, infection by *Leptospira icterohaemorrhagiae* has been included, subject to special conditions, in the schedule of industrial diseases under the Workmen's Compensation Act. Since man is usually infected through the medium of water or slime in or from places infested by rats, such as mines, sewers, fish-cleaning premises, piggeries, farm middens, and slaughterhouses, and since infection may also occur from bathing in polluted water, no special process or work was included in the Order. It therefore rests with the worker to show that the disease was contracted in the course of his or her employment.

The disease has varied in name since it was first described. "Weil's disease" and "spirochaetal jaundice" remain in common usage although the Departmental Committee on Industrial Diseases recommended in its Third Report (1936) that these terms should not be used synonymously for infection by *L. icterohaemorrhagiae* on the grounds that the illness may not in all cases be due to infection by that particular organism and that infection may occur without producing jaundice.

The disease is notifiable in Scotland but not in England and Wales. In British coal-mining the main events in chronological order are as follows. 1923: Buchanan and Gullard recognized and established the occurrence of spirochaetal jaundice among East Lothian miners. 1924: Spirochaetal jaundice became notifiable as an infectious disease in Scotland. 1933: Attention of Mines Department first drawn to cases occurring among Welsh coal-miners. 1940: Scheduled as an industrial disease.

Incidence

The following figures and tables show the prominent part played by certain Scottish and Welsh coal-mines in the epidemiology of the disease.

Scotland.—According to the annual returns, the numbers of cases notified since 1924, when the disease became notifiable, are as follows:

1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943	1944
19	52	27	73	33	21	67	22	34	23	32	24	57	41	48	25	25	33	50	45	57

The returns do not indicate the occupational groups affected, nor do they state whether the diagnosis was confirmed. In 1934 Smith (Aberdeen) introduced Schüffner's agglutination test, which is highly specific. The incidence of known confirmed cases among Scottish mine-workers is as follows:

Year	Fatal	Non-fatal	Year	Fatal	Non-fatal
1924	2	–	1942	2	15
1932	–	3	1943	3	3
1934	–	1	1944	1	–
1936–7	7	2	1945	2	–
1938	–	1		22	30
1939–41	5	3			

South Wales.—Gardner* between 1939 and February, 1943, examined 385 sera from patients all over Great Britain suspected of suffering from Weil's disease. Altogether 58 cases gave positive reactions, and 21 of these were from South Wales (Carmarthen 4, Glamorgan 8, and Monmouthshire 3, mainly coal-miners). The following cases have been reported as occurring among mine-workers:

Year	Fatal	Non-fatal	Year	Fatal	Non-fatal
1933–5	1	4	1943	1	4
1937	1	5	1944	2	5
1939	1	2	1945	1	6
1940	–	2		11	36
1941	1	5			
1942	3	3			

In all the cases noted above as occurring after 1935 the diagnosis was confirmed by serological and/or bacteriological examination. There is now a greater awareness of the disease, and since its inclusion in the industrial diseases in 1940 no case is certified unless confirmed by serological examination.

Mine-workers in Scotland and Wales formed a high proportion of the confirmed cases, fatal and non-fatal, occurring each year. These confirmed cases, Gardner states, may represent only a fraction of the infections actually occurring. Jaundice is usually present before the disease is suspected. According to Schüffner, jaundice is present in only 60% of cases. To quote Gardner: "It would be well if doctors dealing with patients exposed to the special risks by occupation or accident would have a serum test done in febrile cases developing headache, muscular pains, conjunctivitis, and intestinal irritation, without waiting for jaundice to develop."

In the table opposite the incidence in mines of known risk is listed together with certain pertinent data for each mine.

In Scotland and South Wales the mines concerned are drifts, levels, or slants, or if pits (i.e. having shafts) there are one or more connexions to slants. Each mine is known to have been infested with rats to varying degrees at the time of occurrence of the disease. The underground workings are wet over long portions, and collections of water (pools) are frequent. Horses or ponies are employed underground in all the Welsh mines concerned and in the two Scottish mines which show the highest incidence of cases. The regulations under the Coal Mines Act require in effect that horse-feed and water should be taken inbye when horses or ponies are employed underground.

All the recorded cases in mines occurred among underground workers except for one surface worker in Scotland who may have paid visits a little way inbye. Cases have occurred in practically all grades of underground employment.

Seasonal Incidence.—The numbers of cases recorded are insufficient for assessing a causal seasonal factor. There may be a slight relationship between the seasonal variation in the

* Bulletin of the Emergency Public Health Laboratory Service, May, 1943.

occurrence of the disease and the breeding of rats. If there is a seasonal influx of rats to mines with the onset of winter it would seem that certain conditions are required before clinically recognizable human infection can ordinarily occur, as most cases of infection appear from spring onwards.

Underground Environment

The mines of known risk are what are commonly called day drifts, slants, or levels, and lead direct from the surface into the mine workings. The actual coal face may be from 800 to 3,000 yards or more inbye. Double partings, or passbyes, are formed at convenient points inbye, and serve as distributing and collecting centres. Horses or ponies bring along the coal-tubs from the working face to the double parting, where a journey, or rake of full tubs, is formed and brought to the surface by rope haulage. Many mines have replaced horse-drawn traffic by subsidiary rope haulages. Stables are generally maintained underground.

Water from the surface, underground streams, or old workings forms scattered pools along the roadways and workings. Gutters or channels are made along the side of the levels or slants, and the water is thus directed to a central sump or reservoir, from which it is pumped to the surface. It is, however, often impossible to prevent shallow pools forming in the depressions and undulations along the mine roadways. Water is thus splashed about the sides of the roadway during the passage of horse-drawn traffic and men. Slime and fungal growths in which the organism has been cultivated are often seen on the roof and timber supports. Water droppings from the roof are frequent. Under very wet conditions the men may wear oilskins and gum-boots but dispense with them in the drier parts of the mine.

Weil's Disease in Mines of Known Risk

Mine	No. of Men Employed		Incidence of Weil's Disease			Type of Access; Depth of Cover (Yards)	Horses		Stables		Surface Environment	Nature of Underground Workings	Rats Infected
	Surface	Underground	Year	Fatal	Non-fatal		Underground	Surface	Underground	Surface			
						Scotland							
1	123	414	1924	2	—	Shaft and slants (160)	No	No	No	No	Cultivated	Wet	Yes
			1940	—	3								
			1942	—	1								
2	43	117	1936	—	1	Slant and airway (86)	,,	,,	,,	,,	,,	Roads wet; faces dry	,,
3	106	380	1936–7	7 (proved) 13 (reported)		Shaft and slant (200)	Yes	,,	Yes	,,	Woodland	Mostly very wet	,,
			1942	2	6								
4	20	120	1933	—	3	Shaft with adit to riverside	,,	,,	,,	,,	Cultivated	Roads damp; faces wet	,,
			1934	—	1								
			1939	—	1								
			1941	—	1								
			1942	—	6								
			1943	1	1								
			1944	—	—								
5	30	130	1939	—	1	Slants (400)	No	,,	No	,,	,,	Wet throughout	,,
			1939–41	4	1								
			1941	—	2								
6	17	45	1938	—	1	Slant (90)	,,	,,	,,	,,	Cultivated orchard	Roads wet; faces dry	,,
7	117	255	1943	1	—	Slant	,,	,,	,,	,,	Mainly grazing	Wet	,,
8	38	465	1943	—	1	Slant and shaft	,,	,,	,,	,,	Grazing	,,	Not examined
			1945	1	1								
9	54	251	1941	1	—	Slant	,,	,,	,,	,,	Moorland	,,	Yes
10	80	290	1943	1	—	,,	,,	,,	,,	,,	,,	,,	Not examined
11	10	90	1943	—	1	,,	,,	,,	,,	,,	Cultivated	Very wet	Result not known
12	45	219	1944	1	—	,,	,,	,,	,,	,,	Moorland	Faces and roads very wet	Yes
13	44	131	1945	—	1	,,	,,	,,	,,	,,	Edge of town	Mainly wet	,,
14	168	666	1945	—	1	Shaft and slant	,,	,,	,,	,,	Cultivated	Moderate; some roof water	Not examined
15	27	77	1945	1	—	Slant	,,	,,	,,	,,	,,	Very wet and muddy	Yes
						South Wales							
1	112	441	1940	—	1	Slant (350–600)	Yes	No	Yes	No	River-rat-infested; sheep farm	1 seam partly wet	Not examined
			1941	—	1								
2	24	97	1939	1	2	Level (45)	,,	,,	No	Yes	Brooks near	Mainly wet	,,
3	54	242	1933	1	4	,, (170)	,,	Yes	Yes	,,	Two streams near by each entrance	Generally damp; some wet	,,
			1941	—	1								
			1944	1	—								
4	16	498	1937	—	3	Slant (100)	,,	,,	No	,,	Brook near entrance	3 seams: 1 damp, 1 wet, 1 dry	Yes
			1943	1	—								
5	136	453	1941	1*	—	,, (350)	,,	No	Yes	,,	River near entrance	Generally dry	Not examined
6	79	426	1940	—	1	,, (450)	,,	,,	No	,,	Streams near by	Faces wet and dry; pools in roads	,,
			1945	—	1								
7	93	330	1937	—	1	,, (450)	,,	,,	,,	,,	Streams near	Some faces wet	,,
8	47	181	1944	—	4	,, (100–500)	,,	Yes	,,	,,	River intersecting small-holdings	Faces dry; levels wet; pools in roadway	Yes
9	119	543	1941	1	—	Drift (70)	,,	No	,,	,,	Small farms and streams	Wet	,,
			1942	1	—								
			1943	—	1								
			1945	—	1								
10	48	278	1941	1	—	,, (170)	,,	,,	Yes	No	,, ,,	,,	,,
			1942	1	1								
			1943	—	1								
11	124	650	1941	—	1	Shaft and level (150)	,,	,,	,,	,,	Farms and streams	,,	Not examined
			1943	—	1								
			1945	1	1								
12	6	95	1942	1	—	Level and slant (180)	,,	,,	No	Yes	Farms	Not wet	,,
			1945	—	1								
13	16	107	1943	—	1	— (60)	,,	,,	,,	,,	Moorland	Extremely wet	,,
14	14	62	1942	—	1	Level (150)	,,	,,	,,	,,	Small stream	Damp throughout	,,
15	32	578	1944	1	—	Slant intersected with shaft and drainage level (300)	,,	Yes	Yes	,,	Grassland	Moderately damp; wet for first 800 yards	,,
16	26	568	1944	—	1	Slant (400)	,,	,,	,,	,,	Farms; brook runs through colliery surface	Wet in parts	,,
17	3	24	1944	—	1	,, (100)	,,	No	,,	No	Cultivated	Wet	,,

* An ostler who worked in the underground stables.

The day's stock of horse-feed is sent down in sacks to the feeding-points, usually at or near the double partings, where it is emptied into large bowls. Practice, however, varies, and the horses may feed from nose-bags. Spillage is common, and it is usual to find the greatest number of "worked holes," and thus rats, near the feeding-points. Cuts and minor abrasions are a fairly common occurrence underground. Prompt first-aid attention is generally available if required.

There is extensive cover available underground for rats in the goafs (gobs and wastes). The only limiting factors in the distribution of rats in mines are deficiencies in food supply, movement of traffic, and the coal face itself. It appears that rats are attracted to the mine by the horse-feed. The slant or level provides easy access. The extensive cover, mine temperature, wetness, and darkness provide a favourable environment.

Rats

The main carrier of the *Leptospira* is the sewer-rat, *Rattus norvegicus,* and, far less commonly, the black rat, *Rattus rattus.*

Fecundity.—The female is fertile at three months. Oestrus, which lasts for three weeks, occurs every six weeks. Gestation lasts about 22 days. In a year six to eight litters are normally produced. The maximum life of the rat is about two years. A single pair of rats may in one year give rise to progeny numbering 600 or more. Rats are cannibals, and mortality among them is very high.

Breeding.—Under very favourable conditions breeding may take place throughout the year. Under ordinary conditions little occurs during winter months. The peak period is from early March to the end of May, with a lesser peak about the end of August.

Reinfestation.—Experience in factories and warehouses has hitherto shown that reinfestation occurs in roughly ten weeks after extermination has been effected.

Distribution of Rats in Mines.—There is little agreement regarding migration of rats into or from the mines. Some observers state that the rat colonies apparent underground maintain fairly level numbers and that migration is not noticeable. Others take the view that there is migration to the mines with the onset of winter, particularly if they are convenient to rivers, canals, or other waterways. The rats gain access to the mine workings by slants or slopes (surface mines) or via horse-feed. Horse-feed and scraps of bread thrown away by workers are the main sources of food for rats. Men generally carry their food in tin containers, but the practice is not entirely a universal one; even if it were it is often discounted by the unfortunate habit of throwing crusts and other scraps of food away. Human and horse excreta may also form part of the rat diet. Traces of rats in mines are somewhat different from those found in surface buildings or in the open. Often everything is wet and there are no smears. Droppings are often rapidly covered and obscured in the main roadways, and in disused roads are soon coated with fungal growth. Used rat places are polished and worn. These are the main traces. It is said that rats and mice do not coexist in the mine, although exceptions are instanced. It has also been recorded that in a mine where the only access was via the shaft the rats soon exterminated themselves when horses were replaced underground by mechanical haulage.

Preventive Measures

The prevention of Weil's disease in mines of known risk requires the co-operation of the men and the management. Some of the preventive measures are of a specialized nature and will be referred to only briefly. We are of the opinion that the first measures should be: (1) extermination of rats; (2) prevention of reinfestation; (3) rendering all food inaccessible. Further measures to implement the above are: (4) drainage of water and/or rendering stagnant pools unsuitable for the organisms; (5) use of protective clothing; (6) prompt and effective use of first-aid arrangements; (7) pit-head baths.

1. *Extermination of Rats.*—This requires to be intensive, and for this purpose the surface and underground workings should be considered as a single entity. In 1944 the Rat Infestation Branch of the Ministry of Food undertook, with a high degree of success, the extermination of rats in one of the Welsh mines of known risk. Similar treatment of a Scottish mine took place in 1945. This occasion was correlated to extensive surface measures. It is estimated that the rats killed on this occasion numbered: surface, 315; underground, 215. The measure adopted is briefly:

A plan of the mine is inspected and a thorough survey for traces of rats made. The mine is divided into appropriate working sections. A system of pre-baiting with poisoned baits (arsenic or barium carbonate) and post-baiting is adopted. A test for reinfestation is made a month later. Where sections are continuous, special treatment of the overlapping area is called for. Full details of the planning, standard procedure, organization of the squads, and safety precautions are contained in the memorandum on Instructions in Poisoning Rats in Pits and Levels, issued by the Rat Infestation Branch of the Ministry of Food.

In one mine the manager reports that during a holiday period a few years ago, when horses were all taken to the surface, poisoned biscuits were laid down intensively, with good results. No rats have since been seen. At two mines the use of horses underground was discontinued. Rats, formerly rampant, ceased to be noticed anywhere underground within a few months and had not reappeared. This was attributed to starvation plus cannibalism. Even if these reports should be accurate it does not necessarily follow that haphazard methods are as efficient as carefully controlled methods.

2. *Prevention of Reinfestation.*—The proofing of main levels or drifts against rat movement is virtually impossible owing to the requirements of haulage traffic. Old roadways and airways may be effectively sealed against rats by suitable doors, which may be solid or of suitable stout mesh construction. This would depend on the requirements of ventilation. These physical deterrents, however, will not suffice where food is made available underground.

3. *Rendering Food Sources Inaccessible.*—(*a*) Horse-feed: Underground storage should be in steel bins with close-fitting lids. One mine has for this purpose a brick cabin with concrete floor and an accurately fitting door of steel plate. The regulations under the Coal Mines Act require in effect that horse-feed should be taken inbye where horses are employed. As stated previously, the replacement of horse traffic by mechanical haulage results in marked diminution in the rats seen. (*b*) Workmen should all carry food in metal boxes and should desist from throwing away crusts. (*c*) Full use of chemical conveniences, and their importance, should be stressed. (*d*) Restriction of the number of horse-feeding points would simplify the disposal of horse excreta.

4. *Drainage of Water and/or Chemical Treatment of Stagnant Pools.*—Where there is a definite incline drainage by narrow channels to lodgments is to be commended. From these lodgments there should be ultimate pumping to the surface. Level or undulating conditions tend to promote areas of stagnant water. Where such pools are unavoidable, acidification of the water will produce conditions inimical to the viability of the organism. Scottish authorities have recommended the liberal application of lime and/or chloros to roadways, etc., and are of the opinion that this gives satisfactory results. It is difficult to determine just how accurately the treatment is pursued and therefore to what extent it is effective. As in the case of horse-feed, water for horses or for any other purposes requires to be protected adequately from contamination.

5. *Protective Clothing.*—The main practical measure in this regard is the use of gum-boots. This is particularly important where, as often happens in wet mines, workers may be exposed to prolonged or repeated wettings in traversing certain stretches of roadways. In some cases gum-boots are worn to get through such places, and under drier conditions at the coal face the worker changes to ordinary boots.

6. *First-aid Measures.*—Where there is a known risk first-aid treatment should be given for even minor scratches and abrasions. In two recent cases there was a history of a cut on the hand (7 and 14 days respectively) before the onset of symptoms of Weil's disease. In both cases some time had elapsed before the wound received attention. It is believed that these wounds provided the means of entry of the organism.

7. *Pit-head Baths.*—These provide a general hygienic measure, and their use should be encouraged to the fullest extent. Although baths have been provided at a great many collieries for some years now, a few men do not use them. As a further

measure the washing of hands before eating should be urged. This does not seem easily feasible in the case of underground workers, but it ought not to be impossible.

Present Position and Observations

In general the occurrence of Weil's disease is for all practical purposes confined to mines which have direct access from the surface by levels, drifts, or slants, which are generally wet, and which are infested with rats. In South Wales horses are employed and feed is taken inbye in all cases. In Scotland horses are in use in only two of the mines concerned, but these two have the highest incidence of infection continuous over a period of years. The geographical distribution of cases is widespread in both regions, and several recent cases occurring at mines widely separated were the first to be recorded among miners in these areas. Most Scottish cases have, however, occurred within a comparatively small area. Within this same area there are several mines each employing some hundreds of men below ground—mines which have horses with stables below ground and are known to be rat-infested, but which to date are not known to have had a recorded case of Weil's disease.

The occurrence of a case, particularly of a fatal one, usually leads to intensive rat-extermination measures being undertaken for a time at least. This no doubt partly accounts for the sporadic nature of the incidence. The recent success of the Rat Infestation Branches of the Ministry of Food and of the Department of Agriculture in Scotland suggests that much can be done in rat extermination, but any underground efforts in this respect require to be co-ordinated with extensive surface measures. Periods when horses are withdrawn to the surface would seem to be the most suitable, since food for rats will then be at a minimum and poisoned bait will be more likely to be taken. The probability is that the disease is much more widespread than recorded cases indicate. It is rarely diagnosed without jaundice having appeared, and the high rate of mortality justifies the most energetic measures that can be taken to clear mines of rats and keep them clear. In South Wales intensive measures are being undertaken at the mines of known risk. From each of the mines concerned one or two men were selected to undertake a course in the methods of rat extermination adopted by the Ministry of Food. It is hoped that this will result in a marked diminution in the appearance of new cases of Weil's disease.

Certain questions remain unanswered. Among these are: What conditions favour increased virulence or attenuation of the organism? What is the viability of the organism in pit water and slime? Are rats infected *de novo* from such water and slime, or directly or indirectly from other rats? Is there a proper seasonal variation in the incidence or is it related to breeding?

All but one of the cases recorded were among underground workers. In nearly all of them the conditions of work were wet or necessitated traversing wet places. Cuts and abrasions are commoner underground and so facilitate the entry of the organism into the body; moreover, first-aid attention is more difficult than at the surface.

Glossary of Mining Terms

Coal face : The place where coal is hewn and filled.

Drift : A roadway, usually inclined, driven in stone from the surface to the workings.

Goaf (gob or waste): The area from which the coal seam has been extracted, partly or completely filled with debris.

Inbye : In a direction towards the working face and away from the outlet; the reverse of outbye.

Level : A roadway so driven in a particular stratum as to maintain a level course.

Outbye : In a direction away from the working face towards the shaft or outlet; the reverse of inbye.

Slant, slope : See Drift.

Summary

Cases of leptospiral jaundice occur among Scottish and South Wales mine-workers with such regularity and such a high mortality rate as to make the disease a definite occupational risk in certain types of mines.

The mines known to be concerned are all wet and infested with rats, and form a small proportion of the number of colliery undertakings in both regions. Rats gain access to the workings via levels, drifts, or slants, and possibly with horse-feed in course of transit.

In most cases live rats caught in the mines have been proved to harbour the Leptospira, which has also been isolated from specimens of pit water and slime.

Unless circumstances provide a guide there is every possibility that the disease may be mistaken for other conditions, particularly in the early stages. Proof is by positive agglutination reactions in ascending titres.

Facilities for laboratory diagnosis and hospital treatment are available and adequate in both the Scottish and the South Wales coalfields.

Approximately 33% of the recorded cases were fatal. Two to three months is the usual period of illness. One attack confers immunity.

Determined efforts at rat extermination are of primary importance, and should be so co-ordinated as to deal with surface and underground problems simultaneously.

We are grateful to many persons and bodies whose kind co-operation and advice have greatly facilitated the investigation and the compilation of this report. In particular we would mention Dr. S. W. Fisher, Chief Mines Medical Officer, who initiated the investigation and helped us in our labours throughout. We are also indebted to the Mines Inspectorate and to the Rat Infestation Branches of the Ministry of Food and of the Department of Agriculture for Scotland for guidance on the environmental aspects. Our thanks are again due to several medical officers in our respective regions for the notification of cases and advice on the medical aspects of the disease.

INSULIN SHOCK TREATMENT OF BRONCHIAL ASTHMA

BY

Z. GODLOWSKI, M.D.

Physiopathology Department of the Polish Medical School and Paderewski Memorial Hospital, Edinburgh

Insulin shock was first introduced into the treatment of bronchial asthma by Wegierko in 1935; his later report on this subject (Wegierko, 1937) revealed very promising results, as he was able to remove the symptoms of asthma permanently or to mitigate them considerably for many months or even years. He thought (Wegierko, 1937) that the mechanism of insulin shock in the treatment of bronchial asthma lay in a violent stimulation of the whole vagal system, leading consequently to relaxation of the total smooth musculature of the body, including the spasmodically contracted bronchioles in these cases. He thus recommended insulin shock treatment for all conditions connected with spasmodic pains, such as nephrolithiasis, cholelithiasis, migraine, etc. He based his explanation on the fact that, in his observations, some of the cases in the early stages of insulin shock showed a slight fall of blood pressure, bradycardia, hot flushes, etc.—all symptoms described as due to vagal irritation; in the same stage of insulin shock patients began to feel a notable relief of breathlessness. It should, however, be borne in mind that the vagal fibres of the bronchial plexus bring to the bronchial muscles a constrictory stimulus. Thus either the toxic doses of insulin produce a paralysing effect on the vagal system and thus cause relaxation of the bronchial muscles (but in that case cannot develop vagal symptoms), or insulin shock transiently stimulates the vagus nerve but the agent causing the relaxation of the bronchial spasm is not directly dependent on the insulin action.

On the other hand, physiologists have clearly proved, by numerous experiments on cats (Cannon *et al.*, 1924; Elaut, 1929), rabbits (Langecker, 1928), dogs (Tscherboksaroff and Malkin, 1925), mice (Elaut, 1929), and pigeons (Riddle *et al.*, 1924), that insulin shock unmistakably caused a higher production of adrenaline, found either in the blood by biological assessments (Cannon *et al.*, 1924; Tscherboksaroff and Malkin, 1925) or in the adrenal medullas by histochemical or histological investigations (Langecker, 1928; Elaut, 1929). The hyperproduction and increased dissipation of the adrenaline in those cases is a sort of regulative measure of the organism, preventing or diminishing the toxic effects of massive doses of insulin. Bearing these facts in mind, I began to apply insulin shock in cases of bronchial asthma. As the physiologists' explanation of the insulin shock action seems to be more plausible—although not yet proved in human clinics—than the original one suggested by Wegierko (1937), only those cases of bronchial asthma with an allergic aetiology were considered to be suitable for this treatment. A no less important problem