INDUSTRIAL DERMATOSES

WITH SPECIAL REFERENCE TO SOCIOLOGICAL ASPECTS*

BY

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The late Dr. Prosser White, who made this subject his lifelong study and whose book *Occupational Affections of the Skin* has become a classic, gives a rough estimate of new cases of industrial dermatoses in Great Britain for one year as being from 18,000 to 19,000. A further indication of the incidence of skin disorders is afforded by figures given in the current report of the Chief Inspector of Factories and Workshops for the year 1933. Out of a total of 3,465 young persons rejected for employment for medical reasons, no fewer than 1,712, or roughly 50 per cent., were refused for affections of the skin, the largest single cause in this group being pediculosis. In the same report, in a list of causative agents producing dermatitis, in 988 cases four groups easily distance all others. They are alkalis, 180; dyeing and calico printing and the use of dyes in general, 164; engineering, 126; and oil, 112. "Runners-up" in this list are "friction and heat," 84; metal-plating and polishing, 80.

The legislation included in the comprehensive title of the Workmen's Compensation Acts has made an enormous difference in the importance of these disorders. Perhaps the best way of illustrating the overwhelming influence which these Acts have exercised will be to give some figures.

Increase in Compensation Cases

It is now thirty-eight years since the first Act was passed in 1897. It dealt only with accidents. Occupational diseases other than skin diseases were added later (1901). At the present time two compensatable diseases affecting the skin are scheduled: (1) dermatitis, produced by dust or liquids; (2) ulceration of the skin, produced by dust or liquids. The incapacity caused by dermatitis is undoubtedly very much greater than the Acts allow for, and it must be understood that only a small proportion, perhaps 5 per cent., of the compensation claims hitherto made are concerned with diseases of the skin. At the time when the first Act was passed it was estimated, and the monetary arrangements were upon the basis of the calculation, that 150,000 accidents within a year would be the average. This incidence has been grievously underestimated. In the year 1930, in the seven principal industries for which accurate statistics are obtainable, the number of cases of compensation under the Act was 461,130.

This Act, with its many subsequent additions, and the Employers' Liability Act of 1880, have been responsible for an increase in cases of compensation not to be numbered by thousands but by hundreds of thousands, and the cost is not a question of tens of thousands of pounds but of millions. The courts have progressively widened the class of cases to which compensation is awarded, until the tax upon individual industry has become a very serious burden. For example, the actual compensation paid to coal miners in the year 1930 represented an additional charge of nearly 3d. per ton on coal raised, and probably another 1d. per ton should be added for the legal, medical, and administrative expenses involved in assessing the compensation.

The total sum paid in the year 1930 in the seven industries cited, together with the charges and expenses

involved in assessing, came to eight millions sterling, and the Home Office estimated that the total charge of all industries and employments under the Acts amounted to something like twelve millions sterling for the year. (Collie, *Workmen's Compensation*, 1933.) Until 1906 compensation was refused in cases where the mischief was attributable to "serious and wilful misconduct," but since that year a workman's own carelessness and neglect, although it may have caused or have contributed to the injury, does not preclude him from recovering compensation.

It is clear from these figures that the responsibility of the medical man to the community is very serious. The practitioner confronted with a case which may go to the law courts, and which will therefore entail his attendance and evidence there, should take very careful written notes at the time of his examination of the patient, in view of the probability that he will be called upon to face cross-examination in the witness-box. A still more frequent difficulty arises in the decision which the practitioner must make—whether the patient can or cannot return to his work, and the time during which he should be regarded as disabled.

There can, I think, be little question that these Acts have produced a psychological effect, quite sincerely felt by the patient, in the direction of prolonging the period of convalescence and promoting unwillingness to return to work, and the harassed practitioner has to steer a middle way between his duty to the State, of which he himself as a taxpayer is an integral part, and his duty to the patient.

Reaction of the Skin to Irritants

As I have said, I can only speak in general terms on the part played by the skin in these injuries. The reaction of the skin to a direct irritant may be said to depend upon two factors: (1) the strength of the irritant; and (2) the resistance of the individual. Certain substances in certain strengths will inevitably produce destruction of the skin in any individual subjected to their contact, but the reaction of individuals to irritants in more dilute concentration is very different. The normal intact skin offers a very remarkable protection to most poisons applied to the surface, even including bacteriological infections. In the days before gloves were worn in conducting post-mortem examinations—and I can remember those days very well, and have myself carried out these examinations without gloves—one had to be meticulous in inspecting one's hands before beginning the task. The slightest abrasion or cut made one hesitate to undertake it.

This protection is partly mechanical, and is due to the happy resistance to solvents of the substance keratin, which forms the greater part of the horny layer of the skin. Keratin will stand prolonged maceration with mineral acids, but it is soluble even in cold, weak solutions of potash, soda, and lime. Protection is also partly afforded by the secretion of the sebaceous glands, which exude a useful waterproof material. Fat-dissolving agents allow of ingress more readily than others, and the removal of protective fat gives the first opportunity of an injury. It is this circumstance which explains the large part that maceration by fluids plays in producing dermatitis. Housework, for example, which usually includes prolonged soaking of the hands in water, commonly with some alkali added to it such as soap or soda, caused 35 per cent. of a large series of cases of dermatitis in an industrial skin clinic under Guy Lane's observation in the United States.

The follicular orifices of the skin, involving as they do a break in continuity, are a weak spot in the protection afforded by the integument. The follicle is the usual

* A paper read before the Advisory Medical Committee of the Industrial Welfare Society, May 21st, 1935.

entry for septic infections which culminate in the production of boils and carbuncles, and for the injury that results from the application of oil as in the case of "mule spinners," in whom, unfortunately, the initial irritation of the follicle may, and does, not infrequently result in cancer.

Sensitization and Idiosyncrasy in Skin Disorders

A remarkable case of the effect of oil came to me from an insurance company in connexion with the Employers' Liability Act. A man employed in transporting colza oil in a barge on the Thames upset a keg of the oil over his person and was drenched with the fluid from his waist downwards. He wore the same clothes soaked in oil for three days consecutively, and when I saw him a few days after the occurrence almost the entire surface of his skin from the waist to the ankles was occupied by follicular pustules of the impetigo of Bockhart type. In this instance I was able to establish a persistent history of boils during the previous five years, and the man had, in fact, the remains of a carbuncle on his neck at the time of his visit. In reporting to the insurance company I gave it as my opinion that there was a contributory cause (in the sensitization of the patient to *Staphylococcus aureus*) for the very remarkable reaction following upon maceration with colza oil, which, in itself, as an analysis showed, was of extremely innocuous composition.

It is an interesting question whether repetition of stimuli increases or diminishes the natural immunity of the skin. The weight of evidence is in favour of diminution, but this conclusion is not universally accepted. A very striking experiment was reported by Professor Cash of Aberdeen. He investigated an epidemic of dermatitis due to satinwood powder. He isolated a crystalline substance from satinwood and applied it to his own skin. He suffered no inconvenience upon the first application, but twenty-two days later he repeated the experiment and had an immediate and violent inflammation. Sensitization to this particular irritant remained with him, for he suffered a similarly severe result from the application of the agent after three years' interval, during which he had had no contact with the substance.

The infection of a primary dermatitis, which may be due to mechanical or chemical causes, by septic organisms will often produce a complete transformation of the objective appearance and thus mask the original cause. The organisms almost universally responsible for these secondary infections are the *Staphylococcus aureus* and the *Streptococcus pyogenes*. These organisms grow most successfully in parts of the body where warmth and moisture are prevalent—for example, in the groins and flexures generally. Most cases of "weeping eczema" are really due in great measure to the secondary infection of a primary dermatitis.

In any estimation of the cause of skin disorder of external origin the question of individual idiosyncrasy must be carefully considered, especially in cases which threaten to come to the law courts. Individual sensitization may be found in an unusual degree, as in the case recorded by C. J. White, professor of dermatology at Harvard, in which a child of 6 died as the result of coming into contact with a negro servant immediately after that servant had been handling poison ivy, *Rhus toxicodendron*. Lacquer, which is the product of another plant of the *Rhus* genus, may retain its mischievous activity for a very prolonged period. Thus, a lacquer vase found during excavations in Japan produced a rash on the workman handling it, notwithstanding the fact that the vase had been buried in the soil for many hundreds of years. In this connexion I recall a wonderful exhibit in the Japanese pavilion at the Paris Exhibition of 1900, of a

large lacquer box, the property of the Mikado, the date ascribed to its production being round about the year A.D. 500, which indicates how old is the manufacture of lacquer in Japan.

Carcinogenic Substances

The important quality which has been called carcinogenic—that is to say, predisposing to the formation of carcinoma—is definitely attributable to tar products. I believe that a case under my observation constitutes a record for rapidity of the development of carcinoma from the local application of tar. I saw a man at St. Mary's Hospital, a barge-builder by trade, who had spurted hot pitch upon his face while coating a boat with it six weeks previously. When he came to me he had two ulcers upon his right cheek in the site where the hot pitch had come into contact with the face, the clinical appearance of which was so like rodent ulcerations that one of my clerks drew my attention to an open textbook upon his knee with a picture of a rodent ulcer extremely similar to the case under examination. Closer investigation of the patient, however, revealed enlarged glands under the maxilla on the side affected. I referred the case to my colleague, Mr. Clayton Greene, who removed the glands with the drastic completeness that characterized that surgeon's work. Recurrence took place within three months in a worse form, and the man died of mediastinal carcinoma within a year of the accident.

Unfortunately epithelioma of the skin shows definite increase in the Factory Report. The inspector points out that early medical examination and treatment are of special importance in this class of case. In a period of three years in Cardiff, among patent-fuel workers with periodic medical examination, of fifty cases none proved fatal; in Swansea, on the other hand, among the same class of workers, where no such examination was made, of twenty-five cases three were fatal.

Diagnosis

The association of the disorder with the irritant may be very obvious or very difficult to determine. Periodicity of attacks is an important aid in diagnosis. A lady living in a London flat consulted me for a recurrent dermatitis; the discovery after much cross-questioning that the attacks coincided with the reception from time to time of a hamper of cut flowers from a sister living in the country pointed the way to complete cessation of the attacks by the simple expedient of prohibiting the supply of flowers.

Local distribution of the eruptions is again usually distinctive. They begin on the surfaces first exposed to the irritant, or where the irritant is in most prolonged contact. There may be more than one predisposing cause, as in a case I examined for an insurance corporation, in which a stoker of furnaces in a block of flats developed a very curiously distributed dermatitis that dated from the change of fuel to Welsh anthracite. I made the man strip before my consulting room fire and asked him to take up the posture he assumed in stoking. It became immediately apparent that the surfaces most directly exposed to the heat of the furnace were the parts selected for chief implication. My conclusion was that a combination of radiant heat and anthracite dust was the explanation of the particular distribution seen.

If a skin condition gets better when the occupation ceases the probability is that the occupation has a causative share.

Prosser White lays great stress upon the value of what he calls the "patch test" in determining hypersensitivity. A small amount of test material is placed on a clear and apparently healthy area of the skin, and if it

is a dry substance, it is moistened with distilled water and covered with a small square of linen and a square of rubber tissue, which is held in position by a patch of adhesive plaster. This is left in place for approximately twenty-four hours, and the reactions are then noted. A positive reaction consists of redness and the formation of small vesicles at the point of contact. There is an important point to be considered at this time—namely, that occasionally a definite reaction does not appear until twenty-four hours after the patch has been removed, and also that it is sometimes necessary to leave the patch on an additional twenty-four or forty-eight hours before obtaining a positive reaction that otherwise would have been called negative. The "patch test" is probably the most reliable of the direct contact tests, such as the drop, scratch, and intradermal methods. The most important contribution to the subject of the usefulness of the "patch test" is to be found in the *Archives of Dermatology and Syphilology* for March, 1931.

Prevention in Factories and Workshops

In conclusion, I would summarize the excellent exposition in the current volume of the Factory and Workshops Report of the principles to be observed in preventing industrial skin disorders in factories and workshops.

"First, a barrier should be placed between the skin and industrial irritants by means of a protective film of ointment. According to the demands of the work this ointment may be greasy, non-greasy, or waterproof. Gloves may have to be worn where there is contact with powerful irritants.

"Secondly, after work the skin should be thoroughly washed, but without recourse (except in the case of contamination with oil and where there is much staining of the skin) to cleansers. The preliminary protective film applied to the skin will make this possible. Where a chemical cleanser is necessary for removal of oil, dyes, french polish, etc., the appropriate solution (never in solid form) should be used as weak as makes for effectiveness, and should itself be invariably removed with warm water and a bland (not soft) soap. Nail brushes are intended for cleaning the nails only; much damage can be done by plying these as scrubbing brushes to the skin.

"The value of a regular inspection of workers' hands by a careful observer cannot be over-emphasized. The necessary precautions are then more likely to be observed, and the early signs of skin irritation can be detected and relieved before the resistance of the skin breaks down."

Jiménez Díaz and two others (*Rev. Españ. de las Enferm. del Aparat. Digest.*, January, 1935, p. 5) believe that phosphatase (that is, phosphorus in organic combination) as found in the blood is derived from various sources, such as bone, liver, kidney, intestine, and muscle. Its percentage in blood plasma estimated by Kay's method averages 0.142 in adults and 0.26 in children. It is high in rickets but fails as the disease is overcome. It may be fifty times higher than the normal figure in Paget's disease, fibrocystic disease, osteomalacia, and during repair of fractures. In osteoporosis the percentage is in proportion to the extent and intensity of the process. In the "degenerate" forms of rheumatism there is an increase not observed in the infectious forms, although in tuberculous joint disease this increase is present. In liver diseases—hepatitis, hepatosis, cirrhosis, and obstructive and catarrhal jaundices—the phosphatase increase is in proportion to the functional state. In the healthy, ingestion of glucose does not affect the percentage, nor is any alteration noted in diabetes, Addison's disease, and the muscular dystrophies; but in hyperthyroidism with osteoporosis it is elevated. The plasma of the pregnant is unaffected until the final weeks, when a rise lasting through the early days of the puerperium is seen.

CLINICAL INTERPRETATION OF THE ARNETH COUNT

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While it is well established that infections tend to produce a shift to the left in the Arneth count (Arneth,¹ Cooke and Ponder,² etc.) we have observed in the course of clinical work that the count sometimes fails to show a shift to the left in acute infections, and that it may show a left-handed shift in the absence of infection. Such exceptions to the rule detract considerably from its clinical utility. Our observations indicate, however, that the apparent failure to conform to expectation is to be associated with the percentage method of recording the count; and by expressing it in absolute figures per c.mm. of blood, errors in its clinical interpretation can generally be avoided.

Methods

The method employed has been that of Cooke,² which consists in classifying 100 polymorphs into five classes, the class numbers corresponding to the numbers of nuclear lobes of the cells in each class. Cooke also determined the average number of nuclear lobes per cell, the result being termed the "weighted mean." In the following observations this figure has been expressed as the total number of lobes per 100 polymorphs, thereby eliminating the fraction. The percentage sign has been employed to indicate the percentage counts, and to differentiate them from the absolute counts. Cooke included any cells with more than five nuclear cells in Class V, but as the presence of such cells is almost always of pathological significance they have been given additional classes when present, and their full value computed in the total lobes per 100 polymorphs.

Cooke's² average count for ninety persons of both sexes between 12 and 25 years of age, stated to be healthy, is shown in Table I.

TABLE I.—Normal Arneth Counts

Average Arneth Count per 100 Polymorphs (Cooke ²)						Total Lobes per 100 Polymorphs	Total Polymorphs per c.mm.	Arneth Count per c.mm.				
Classes	I	II	III	IV	V			I	II	III	IV	V
	10	25	47	16	2%	275%	3,000	300	750	1,410	480	60
							5,000	500	1,250	2,350	800	100

Two normal absolute counts are also shown in Table I, calculated from Cooke's normal average percentage count, one based on 3,000 and the other on 5,000 polymorphs per c.mm. To Classes I and II belong the polymorphs occurring normally in the bone marrow,⁴ and the sum of these two classes may be employed as an indication of the marrow output of polymorphs, including as it does only cells which have recently passed from the marrow to the peripheral blood. Normally this figure lies between 1,000 and 2,000 per c.mm.

In Cooke's normal counts the numbers of lobes in 100 polymorphs varied from 247 to 311, but we have not met with counts over 290 without being able to find evidence of some disturbing factor. We regard the normal range as 240 to 290, but it will be shown that counts between these two figures do not necessarily represent a normal state of the polymorphs.

Normal Percentage Arneth Counts in the Presence of Infection

Such counts are shown in Table II. Case 1 was shown, through operation, to have a suppurating salpingitis, but had no pyrexia during nine days in hospital prior to