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DERMATITIS FROM CUTTING OILS, SOLVENTS AND DIELECTRICS, INCLUDING CHLORACNE

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The use of solvents and cutting oils is so widespread that it is not possible to inspect any large manufacturing plant without encountering some department where one or the other is used. All operations in which cutting tools are used are literally bathed in oil of one type or another. It is almost impossible under ordinary conditions and much more so under the pressure of war production for the workers to avoid intimate contact with either the solvents or the cutting oils used in their operations.

Dermatitis from cutting oils, especially those of the insoluble type, occurs more frequently than any other occupational disease of the skin. If its incidence could be decreased, one of the most vexing problems of the industrial physician would be solved.

The use of the dielectrics, especially the chlorinated hydrocarbons, is rapidly increasing. The latter give rise to a characteristic cutaneous eruption, known popularly as chloracne, which was first described in this country by Schwartz.[1] The early diagnosis of this condition and the knowledge of its possible occurrence in any industrial process is of great importance. Once the condition develops, it is very persistent and takes many weeks to cure, even after the exposure has been

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1. Schwartz, Louis: Dermatitis from Synthetic Resins and Waxes, Am. J. Pub. Health 28: 586 (June) 1938.

eliminated. Chloracne can be prevented almost entirely by the institution of proper preventive measures.

While it is true that at times dermatologists may not be entirely acquainted with the exact chemical entity which is responsible for an occupational dermatitis, they have in the last few years learned enough about the mechanism of the production of industrial dermatitis to institute proper preventive measures. This is especially true as far as the cutting oils and the solvents are concerned.

It is important to stress over and over again that proper preventive and protective measures can decrease the incidence of occupational dermatoses.

CUTTING OILS

Cutting oils not only are the most frequent causes of dermatitis among the workers with machine tools and metals but have been shown to give rise to more occupational dermatitis than any other agent. The cutaneous eruptions which they elicit are usually of the acneform group, but they sometimes cause allergic dermatitis as well. This is not due to the fact that they are the most potent producers of acne or to the fact that they contain substances having unusual sensitizing properties but to the fact that more workers are exposed to their action and fewer precautions are taken against their effects on the skin.

The cutting oils can be divided into two main groups, the insoluble and the soluble. Of the two, the insoluble cutting oils are most frequently the etiologic agents in cutting oil dermatitis.

The insoluble cutting oils vary in their composition according to the particular types of machining for which they are to be used. The formulas of these oils are rarely known by their users, since they are trade secrets. Essentially they consist of a large percentage of petroleum oil to which is added a small amount of animal and vegetable oil ("lard oils"), chlorine compounds, sulfur and an inhibitor to prevent deterioration of the fatty oil.

"Lard oils" were first used, but the oils derived from petroleum have been substituted, both because of their cheapness and because, unlike the vegetable or the animal oils, they do not become rancid. The mineral oils may be obtained from crudes of various types.

The so-called lard oils, which are now added only in small amounts, may be oleic acid, fish oils, lard oils and vegetable oils. The inhibitors which are incorporated to prevent rancidity of the lard oils should not have the property of rusting iron and usually are phenolic amines.

The insoluble cutting oils are used chiefly as aids to help in the cutting operation. One of their chief functions is the reduction of adhesion between the chip and the tool face. According to Ernst and Merchant [2] a chemical reaction may take place between the cutting fluid and the freshly ruptured chip surface. It is important to bear this in mind, as the chemical compounds which are formed may act as a possible source for some of the dermatitis from the cutting oils. Apparently this possibility has not been previously considered.

The sulfur which is added gives somewhat different characteristics to the cutting oils than do the chlorine compounds. At low cutting speeds chlorinated fluids are more effective in reducing the friction between the tool and the tool face as compared with sulfurized fluids. Sulfurized fluids are more effective at high cutting speeds or under severe cutting conditions.

The insoluble cutting oils are usually sterile in spite of the high incidence of folliculitis that they produce. It is not necessary and in fact adds to the possibility of a cutaneous irritation when antiseptics are added because of the mistaken idea that the bacterial content of the cutting oils is the cause of the folliculitis.

The soluble cutting oils act mainly to cool the cutting tools. Lubrication is a secondary function. According to Schwartz [3] the main constituents of the soluble cutting oils are sulfonated mineral and fatty oils 60 to 95 per cent, soap 5 to 30 per cent and volatile contents 0 to 10 per cent. Inhibitors such as phenolic amines are added to prevent rancidity. The soluble cutting oils are diluted many times with water (5 to 100 or 1 to 100) before they are used.

It is the soluble cutting oils which have a high content of bacteria, many of them pathogens. However, folliculitis and infections and even contact dermatitis are relatively rare among workers exposed to them as

2. Ernst, Hans, and Merchant, M. E.: Chip Formation, Friction and Finish, Cincinnati, Cincinnati Milling Machine Company, August 1940.
3. Schwartz, Louis: Dermatitis from Cutting Oils, Pub. Health Rep. 56: 1947 (Oct. 3) 1941.

compared with those exposed to the insoluble cutting oils. This can readily be understood when one considers how they are diluted before being used. Spolyar and Ferree [4] recently reported systemic effects from the hydrogen sulfide encountered in a cutting oil.

Dermatitis from Cutting Oils.—The cutting oils contain metal slivers which may cause small wounds. Often the worker will use old waste impregnated with the oil containing the metal particles to wipe his hands and thus cause wounds and scratches.

The petroleum oils may defat the skin. This is only slightly modified by their content of fatty oils. Just as in dermatitis due to solvents, especially in older persons with dry skins, the degreasing action may lead to drying and fissuring of the skin. Secondary infection may occur through the wounds and scratches.

Papillomas may be seen on the hands and arms of those exposed for many years to mineral oils and greases. These are small, flat, brownish verrucous lesions, usually seen on the backs of the hands.

Allergic eczema is relatively of infrequent occurrence. It may be due to idiosyncrasy for the animal or the vegetable oil, the inhibitors, such as the nitrobenzenes, cresols and phenols, or the other antiseptics which may be added. As has been pointed out previously, chemical compounds may be formed in the cutting operation by the interaction between the cutting tool, the face of the cut metal and the sulfur and chlorine compounds in the cutting oil. These chemical compounds may be factors in allergic dermatitis. The specific hypersensitivity can be demonstrated by means of the patch test. Not only may the dermatitis be aggravated by the use of harsh cleansers, but these themselves may often give rise to dermatitis.

The lesions most frequently seen after exposure to the cutting oils (usually the insoluble and rarely the soluble cutting oils) are folliculitis and comedos. The hairy portions of the arms and the anterior surfaces of the thighs are the sites of predilection. They are also seen on the backs of the hands and fingers and on the abdomen (figs. 1 and 2).

4. Spolyar, W. L., and Ferree, J. W.: Some Occupational Diseases Associated with the War Production Program, J. Indiana M. A. 35: 402 (Aug.) 1942.

Fig. 1. Dermatitis from insoluble cutting oils. The patient was an automatic screw machine operator (patient of Dr. L. W. Spolyar, Indiana State Board of Health).

The eruptions are especially prone to appear in hairy persons with a well developed pilosebaceous apparatus. Those areas of the body, such as the waist and the anterior parts of the thighs, which are exposed to intimate contact with oil soaked clothing, may also be affected.

Comedos may be seen occupying almost all the follicular openings on the forearms and the upper anterior surfaces of the thighs, with relatively little inflammatory reaction. Usually, however, there are interspersed papules, pustules and patchy areas of perifollicular erythema. The papules and pustules are usually perifollicular. When secondary infection occurs, abscesses or even carbuncles become evident.

The histologic nature of oil folliculitis was recently studied.[1] The process could be seen to consist of a stimulus to the formation of keratin leading to the formation of a keratogenous plug in the follicular opening (comedo formation) similar to that seen after irritation with coal tar, coal tar distillates, coal tar pitch and the chlorinated hydrocarbons. The lesions produced by the cutting oils usually begin as folliculitis, and the process is much more inflammatory and extends some distance into the skin surrounding the affected hair follicles. Even the sweat glands may be involved. No bacteria were demonstrated in the lesions.

For a long time it was thought that the inflammatory reaction caused by the cutting oils was due to their content of pathogenic bacteria. It has been shown time and again that the insoluble cutting oils with their high incidence of folliculitis are sterile while the soluble cutting oils which may contain bacteria rarely cause any inflammatory reactions. Secondary infection may occur, but the bacteria are not from the insoluble cutting oils; they find their entrance through the wounds and scratches from the metal slivers or the abrasions caused by friction of the clothing against the inflamed skin. The bacteria may originate from the clothing and even from the skin of the affected worker.

It seems clearly brought out both by the study of histologic sections from areas of oil folliculitis and by the bacterial examination of insoluble cutting oils that

1. Schwartz, Louis, and Peck, Samuel M.: Occupational Acne, New York State J. Med. 43:1711-1718 (Sept. 15) 1943.

the inflammatory reaction which is produced by the oils is due to the presence of irritants in them. These irritants may be sulfur compounds, chlorine compounds, the inhibitors or other not as yet identified chemical substances in the insoluble cutting oils.

Schamberg [6] conducted exhaustive experiments with the insoluble cutting oils in an attempt to reproduce oil folliculitis in human subjects. According to his findings it was the organically combined hydrocarbon sulfonate which was mainly responsible for the irrita-

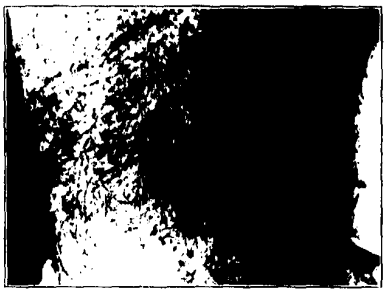

Fig. 2. Cutting oil dermatitis on thigh. Note the comedo formation. The patient was a safety glass worker in contact with petroleum oil (patient of Dr. Louis Schwartz, U. S. Public Health Service).

tion. This is substantiated by the well known fact that petroleum products which are not sulfurized, such as petrolatum, which is widely used as a dermal application, soothe rather than irritate. The formation of the comedo is due to the stimulation of keratin formation by the mineral oils acting on the cells lining the follicular openings. When in addition these oils contain solid chlorinated hydrocarbons, acneform lesions of the more cystic type such as will be described under chloracne may be seen associated with the folliculitis and comedo formation.

6. Schamberg, J. F.: Causes of Skin Sores and Boils Among Metal Workers, Philadelphia, E. F. Houghton & Co., 1920.

A discussion of the possible relationship between contact with some of the insoluble cutting oils and the elicitation of latent epidermophytids is beyond the scope of this paper. Biram[7] has called attention to this possibility. It is hoped that from the work now being done more light will be thrown on this possible relationship.

Prevention.—The following suggestions with a few changes to suit a particular problem can be used as the basis for an attempt to prevent almost any occupational dermatitis. The problem consists essentially in reducing to a minimum the contact between the worker and the irritant.

1. The machines should be kept as free from grease and dirt as possible by a daily cleansing. The oil should not be allowed to accumulate at the base of the machine or on the floor. In some manufacturing plants metal aprons are attached to the machines to prevent splashes of oil coming in contact with the workers or reaching the floor. The oil should be changed at least once a week. If it is to be reused it should be filtered to remove metal slivers. Instead of adding antiseptics which increase the hazard of dermatitis, sterilization can be employed, but this applies only to the soluble cutting oils. The rancidity can be removed by neutralization. It must be borne in mind, however, that a number of the chemical compounds which are formed in the oil by the cutting operation or which are due to sulfurization or to the addition of chlorinated hydrocarbons cannot be removed by reprocessing or cleaning the oil.

2. Adequate washing facilities with hot and cold running water and shower baths should be provided. The use of the showers should be compulsory and supervised, and enough time should be allotted for their use. Clean towels should be given to the workers daily, and they should have free access to clean waste at the machines. Old waste with its content of metal slivers should be discarded. The dressing rooms should have two rows of lockers: one in which the street clothes are removed and the other preferably in a room which would be entered only through the showers for

7. Biram, J. H.: Prevention of Skin Rashes, Indust. Med. 12: 208 (April) 1943.

the work clothes. To guard against epidermophytosis, wooden soled sandals should be worn to and from the showers. Proper antiseptic foot baths should also be provided.

3. Proper solid or liquid skin cleansers should be provided. For those workers whose skins become defatted and for those who have dermatitis, the neutral sulfonated skin cleanser advocated by Schwartz [8] should be used or a similar preparation. Schwartz has recommended the use of a neutral sulfonated castor oil to which 2 per cent of a synthetic wetting agent has been added. He has further suggested that for ordinary use the cleanser should consist of a neutral toilet soap plus a wetting agent or a synthetic detergent and a scrubber which softens or dissolves in water and does not clog the plumbing.

4. Clean work clothes should be provided daily for the workers and laundered by the plant.

5. To protect the exposed portions of the body, the workers should be provided with impervious sleeves, aprons and gloves made from one of the synthetic resin films. The sleeves should fasten over the gloves and be long enough to extend over the elbows.

6. Protective ointments are often used. They are not as efficacious as protective clothing and should be used only on those parts of the body, such as the face, which cannot be protected otherwise. The invisible glove type of protective ointment can be used, which leaves a film on the skin insoluble in oil but soluble in water, or a greasy ointment made of animal or vegetable fat, which fills up the pores and acts as a buffer between the skin and the cutting oil. In all such ointments a wetting agent should be incorporated to make them easily removable.[8]

Treatment.—The best treatment of dermatitis caused by cutting oils is the prevention of further contact with the cutting oils. When folliculitis and inflammation are present, wet dressings of 50 per cent alcohol, solution of aluminum acetate or solution of boric acid are helpful. The wet dressings can be applied to the arms and covered with one of the impervious sleeves suggested under prevention, and thus the worker can continue his occu-

8. Schwartz, Louis: Protective Ointments and Industrial Cleansers. M. Clin. North America 26:1195 (July) 1942.

pation. Several times during the day he can visit the first aid room to have the wet dressings renewed. Thus no time is lost, and the worker actually receives better treatment than if he were to stay home. If an abscess or a carbuncle develops, surgical treatment is necessary. Unless there is definite secondary infection, the local use of the sulfonamides is not only unnecessary but often increases the dermatitis. For the defatted skins a soothing ointment, such as a cold cream, perhaps one containing hydrous wool fat or lecithin, or any good emollient cream rich in vegetable and animal fats can be used.

SOLVENTS

Dermatitis is a frequent occurrence among persons exposed to solvents. It frequently occurs among the users of solvents but is relatively rare among the workers who are engaged in their manufacture. This is due to the fact that the processes of their manufacture are almost entirely enclosed.

Among the solvents are included the organic liquids which are used as cleansers in degreasing operations of various kinds, also those used to extract oils, fats and wastes, the solvents for plastics, resins and rubber and those used to dissolve varnishes, paints and lacquers.

The organic solvents can be divided into the following groups:

1. Petroleum derivatives.
   - (*a*) Pentane.
   - (*b*) Petroleum ether.
   - (*c*) Benzine in that portion of crude petroleum distilled below 150 C.
   - (*d*) "Stoddard solvent," a petroleum distillate which boils between 150 and 200 C. It is popular as a degreasing agent.
   - (*e*) Varsol, also popular as a degreasing agent.
   - (*f*) Kerosene.
2. Coal tar derivatives.
   - (*a*) Coal tar naphtha, or light oil. It is a complex compound containing phenols, aniline, toluidine, naphthalene, pyridine and other sulfur compounds.
   - (*b*) Benzol (benzenes), the fraction which distills below 120 C. It is not pure benzene (C_6H_6) but consists mainly of benzene and toluene with small amounts of carbon disulfide and hydrocarbons.

(c) Toluene (toluol) (C_7H_8). It is obtained from the fractional distillation of coal tar naphtha.
(d) Xylene (xyol) (C_8H_{10}).
(e) Light solvent naphtha.
(f) Heavy solvent naphtha.
(g) Tetralin (tetrahydronaphthalene) ($C_{10}H_{12}$).
(h) Dekalin ($C_{10}H_{18}$).

3. Turpentine: Turpentine is derived chiefly from the resinous exudation of various species of pine and other Coniferae.
(a) Gum turpentine, obtained by closed distillation of the oleoresin from the pine tree. The turpentine comes off, and the resin remains.
(b) Russian turpentine, obtained by destructive distillation of wood.
(c) American steam distilled turpentine, made from pine tree stumps. It contains 70 to 90 per cent of alpha beta pinene, about 10 per cent dipentene (inactive limonene) and a small amount of paramenthane.
(d) Pine oil, a by-product of the steam distillation of turpentine. It consists of a mixture of higher alcohols.
(e) Terpineol, spirit of resin, spirit of tar and oil of pine needles.

4. Alcohols.
(a) Methyl alcohol (CH_3OH), or wood alcohol.
(b) Ethyl alcohol (C_2H_5OH). This is usually denatured for commercial use by the addition of naphtha, acetone or zinc sulfocarbolate, all of which render it unfit to drink.
(c) The higher alcohols, such as butyl, amyl and propyl.

5. Chlorine derivatives.
(a) Chloroform.
(b) Carbon tetrachloride (CCl_4).
(c) Dichloroethylene ($C_2H_2Cl_2$).
(d) Trichloroethylene (C_2HCl_3).
(e) Perchloroethylene (C_2Cl_4).
(f) Tetrachloroethane ($C_2H_2Cl_4$).
(g) Monochlorobenzene, dichlorobenzene.

6. Esters.
Methyl, ethyl, butyl and amyl acetate and derivatives.

7. Glycols.
Ethylene glycol and diethylene glycol.

8. Carbon disulfide (CS_2).

9. Ketones. Acetone, methyl ethyl ketone, methyl acetone.

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According to Schwartz,[9] about 3 per cent of 6,000 cases of occupational dermatoses reported were found among painters. Paint consists essentially of a pigment in a drying oil, to which lead, manganese or cobalt is added to hasten the drying. Thinners are added to the paint both to allow for easier application and to hold in solution the oils and resins which paint contains. Turpentine, gasoline, naphtha, petroleum ether, mineral spirits, benzene and toluene are among the thinners used. The largest percentage of cases of dermatosis caused by paint is due to these thinners.

The solvents frequently encountered in the war industries are the dopes used in spraying the wings and the control parts of planes. The dopes consist of a solution of cellulose nitrate or acetate in a volatile solvent such as acetone or amyl acetate. As these evaporate they leave the resin on the fabric. Dermatitis frequently results from contact with the solvents in the dopes.

Another frequently occurring occupational dermatitis is found among workers engaged in degreasing small metal parts, for which the petroleum distillates, kerosene, varsol and others are used. In many industries large degreasing tanks are used which contain trichloroethylene. If proper protective measures are not used in these operations, not only dermatitis but systemic poisoning may occur.

Solvent dermatitis is also not infrequently seen in the printing industry, especially among pressmen and compositors, from the action of turpentine, xylene, benzene and other petroleum distillates used in cleaning types and presses.

Clinical Characteristics.—The solvents exert their drying effect on the skin by removing the fats and oils. This results not only in dryness but in cracking of the skin which may eventually lead to a dry fissured appearance which is characteristic (fig. 3). Those most frequently affected are older persons who naturally have dry skins and in whom the natural fats and oils which are removed by the solvents are not easily replaced.

9. Schwartz, Louis: Skin Hazards in American Industry: III, Public Health Bulletin 249, United States Treasury Department, Public Health Service, 1939, pp. 33-42.

The hands, wrists and forearms are usually affected. In some patients not only the dorsa of the hands but the palms may show fissuring dryness and desquamation. Patients with thin dry skins may even have actual dissolution of the keratin layers, with erythema and vesiculation as a result.

Hypersensitivity may develop with the production of allergic dermatitis, which when it is acute shows typical erythema, papules and vesicules at all places of contact. In such cases cutaneous eruptions may be seen in other parts of the body, such as the legs and even the feet, which may have been in only slight contact with the

Fig. 3.—Dermatitis as a result of daily contact with a solvent (diethylene chloride) (patient of Dr. Louis Schwartz, U. S. Public Health Service).

solvent. Turpentine is a primary cutaneous irritant and will cause dermatitis if allowed to remain on the skin any length of time.

Most organic solvents are systemic poisons, and poisoning may occur as a result not only of inhalation but of absorption through the skin.

Diagnosis (a history of exposure).—A visit to the plant to inspect the process and to see to what the worker is exposed plus the observation of the characteristic dry fissured scaling dermatitis, especially when it involves the palms, are sufficient to make the diagnosis of solvent dermatitis. However, when the allergic

type of eruption is seen, a positive diagnosis can be arrived at only by a patch test properly performed.

Since the solvents are primary irritants, they cannot be put on the skin as in the ordinary method of performing a patch test. They have to be diluted so that the final concentration used on the skin is known not to irritate the skin of normal persons. About 50 per cent of the solvent in corn oil can be used for the patch test.

Prevention.—To prevent the fumes of the volatile solvents from reaching the workers, hoods, suction devices and other mechanical means should be used. The suggestions for individual protection, however, must be followed to prevent dermatitis from the solvents.

Protective clothes made of synthetic rubber must be used, since rubber is attacked by many of the carbons of petroleum and by carbon disulfide also; gloves made from the polyvinyl alcohols can be substituted for those of synthetic rubber. Impervious sleeves which fasten over the gloves and reach over the elbow made from the same materials should also be worn. Aprons long enough to protect the body should, of course, be made from the same fabric.

As far as the rest of the clothing is concerned, including its laundering and other care, the rules laid down for the prevention of cutting oil dermatitis can be carried out.

As to cleanliness, because of the defatting action of the solvents on the skin, the suggestions made for washing and other cleansing measures under cutting oils may not be carried out in the same way. The workers should be taught not to use the solvents to clean off paints and other materials from their skins. Those who show the effects of the solvents on their skins must use safe cleansers, and the cleanser for dry skins previously recommended should be used. As has been stated previously, after washing an emollient like that mentioned under cutting oils should be rubbed into the skin.

DIELECTRICS CAUSING CHLORACNE

The increasing use of dielectrics in insulating wires and condensers, especially chloro compounds, has increased the incidence of the so-called chloracne. These compounds are important dielectrics or insu-

lators because they are heat resistant, flameproof and waterproof. The chloronaphthalenes, the chlorodiphenyls and the chlorodiphenyloxides are especially prone to cause occupational acne. The solid chlorobenzols and the solid chlorophenols are also potent acne producers. Nearly every worker who is sufficiently exposed to these compounds for a few months will have chloracne. Even members of the immediate family who come in contact with work clothes soiled with these chloro compounds have been known to acquire these acneform lesions. The term "chloracne" is a misnomer. Chlorine itself does not cause occupational acne either by contact or by oral administration. Neither the solvent chlorinated hydrocarbons nor naphthalene, benzene, diphenyl or phenol have caused acneform eruptions. Only the highly viscous or the amorphous solid chlorinated hydrocarbons cause acneform lesions.

The solid chloronaphthalenes are made by substitution of chlorine for the hydrogen in the naphthalenes. Any number of the hydrogen atoms may be replaced. Those most frequently used as dielectrics are the trichloronaphthalenes. Usually these are combined with the chlorodiphenyls (sold under the trade name Halowax). Not all compounds sold as Halowax necessarily consist of the chlorinated hydrocarbons.

Chlorodiphenoloxide is a semisolid compound made by chlorinating diphenoloxide. The chloronaphthalenes and chlorodiphenols not only cause lesions of the skin but give rise to acute yellow atrophy of the liver. While the acne caused by them has been known abroad for some time, the systemic effect was first pointed out by Schwartz in 1935.[10]

Recently because of the pressure of war work an increasing incidence of acne-like lesions has been reported among electricians installing cables on ships. It was found that cables were coated with chloronaphthalenes and chlorodiphenyls (halowax). The acne was found usually in electricians engaged in "strip-

10. Drinker, Cecil: Certain Chlorinated Hydrocarbons, in Symposium held at Harvard University School of Public Health, Boston, June 30, 1937. Fulton, W. B., and Mathews, J. L.: Dermatological and Systemic Effects of Exposure to Hexachlornaphthalene and Chlordiphenyl, Special Bulletin 43, Pennsylvania Department of Labor and Industry, pp. 1-13. Myer, May R., and Silverberg, Mabel G.: Skin Conditions Resulting from Exposure to Certain Chlorinated Hydrocarbons, J. Indust. Hyg. & Toxicol. 20:244 (March) 1938. Jones, J. W., and Aldan, H. S.: Acneform Dermatergosis, Arch. Dermat. & Syph. 33:1022 (June) 1936. Morris, G. E., and Tabershaw, I. R.: "Cable Rash": Note on a New Cleansing Mixture, J. A. M. A. 121:192 (Jan. 16) 1943.

ping" the coated cables; the halowax was impregnated into asbestos which was wrapped around the wires as insulation.

In shipyards visited by Schwartz[11] it was found that only those exposed continuously for relatively long periods to cables from which the halowax containing the chlorinated hydrocarbons flaked off easily were affected with the acne. He did not see any cases of yellow atrophy of the liver. Workers exposed to the fumes of halowax also had acneform lesions.

Clinical Characteristics of Chloracne.—The lesions of chloracne consist of pinhead to pea sized or even larger pale straw colored cysts. Comedos are present but are not a striking feature. The cysts are located on the face and the lobes of the ears, behind the ears, on the back of the neck, the shoulders, the abdomen, particularly around the umbilicus, and on the thighs and even on the scrotum and the shaft of the penis (fig. 4). Everywhere that the fumes or the clothing soiled with the chlorinated hydrocarbons might come in contact with the skin is an area of predilection. The individual lesions increase in size for a few months and then remain stationary. They may still be present months or even years after exposure has been eliminated.

Systemic absorption does not seem to be the cause of the lesions. This is suggested by the fact that they occur on exposed parts of the body or those intimately in contact with soiled clothing. Even experimental local reproduction of the chloracne has been accomplished by long continued local application of these acne producing substances.[12]

The lesions are due to chloro compounds deposited as fine particles or condensations on the skin from the fumes and from solution. They plug the orifices of the pores and by their keratogenous action cause the formation of comedos. This in turn gives rise to cysts by a combination of mechanical plugging of the mouths of the glands plus actual keratinization of their walls.

This is well brought out in microscopic studies of the lesions[13] in sections of characteristic straw colored

11. Schwartz, Louis: An Outbreak of Halowax Acne ("Cable Rash") Among Electricians, J. A. M. A. 122:158 (May 15) 1943.
12. Nahmmacher, V.: Acneform Lesions, Jap. J. Dermat. & Urol. 40:87 (Oct.) 1940. Schwartz, Louis: Personal communication to the author.
13. Drinker.[10] Schwartz and Peck.[4]

cysts. Large cysts can be seen with very thin walls filled with keratinous material but little sebaceous matter. Associated with such cysts are the wide follicular openings filled with keratin plugs and having hyperplastic follicular walls. Cocci are not evident in the comedos. Just as in acne vulgaris, a foreign body

Fig. 4. Chloracne from halowax (patient of Dr. Louis Schwartz, U. S. Public Health Service).

granuloma may occur due to rupture of a cyst wall and contact of the sebum with the collagen.

Coal tar pitch is sometimes used as an insulating material. It may also cause acneform lesions, but the lesions can be differentiated from chloracne by the accompanying melanosis and the presence of comedos rather than cysts as prominent features.

Acne due to the chlorinated hydrocarbons can be differentiated from acne vulgaris by the history of exposure, by the occurrence at any age, by the distribution on areas of the body where acne vulgaris is usually not seen, such as the abdomen, the back of the neck and even the forearms, by the much less inflammation as compared with acne vulgaris, sometimes by the dryness of the skin, by the fact that comedos are not a predominant feature, by the persistence of the lesions and by the much greater amount of keratinous material contained in the cysts. Cocci are easily demonstrated in the comedos of acne vulgaris, while they are not seen in those due to the chlorinated hydrocarbons.

Prevention.—1. Workers engaged in stripping the cables should wear hood respirators containing proper filters. Where hoods cannot be worn, proper ventilation should be installed to remove fumes and dust.

2. The exposed parts, such as the face, should be covered with protective ointments of the invisible glove type reinforced with inert powders. Clean coveralls should be supplied daily and must be laundered by the plant or the shipyard. It is important that the underclothes should be cleaned daily also.

3. Adequate washing facilities should be provided, and taking showers at the end of the working day should be compulsory. Workers should be instructed to wash their hands thoroughly before eating lunch, and no smoking should be allowed without similar precautions being taken. The soap furnished the workers should preferably contain one of the synthetic wetting agents, such as one of the duponols (a group of higher aliphatic alcohol sulfates and derivatives of them) or santamerse (alkylated argylsulfonate), which will remove soil more easily than ordinary soap.

Treatment.—The only way to remove the cysts is by manual expression. Keratolytic local applications are not sufficient to remove them. In most cases use of x-rays is not indicated, because the patients have dry skins and it is not a question of reducing the activity of the sebaceous glands as it is in acne vulgaris.

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