hand, are more flexible, and so require to be pulled in on to the patient's trunk by means of the two elastic straps across the back. The leather strap of the KIFA is needed only if positive pressure is being used in the cuirass. The chest-piece will usually seal without any difficulty as soon as the pump is switched on, but the pneumatic pressure inside the rubber seal may have to be adjusted by means of the inflator provided. The negative pressure will pull the shell down on to the patient at each stroke, the travel being often as much as half an inch. In order to prevent sores it is important that the clothing under the shell shall not become wrinkled, and we have found that a stockinet singlet is best. Care should also be taken to see that the lower edge of the Monaghan does not cause redness or chafing over the iliac crest; the occurrence of this has prevented some patients from using the Monaghan. The down-and-up movement of the KIFA can be restricted to some extent by the gantry, which consists of two adjustable legs supporting a horizontal bar to which the shell can be clamped. Some movement of the shell must be allowed or the seal will not be airtight. The comfort of the KIFA respirator is considerably improved when the gantry is in use.

The performance of these respirators in terms of tidal volume for a given negative pressure cannot equal that of a cabinet respirator. For example, on some subjects, using either KIFA or Monaghan, it is impossible to produce a tidal volume greater than 500 ml., even though the negative pressure amounts to 35 cm. H₂O (26 mm. Hg). On the same subjects a cabinet respirator may give a tidal volume of as much as 1,000 ml. at a negative pressure of only 20 cm. H₂O. However, for lower pressures the differences are not so marked, and at a negative pressure of 15 cm. H₂O the figures on these subjects are 300-500 ml. for the cuirass type as against 700 ml. for the cabinet respirator. Thus, for patients who are convalescent and not entirely without respiratory power these respirators may be quite suitable. If the chest-piece can be made to fit comfortably the cuirass respirator may also be used for the chronic case with severe paralysis and wasting, since the need for ventilation has become much less than normal.

If in practice a negative pressure of 15 to 20 cm. H₂O does not give sufficient ventilation for a patient in a cuirass respirator there is usually little to be gained by increasing the negative pressure further, and, indeed, to do so may be harmful. Severe pulmonary emphysema of the anterior portions of the lungs, with dilatation and fragmentation of the alveoli, has been reported in such circumstances (Plum and Wolff, 1951). Should the patient not obtain adequate ventilation in the cuirass he should be returned to a cabinet respirator.

Discussion

Sufficient has been said of these cuirass respirators to indicate that, though of great value and convenience in certain cases, they are not so efficient as cabinet-type breathing machines as regards the ventilation produced. Nevertheless, their development shows interesting possibilities, and sufficient should be available for special cases. The operation of the Monaghan by a 12-volt battery is an enormous advantage when a patient with respiratory paralysis requires transportation, since the whole machine with a patient in it can be conveyed easily in an ambulance. Further, in slight cases of respiratory paralysis the limited assistance of the cuirass may be sufficient to tide the patient over a short period of respiratory difficulty.

Our clinical experience of the use of these cuirass respirators is limited, but we have used them both on children and adults, on patients in the acute stage, and on convalescent patients requiring only periodic or partial assistance with respiration. We have found that, though they are not as yet able to take the place of the cabinet-type respirator, they are certainly useful in selected cases.

Summary

The advantages and disadvantages of the cuirass type of respirator are reported.

The Monaghan and KIFA types are described.

Such machines are useful in certain cases of respiratory paralysis, particularly in the convalescent stage, where the full use of a cabinet respirator has become unnecessary and burdensome.

Further improvements in design may be hoped for.

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NEUROLOGICAL COMPLICATIONS ASSOCIATED WITH INSECTICIDES AND FUNGICIDES

BY

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This paper describes several cases of polyneuritis that occurred in men and women who had been using a certain insecticide preparation for treating woodworm. The insecticide is a proprietary preparation, the exact formulation of which is unknown, but which contains *ortho*- and *para*-dichlorobenzene, D.D.T., and pentachlorophenol.

Cases 1 to 5 had a peripheral neuritis, and Case 2 had, in addition, a retrobulbar neuritis. In Cases 6 and 7 retrobulbar neuritis developed a few days after using the insecticide.

Cases 1 and 2

Case 1.—A butcher, aged 42, attended the out-patient department in December, 1949, complaining of tingling in the feet and hands for the past nine months. Previous illnesses were irrelevant and there was no family history of polyneuritis. On examination a slight sensory loss in the fingers and toes to pin-prick and cotton-wool was noted, but otherwise there was no abnormal physical sign. His blood count was normal and there were no signs of anaemia. A test meal showed a normal acid curve. He was treated with vitamin B₁ without any improvement, and three months later he brought his wife to hospital with the same symptoms.

Case 2.—The wife of Case 1, aged 39, had begun to notice symptoms of tingling in both hands and feet, with slight instability in walking and a feeling of tightness round the waist and paraesthesiae in this area. Her symptoms had developed in November, 1949—that is, eight months after those of her husband—and were generally more severe. From January to May, 1949, she was treated with vitamin B₁ and a course of dimercaprol without improvement.

They were admitted to hospital and investigations were repeated on their acid curves and blood counts without any abnormality. Examination of their food and water supply for lead and arsenic revealed nothing abnormal. A pyruvate-tolerance test showed abnormal tolerance (see Table). In

Pyruvate Tolerance Test

	Fasting	After 60 Minutes	After 90 Minutes
Case 1	0.69 mg.	0.93 mg.	0.97 mg.
" 2	0.82 "	1.43 "	2.04 "

Expressed as mg. of pyruvic acid per 100 ml. of blood. Maximum normal values do not exceed 1.4 mg./100 ml. Thus, only Case 2 is definitely abnormal.

May, 1950, the wife developed an acute retrobulbar neuritis in the left eye, with a large central scotoma. This lasted for six weeks.

It was not until July, 1950, that a clue to the possible toxic agent was obtained. It was found that both patients had been using a proprietary compound of woodworm killer, containing the mixture stated above, for about a year. The time relationships in this usage were of importance. The husband had moved down to Clevedon, leaving his wife in Bristol, and had started using the substance several months before his wife, and his symptoms had preceded hers by about the same number of months. They had used the substance continuously twice a week over the period stated, getting their hands covered with the chemical when mopping it on to the furniture with a cloth. On entering their house it was quite clear that most of the furniture had been saturated in the substance and there was an extremely strong smell of *para*- and *ortho*-dichlorobenzene.

Immediately the possibility was realized that this was the toxic agent, steps were taken to stop its use, and both patients have made a slow improvement. Vibrationmeter tests show that vibration sense had improved by about 50% in nine months. The patients' symptoms persisted for a long period and only after a year were they relatively free of severe cramping pain and pins-and-needles in the extremities. One characteristic of their syndrome, shown also by other cases, has been the severity of the sensory disturbance compared with the objective findings. It is important that these two patients, as did most of the other cases described below, saturated their hands with the substance and did not apply it with a brush or with a syringe as advised by the makers, and that they also used it on a cupboard containing food.

Other Cases

Case 3.—A housewife aged 44 suffered acute epigastric pain early in November, 1949. It lasted for three days, and on the third day of the illness she developed weakness of the legs with gross ataxia and pins-and-needles in all four limbs. The symptoms appeared to improve about a week after the onset, although by this time a facial paralysis on the right side had developed. I saw her three weeks later and found a right facial paralysis and a glove-and-stocking anaesthesia to all forms of sensation anywhere between the ankle and just above the knee. There was marked ataxia in arms and hands, with a diminution in the grip of both hands. She made a slow but steady recovery, and when seen six months later there was no abnormal physical sign. In view of the history of the previous two cases, inquiry was made about the use of insecticide. This patient had used the same compound three days before the onset of her illness, and she admitted to using about a bottle on old furniture, having mopped it on with a cloth in the same way as the previous patients. Her hands were covered with abrasions from gardening, and during the treatment of the furniture she noticed a stinging pain in these abrasions from contact with the solution. She refused to enter hospital.

Case 4.—A retired man aged 61 was first seen in October, 1951, complaining of pins-and-needles in his feet and hands for the past three months. At the end of August he had noticed the onset of cramping pain in his feet and hands, and particularly in his calves, and one month after the onset had become unsteady on his legs and had a feeling as if he was walking on air. In July, 1951, one month before the onset of the symptoms, he had used the same compound on furniture, applying it with a swab of cotton wool tied to a stick, but he admitted that his hands had got contaminated with the solution. On examination he showed a marked sensory loss to pin-prick, vibration sense and touch up to the mid-calf, and a slightly less impairment in the hands. He was treated with vitamin B₁, 100 mg. daily, and over a period of five weeks made considerable recovery. Investigations showed the blood count, urine, cerebrospinal fluid, and test-meal curve to be normal.

Case 5.—A housewife aged 38 was seen after her symptoms had cleared up, but her doctor had recognized the possibility of this toxic agent and had confidently diagnosed

that her symptoms had been due to it. Her history was as follows: She moved to a new house in April, 1951, and applied the same woodworm killer to furniture, soaking a cloth with the chemical and applying it with both hands to three or four cupboards. She contaminated her hands with the fluid, more on the right side than on the left, and used it for five days. A week after its application she noticed weakness and numbness in both hands, particularly at the finger-tips and much more acutely on the right than on the left. There was also some clumsiness of the right hand and an inability to perform fine movements. She visited her doctor, who diagnosed mild peripheral neuritis, the symptoms of which took about five weeks to clear up. When seen three months later she had made a complete recovery.

Case 6.—A housewife aged 34 had used half a bottle of this solution on bedroom furniture. The onset of the eye symptoms followed five days after using it. She had a left retrobulbar neuritis with a central scotoma, which recovered completely in three months. No polyneuritis was present.

Case 7.—A railway clerk aged 38 developed a left retrobulbar neuritis with a visual acuity of 6/36, recovering over a period of three months. He had used the same material three times on furniture, the last occasion being on the day before the onset of his eye symptoms. There was no evidence of polyneuritis.

Discussion

It must be remembered that over 30% of cases of peripheral neuritis and retrobulbar neuritis seen in any outpatient department are of unknown aetiology. It is therefore with some caution that one would associate a small series of such cases with any specific cause. It is necessary to consider which, if any, of the ingredients of this preparation might be suspected.

Para- and *ortho*-dichlorobenzene have been widely used in industry for many years and have a reputation for being non-toxic. It is unlikely that they would have maintained this reputation had they been a cause of peripheral neuritis even in a small percentage of the workers handling them. They have been shown to be liver poisons.

D.D.T. has been widely used for many years now, and often under conditions in which those handling it were grossly contaminated with the material. Small doses have been alleged to cause liver lesions in the rat, while lethal or near-lethal doses are associated with serious neurological disturbances—tremors, convulsions—which eventually kill the animal.

Studies on insects suggest that D.D.T. interferes with the proper functioning of the peripheral nervous system. The only record of peripheral neuritis alleged to be due to D.D.T. is that of Klingemann (1949). A hospital orderly was using 10% D.D.T. powder to disinfect mattresses. He mixed the powder with an ointment and got the D.D.T. into an oily solution, which grossly contaminated his skin. He sweated profusely, and had a bitter taste in his mouth, which was followed by paraesthesia and vomiting. The next day he had great fatigue, and tremors and ataxia in the legs with some sensory loss. On examination he showed marked peripheral neuritis, with absent reflexes and diminished sensation, which persisted for several weeks. During the second week of the illness he developed jaundice and some nerve deafness. No visual disorders were recorded in this case.

Velbinger (1947) administered D.D.T. to human volunteers and described vague sensory disturbances in the limbs and a marked hyperaesthesia round the mouth. I have seen seven cases of retrobulbar neuritis in men and women with a history of having handled D.D.T. immediately before the symptoms appeared. However, the association has not been clear enough to incriminate the D.D.T. with certainty. It is particularly absorbable in oily solvents and is more likely to be toxic in those circumstances. From recent experiments on cows carried out in Switzerland it seems to be much more toxic to the nervous system of the young animal.

Pentachlorophenol has been extensively used in recent years as a fungicide for the treatment of timber. Care in

handling solutions of this substance is advised, because it can produce a severe dermatitis. Biochemically, pentachlorophenol resembles the dinitrophenols in its action on metabolism by inhibiting phosphorylating processes and allowing oxidative reactions to proceed more rapidly. From Germany comes a report of severe sciatic pain and neuritis and associated skin eruptions occurring in eight persons working with pentachlorophenol. The symptoms and signs were in the legs, but otherwise closely resembled those in the upper limbs of the cases described above.

Animals poisoned with pentachlorophenol may show slight motor weakness and convulsive seizures. Applied to the skin of rabbits the insecticide preparation caused a fatal liver necrosis, and when given orally to rats in lethal or near-lethal doses it produced coarse tremors and convulsions characteristic of either D.D.T. or pentachlorophenol poisoning. Liver damage in rats was not conspicuous.

It was administered to three hens, because this species is especially susceptible to the neurological damage produced, for example, by tri-*ortho*-cresyl phosphate. Doses sufficient to make the hens very ill and cease eating were not followed by any evidence of neurological damage. This is perhaps not surprising, as the injury in these cases was mainly sensory, while in tri-*ortho*-cresyl phosphate poisoning they are mainly motor in distribution. It has thus proved impossible to obtain confirmation of suspicions about this insecticidal preparation by means of animal experiment.

Conclusion

The purpose of writing this article is to draw attention to the possibility that the insecticide preparation under review may be a cause of some cases of peripheral neuritis. It should be emphasized that in all the cases the material had been handled carelessly and contrary to the maker's recommendations, and gross skin contamination had taken place.

It seems probable that the condition will be seen only in those who handle the material carelessly and are themselves particularly susceptible to neurological injury by chemical substances. Little is known about the aetiology of 30% of cases of peripheral neuritis, and this description may serve to draw attention to at least one other possible causal factor.

Summary

Several cases with neurological symptoms have been described after exposure to a proprietary insecticide. On the evidence available it is impossible to say with certainty what chemical in the preparation was responsible for the symptoms, but it is thought most likely that they were caused by pentachlorophenol, as it is highly soluble in fat. It is not possible to exonerate D.D.T. completely, and further experiments and observations would be necessary before stating with certainty that D.D.T. did not play a part in the development of symptoms in these cases.

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ADDENDUM.—Since this paper was written a patient has presented with very similar signs of polyneuritis accompanied by purpura, following exposure to a concentrated D.D.T. aerosol preparation during his work as a chemist. This is of interest because in the United States (F. E. Karpinski, *J. Pediatr.*, 1950, 37, 373) purpura has been found to occur in children exposed to aerosols containing D.D.T.

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PSYCHIATRIC SURVEY OF A RANDOM SAMPLE OF SKIN OUT-PATIENTS

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An appreciation of the importance of psychological factors in many dermatoses is by no means new. Sydenham (1681), for example, writing of the "hysterical diseases," described angioneurotic oedema affecting one leg; Turner (1726) cited a case of rosacea in a woman which he attributed to grief at the death of her husband; Bateman (1829) observed that pompholyx diutinus seemed often to occur after continued fatigue and anxiety.

In the past twenty-five years interest in the subject has been revived, and in the last ten years there has been a spate of literature on many aspects of this complex relationship. Reports have mostly been of three types: (1) Intensive studies of individual cases of skin disorder which seek to show a causal relation between psychic stress and skin eruption. (2) Extensive studies of the psychic characteristics of sufferers from a particular type of skin disorder—for instance, pruritus ani (O'Donovan, 1927), rosacea (Klaber and Wittkower, 1939), seborrhoeic dermatitis (Wittkower, 1947). (3) Wide generalizations linking particular skin disorders to particular types of temperament or psychic constitution (Hillier, 1865; MacKenna, 1944).

Despite the older observations and the more recent publications, reference to the subject is making only a tardy appearance in modern textbooks of dermatology. It is difficult to gain from this rapidly expanding literature any clear impression of the nature, the extent, or the limits of this relationship. Is the connexion one of association only, or is it dynamic and more correctly represented in psychopathological terms? What proportion of cases of a particular skin complaint can be said to depend on psychic factors? In what kinds of people do particular skin illnesses tend to crop up? Are there, indeed, any skin complaints which are unrelated to temperament and to emotional stress?

In an attempt to answer some of these questions a psychiatric investigation has been made of a random sample of patients attending a hospital out-patient department for skin diseases.

Method

The random sample was built up by referring the first, sixth, eleventh, and sixteenth skin patient seen each day (whether a new case or not) to the psychiatrist. By this means waiting was reduced to a minimum. If one of these patients had already been interviewed the next patient was referred in his stead. The interview lasted from half to one hour. This is probably not long enough to obtain all the relevant facts and attitudes, but there was a practical limit to the length of the interview. On several occasions the patient was actually walking to the door at the end of the interview before he let slip significant information.

Little resistance to psychiatric investigation was encountered. A surprisingly large proportion, after the