bodies were present in the blood in excess of the normal. The highest figures obtained were from the blood of a patient with severe diabetes at a time when he exhibited signs of impending coma. In this instance, the oxybutyric acid amounted to 45.2 mg. per 100 gm. and the gross aceto-acetic acid to 28.0 mg., both calculated in terms of acetone.

The accumulation of the acetone substances in the blood and the excretion of these substances in the urine did not always run parallel. Administration of alkali resulted in considerable alteration in the relative distribution of the acetone substances between the blood and the urine, the effect being to diminish very considerably the concentration of these substances in the blood, without at the same time bringing about any appreciable change in the total daily output in the urine.

Analyses of the blood for preformed acetone indicated that this substance may amount to more than 60 per cent. of the gross aceto-acetic acid, in conditions of severe diabetes. With alkali therapy, preformed acetone showed a relative diminution. That is to say, the alkali appeared to decrease the decomposition of aceto-acetic acid.

In the bloods examined the ratio of oxybutyric acid to total acetone substances ("beta ratio" or Kennaway, Pembrey and Poulton) varied from 50 per cent. to 80 per cent. The significance of this ratio is not, as yet, entirely apparent. It is possible that a high ratio may be an indication of partial asphyxia; for we know from the work of Embden, Friedmann, and Dakin and their collaborators that, with diminished oxygen supply, various organs of the body readily effect the reduction of aceto-acetic acid to oxybutyric acid, whereas the reverse change is favored by the presence of an abundance of oxygen.

So far I have spoken only of the accumulation of the acetone substances in the blood, and have said nothing of the tissues. The blood, however, appears to be a fairly satisfactory index of the extent to which acetone substances may accumulate in the tissues. For example, it was found that the blood and liver of a starved phloridzinized dog contained the same amounts of acetone bodies per 100 gm. and the muscles approximately one-half as much. The beta ratio, however, was higher in the muscles and liver than in the blood, and this would, of course, be expected as there would be relatively less oxygen in these organs than in blood.

It is not intended here to present a detailed discussion of acidosis but merely to indicate some applications of a method which I believe to be capable of throwing light on the subject of acetone body acidosis.

Washington University Medical School—Laboratory of Biological Chemistry.

ABSTRACT OF DISCUSSION

PROF. A. J. CARLSON, Chicago: I should like to ask Dr. Marriott for the findings in the pancreatic diabetes in dogs. It has been my experience in this experimental diabetes that there is not in the urine or in the breath of these dogs the characteristic acetone odor that is found in advanced cases of human diabetes. Was there any indication of increase of acetone in the experimental dogs comparable to that in cases of human diabetes?

DR. W. MCKIM MARRIOTT, St. Louis: I was surprised to find that in pancreatic diabetes in the dog there was only the very slightest increase in acetone bodies, nothing at all comparable to that of human diabetes or even of phloridzin diabetes in the dog; the figures were just above the normal.

DIPHTHERIA OF THE SKIN OF UNUSUAL TYPES

REPORT OF TWO CASES *

FRANK CROZER KNOWLES, M.D.

Instructor in Dermatology, University of Pennsylvania, Department of Medicine; Clinical Professor of Dermatology, Woman's Medical College of Pennsylvania

AND

LEONARD D. FRESCOLN, M.D.

PHILADELPHIA

Diphtheria of the skin was first recognized by Chomel¹ in 1759, and by Samuel Bard¹ in an epidemic in New York in 1771. Although the diphtheria bacillus was not discovered until 1883 by Klebs¹ and 1884 by Loeffler¹ of Greifswald, working independently, as early as 1830 Trousseau¹ wrote extensively of cutaneous diphtheria. It was not, however, until 1891 that the integumentary outbreak of this affection was studied not only clinically but also bacteriologically by Neisser.²

The invasion of the skin by the Klebs-Loeffler bacillus is of infrequent occurrence, as shown by the report of the St. Anne's Children's Hospital of Vienna.² From 1894 to 1902, out of 2,217 clinical and bacteriologic cases of diphtheria the cutaneous surface was attacked in but twenty-three instances, and the most of these were of the false-membrane type. Mallory¹ has found in a series of 251 cases of diphtheria that the skin was attacked in but one instance and the lesion was then of the false-membrane type.

Trousseau's original contention that cutaneous diphtheria was preceded by some tissue loss, no matter how slight, is the view held by the present-day investigators, notwithstanding Daviot's³ view to the contrary.

The bacillus gains entrance to the skin through some opening, in cracks, slight excoriations, erosions resulting from herpes, in the breaks in the continuity of the skin secondary to an eczema, an intertrigo or an impetigo, etc. Cutaneous diphtheria may be of primary occurrence and limited to the integument; the infection may be conveyed to the larynx, throat or nasal mucous membrane, or, as is usually the case, the skin is secondarily involved, the mucous membranes, just mentioned, showing the original lesions.

Inoculation of the skin with the Klebs-Loeffler bacillus occurs in one of three ways: by auto-inoculation, by means of some article of clothing, utensils, etc., containing the same, and from one person to another by close contact, as by kissing, coughing, circumcision, etc.

Numerous varieties of lesions have been reported in which the diphtheria bacillus has been found. The most frequent of these is the false-membrane type. The other types which have been recorded are the ulcerative, gangrenous, eczema-like, impetiginous eczema-like, pustular and impetigo-like, ecthymatous, vesicular and varicella-like, bullous, dermatitis herpetiformis-like, carbuncular-like, and the tumor and abscess.

False-Membrane Type.—The older writers on diphtheria of the skin affirmed that every case had a diagnostic false membrane. The break in the conti-

* Read before the Section on Dermatology at the Sixty-Fifth Annual Session of the American Medical Association, Atlantic City, N. J., June, 1914.

1. Quoted by Nuttall, G. H. F., and Graham-Smith, G. S.: The Bacteriology of Diphtheria, New York, G. P. Putnam's Sons, 1908.

2. Quoted by Marschalko: Arch. f. Dermat. u. Syph., 1909, xciv, 379.

3. Quoted by Jack: Brit. Jour. Child. Dis., 1913, x, 456.

nity of the skin attacked by the bacillus would become painful, puff up, there would be a profuse fetid discharge, a false membrane would form and the edge of the patch would become elevated and the bottom ulcerated. Not infrequently an attack of erysipelas would develop around the diphtheritic patch. It was not rare, however, to observe an attenuated form that consisted of grayish plaques, more dry than moist, discrete and slightly spreading. These plaques are detached in from about eight to ten days, some persisting for a longer period.

Bernard and Jacob¹ found diphtheria bacilli in gray ulcerating patches on the thigh of a soldier. Bolton and Brewer¹ cultivated the organism from a sore, showing a black central scab surrounded by sloughing portions of dirty white skin, on the groin of a girl. Williams¹ isolated virulent diphtheria bacilli from a membrane on the finger and from the throat of the same patient. Other instances are too numerous to mention.

Wound Diphtheria.—Wound diphtheria, so-called, is of fairly common occurrence, developing either secondary to nasal, throat or laryngeal diphtheria of the afflicted person or from some one else with the disease. Several instances of cutaneous diphtheria have occurred in insignificant wounds (Park,¹ Pitts¹ and others). Tavel¹ mentioned a case of infection in the operation for spina ventosa; Bruner,¹ three cases of wound infection, in one of which virulent, and in the other two non-virulent, diphtheria bacilli were found; Sponck,¹ three examples of infection of tracheotomy wounds. Treitch and Abel¹ (quoted by Flexner) and Scheller¹ also mentioned examples of wound infection. Further instances of this type of affection have been cited by Paterson,⁴ and Abel² of the finger; Sowade,⁵ of the right deltoid; Place,⁶ on and surrounding the vulva; Gerloczy² found the infection in the left inguinal region and Schwab,² in the genital region.

Ulcerative Type.—Although most of the cases of this variety have developed false membranes, there have been some exceptions. Jack⁷ had a patient, the mother of a child with nasal diphtheria, who developed at the site of a trauma above her left elbow a red spot which ulcerated. The diphtheria organism was found in this lesion. Heelis and Jacob⁸ found diphtheria bacilli in an ulcer on the dorsum of the right hand. The latter infected the outer canthus and from this the disease spread to the conjunctiva. Kanthack and White¹ found the bacillus in phagedenic ulcers of the neck.

Gangrenous Type.—Gangrene of the skin has been reported by Bolton,⁸ Dawson⁹ and Marschalko¹⁰ by the implanting of the diphtheria bacillus. Pernet¹¹ had an infant with gangrenous lesions on the side of the anus. The little patient developed difficulty in deglutition and finally died of paralysis of the diaphragm. Virulent diphtheria bacilli have been found by Steffens¹ in a case of gangrene of the eyelid. Freymuth and Petruschnky¹² have found the Klebs-Loeffler bacillus in cases of noma.

Eczema-Like Type.—Richard¹¹ had a young girl with a patch of eczema for some years below the left ear, which spread and attacked the commissure of the left lip. The bacillus of Loeffler was found. Her sister developed a typical case of diphtheria. Glucksmann¹ found the diphtheria bacillus in five cases with an eczema-like outbreak. Baginsky² has reported cases of cutaneous diphtheria developing on patches of eczema.

Tumor and Abscess Types.—Müller¹³ described the cases of two children, a brother and sister. The girl had a tumor on the left labium majus extending to the inguinal region; there was also throat diphtheria present. The brother also developed diphtheria of the throat and a swelling at the root of the nose. Both children died and microscopic examination showed numerous diphtheria bacilli in the tumors. Deutschlander¹⁴ has collected reports of forty-eight similar diphtheritic tumors from the literature.

Hála¹ found virulent diphtheria bacilli in an abscess of the eyelid. Councilman, Mallory and Pearce¹ found diphtheria by culture in four out of ten cases of cervical abscesses developing in the course of diphtheria. Schöttmüller¹ isolated non-virulent diphtheria bacilli from the pus of an inguinal abscess and from the throat of a boy suffering with diphtheria. Tavel¹ has found the Klebs-Loeffler bacillus in abscesses. Leary discovered the diphtheria bacillus in an abscess which developed about a hair-follicle two days after a necropsy in a case of diphtheria.

Unclassified Types.—Bokay² has recorded instances of skin diphtheria and diphtheritic balanitis and vulvitis. G. C. Garratt³ has written on acute diphtheritic whitlow. Heelis and Jacob⁸ found the diphtheria bacillus in broken chilblains in children associated with faucial diphtheria.

Pitts¹ recorded an instance of diphtheria of the umbilicus in a child 4 days old, and Caddy,¹ a case of diphtheria of the nipple and areola of a woman suckling an infant, which shortly afterward developed diphtheria.

Wright¹ found the Klebs-Loeffler bacillus in a case of anal fistula.

Impetiginous Eczema-Like, Impetiginous, Ecthymatous, Pustular, Vesicular and Bullous Types.—These vesicular, bullous, pustular and crusted types constitute varieties of diphtheria of the skin which have only recently been recognized as such and are of rare occurrence. In all intractable cases in which these lesions are present, careful cultural tests should be carried out.

Todd¹⁵ recorded the occurrence of six cases, out of fifty-one of external rhinitis due to the Klebs-Loeffler bacillus, in which secondary pustules developed on the skin. These pustules when examined at an early stage contained the diphtheria bacillus.

Slater¹⁶ reported a case in a girl of 13 with a large number of vesicles, resembling varicella, some of a crescentic arrangement and with a profuse discharge. The condition had lasted for three years. The diphtheria bacillus was isolated from cultures. Antitoxin cured the patient.

Dawson⁹ recorded a case in a man of 58 who showed groups of bullae on an erythematous base, resembling dermatitis herpetiformis, from which virulent diphtheria bacilli were recovered.

4. Paterson: Med. Times and Gaz., 1866, ii, 608.
5. Sowade: Arch. f. Dermat. u. Syph., 1912, cxiii, 1039.
6. Place: Boston Med. and Surg. Jour., 1910, ii, 730.
7. Jack: Brit. Jour. Child. Dis., 1913, x, 456.
8. Quoted by Dawson: Brit. Med. Jour., 1910, ii, 859.
9. Dawson: Brit. Med. Jour., 1910, ii, 859.
10. Marschalko: Arch. f. Dermat. u. Syph., 1909, xciv, 379.
11. Quoted by De Verbizier: Ann. de dermat. et de syph., 1912, p. 82.
12. Quoted by Kautlack, following Todd's article (Lancet, London, 1898, i, 1458).

13. Müller: Deutsch. Arch. f. klin. Med., March 1, 1913.

14. Quoted by Müller (Footnote 13).

15. Todd: Lancet, London, 1898, i, 1458.

16. Slater: Lancet, London, 1908, i, 15.

Place states that he has had cases in which impetigo-like lesions developed on the face and the hands, in which diphtheria bacilli were found, associated with diphtheria of the respiratory tract.

Labbé and Demarque¹¹ recorded an instance of disseminated impetiginous eruption in a child of 4, accompanied by several sharply margined ulcers. The Klebs-Loeffler bacillus was present. They also reported a second case, in a child of 2½, with diphtheritic impetigo-like lesions on the face and the scalp and excoriations on the lips.

Goodall and Washbourn⁸ have cited instances with diphtheritic pustules yielding thin pus and producing ulcers, slow to heal and often free from membrane.

Eddowes and Hare¹⁷ recorded a bullous and pustular case in a girl of 11. The lesions were found on the arms, the hands, the lips, and one lesion on the left anterior pillar of the fauces. There was no false membrane present. Klebs-Loeffler bacilli were found. They reported another case, in a woman of 41, of three years' duration, with lesions of an impetiginous aspect.

Douglas Heath¹¹ observed a somewhat generalized diphtheritic eruption of an impetiginous type.

Brandal, Herley and S. Edin¹¹ recorded a lesion of a pustular carbuncular type in which they found the diphtheria bacillus.

Jéz¹ found virulent diphtheria bacilli in the fluid from the vesicles of herpes labialis in a patient suffering with diphtheria. Dávalos¹ discovered the organism in the fluid of impetiginous lesions covering the face and the neck of a baby.

Prescott¹ reported a case of a child in which a blister was raised by the application of a plaster, a false membrane formed and the diphtheria bacillus was found; no bacilli were found in the nose and the throat although the child had recently recovered from diphtheria.

Waelsh¹ described diphtheria-like bacilli, pathogenic for rabbits and guinea-pigs, in a pustular eruption of the skin of the trunk. Müller found diphtheria bacilli in a pustule on the nates.

Schuch¹² recorded an instance of infantile ecthyma, with sharply margined ulcers, and a purulent discharge from the ear, in a child of 3, in which the organism was found.

Verbizier¹⁸ cites ten cases, in which nine did not have the membrane or other usual manifestations of diphtheria. All but two of the cases occurred in infants. Four of the cases ended fatally. Seven among those recorded were of the impetiginous eczema type, and in three, vesicles and bullae gave rise to an abundant discharge. Four showed a grave conjunctivitis. The most common form, and, therefore, the most typical type observed in infants, had the appearance of an impetiginous eczema, affecting almost always the head and the face, and associated with a grave conjunctivitis, sometimes also an otorrhea and rhinitis, the whole forming a distinct clinical entity.

The two following cases were first seen by us Sept. 5, 1913.

CASE 1.—Lillian J. W., aged 4 years, had always been healthy and well nourished, and is plump and well built. Three days before she came under observation the outbreak appeared on the body, with an accompanying sore throat. There were observed on the trunk, the extremities and the

buttocks two dozen pustular and bullous lesions varying from a pea to a pigeon's egg in size. The lesions were discrete and of a whitish-yellow to an orange-yellow color. The large bullous lesions had an inflammatory areola, and on rupture were found to be multilocular and filled with a thick, cheese-like, yellow pus. The throat was swollen, the glands of the neck enlarged, the patient restless and there was a high temperature. Examination showed membranous, white patches on both tonsils. Cultures were made from an unruptured lesion on the lower abdomen and also from the throat. Diphtheria bacilli were obtained from each location, the one of Type D and the other of Type C, according to Wesbrook's classification. Staphylococci were also found in the cultures. The patient was given 3,000 units of antitoxin and was sent to the Municipal Hospital. Death ensued two days later.

CASE 2.—Mary W., sister of Patient 1, aged 8 years, who had been unusually free from sickness, developed, the day previous to our visit, sore throat and an eruption on the skin. The right tonsil was covered by a white membrane. The temperature was moderately high. Scattered over the trunk and the extremities were about a dozen lesions, mostly pea in size but a few with the proportions of a hazelnut. They were of the same character as her sister's; the inflammatory areola, however, was less marked and the contents were of a thinner consistency. Cultures were made from the tonsil and from an unruptured lesion on the leg. Diphtheria bacilli were found in each, corresponding to the C type of Wesbrook. Staphylococci were also found. The patient was given 1,250 units of antitoxin and was transferred to the Municipal Hospital. Although the little patient developed scarlet fever while in the hospital, she finally recovered.

The Klebs-Loeffler bacillus varies considerably in regard to its virulence both in the patients attacked and in the animal experiments. Abel, Neisser and Marschalko obtained positive results in their animal inoculations. The diphtheria bacillus obtained from Slater's case killed the guinea-pig. A pure culture of the Klebs-Loeffler bacillus obtained from Leary's case was inoculated into a guinea-pig and killed the animal in forty-eight hours. Eddowes and Hare inoculated 2 cm. of the serum suspension of the culture of the Klebs-Loeffler bacillus found in their case into a guinea-pig, and death occurred in twenty-seven hours. The organism was recovered from the guinea-pig.

Extensive cultural experiments made by numerous investigators demonstrated the fact that other pathogenic organisms are almost invariably associated on serum cultures with the diphtheria bacillus; although the streptococci are the most frequently associated, pyogenic cocci, staphylococci and pneumococci may also be found. Eddowes and Hare found in their case the *Staphylococcus aureus* and streptococci associated with the diphtheria bacilli. We found staphylococci in addition to the diphtheria bacilli in our cases.

DIFFERENTIATION OF THE DIPHTHERIA BACILLUS AND THE PSEUDODIPHTHERIA BACILLUS (BACILLUS OF HOFMANN)

In an unusual type of lesion in which a diphtheria-like bacillus is found it is always essential to distinguish the true diphtheria bacillus, or the Klebs-Loeffler bacillus, from the pseudodiphtheria bacillus, or the bacillus of Hofmann.

The pseudodiphtheria bacillus is generally much shorter than the common forms of the diphtheria bacillus; it usually is a short, straight, oval bacillus, with rounded ends, and one median, lightly stained transverse septum. The former in proportion to its length is much broader than the latter, and the widest part, which is about equal to one-eighth of the length,

17. Eddowes and Hare: Lancet, London, 1908, i, 282.

18. Verbizier: Ann. de dermat. et de syph., 1912, p. 82.

is at the middle. Some of the forms of the Hofmann's bacillus are clubbed and often slightly curved but take the stain more deeply than the diphtheria bacillus. Sometimes after forty-eight hours' growth on the culture-medium the bacilli are even shorter than at an earlier period.

Metachromatic granules (polar bodies) are rarely found in any of the forms. In young cultures of Hofmann's bacillus, in those thirty-six hours or older, polar bodies are occasionally found, especially in the larger forms, but they are seldom so sharply defined as in diphtheria bacilli and are frequently ovoid and elongated. In Klebs-Loeffler bacilli, according to Denny,¹ polar granules are first seen as very minute objects after eight hours' growth, but do not become abundant until cultures have been growing for fifteen hours. They are found most frequently produced in cultures incubated at from about 34 to 36 C. (93.2 to 96.8 F.). Clubbing and segmentation are marked features.

Neisser's special stain should be used in the demonstration of these granules.

NEISSER'S SPECIAL STAIN¹

Solution 1:

Methylene blue (Grübler), 1 gm., dissolved in alcohol (96 per cent.)	20 c.c.
Distilled water	950 c.c.
Glacial acetic acid	50 c.c.

Solution 2:

Bismark brown	2 gm.
Boiling distilled water	1,000 c.c.

Solution 1 is used for from one to three seconds and solution 2 for from three to five seconds. The polar bodies are stained dark blue and the protoplasm brown.

Hofmann's bacillus begins to develop at a lower temperature (18 C. or 64.4 F.) than the diphtheria bacillus and the growth is more luxuriant. The former shows a whiter, softer, larger, and usually flatter growth than the latter on Loeffler's serum. The growth being more rapid, the colonies attaining considerable dimensions in the first twenty-four to forty-eight hours.

Hofmann's bacillus also shows a larger and whiter growth on alkaline serum; is more abundant on nutrient agar and glycerin-agar; shows a larger growth both on the surface and along the needle-tract in stab-cultures, more abundant on gelatin; on broth causes an earlier diffuse clouding of the medium and a greater alkalinity (acid is never produced); in glucose broth neither gas nor acid is produced, and there is an increase in the alkalinity; it does not produce acid even after prolonged growth in broth or Hiss' medium containing glucose, lactose, maltose, galactose, saccharose, levulose, dextrin, mannite or glycerin.

The diphtheria bacillus, in cultures from 36 to 48 hours old, shows the polar bodies much enlarged and occupying a large part of the club-like dilatations of the organisms; the polar bodies appear to be increased in number as well as in size, so that several are found in each bacillus.

The diphtheria bacillus in broth splits the meat-sugar contained in ordinary broth, producing acid, and thus changes the reaction of the medium, making it less alkaline, or even slightly acid. Roux and Yersin were the first to demonstrate these changes.

In glucose broth the diphtheria bacillus makes the culture-medium acid. This phenomenon was observed with glucose (dextrose), galactose, levulose and glycerin.

Lubowsky¹ suggested the differentiation of the two organisms by an immunization of animals with the non-virulent bacilli and tested the agglutinating properties of their serum to the diphtheria bacillus and Hofmann's bacillus, the former alone causing agglutination.

As a last resort in differentiating the two organisms, animal inoculation may be carried out, the diphtheria bacillus causing the death of a guinea-pig within from one to four days, while the bacillus of Hofmann proves innocuous.

CLASSIFICATION OF DIPHTHERIA BACILLI

Diphtheria bacilli have been classified in various ways. The one followed in the laboratories of the Philadelphia Board of Health was devised by Westbrook.

Wesbrook, Wilson and McDaniel¹ classify the organism according to its morphologic types, three main groups being used.

Group 1, Granular Forms: There are distinct spherical, ovoid or markedly rounded granules present. They label the forms from A to G. In each variety, excepting B, the granules show metachromatism. The granules are fairly uniformly found at one or both poles of the bacilli. The protoplasm not included in the granules stains with a much less intensity than the latter bodies.

Group 2, Barred Forms: These are distinguished by their irregularity of staining; bacilli present a distinct barred appearance as if segments of protoplasm had been actually removed. The darkly stained portions vary considerably in staining reaction both in different bacilli of the same variety and even in the individual bacillus. They vary in size and shape; metachromatism is not suggested. The number of dark segments varies from three to nine. Types A¹ to G.²

Group 3, Solid Color Forms: The organisms are of a solid or uniformly staining shape and size, and also some have the appearance of diplococci. Types A² to G.²

In the cases which we have reported above, Type C was present in one and Types C and D in the other. In other words, the organisms corresponded to Group 1, the granular form; Type C is of a curved shape, in which the protoplasm stains lightly excepting at the poles and occasionally at one point between the poles, where rounded, rarely ellipsoid metachromatic granules occur. This is the most common form encountered in the clinical cases. Type D is similar in most respects to C, but shorter, thicker and apparently straighter; the former is from 0.75 to 1 micron in thickness and from 2 to 3 microns in length, showing metachromatic granules at both poles and none in the center, and the latter is from 3 to 6 microns in length and from 0.5 to 1 micron in thickness, with both central as well as polar metachromatic granules.

CONTAGIOUSNESS OF DIPHTHERIA

It is extremely important to recognize diphtheria of the skin because of its contagiousness. Loeffler¹ found that bacilli from cultures dried on silk threads were viable for from three to four weeks; from small dried pieces of membrane he was able to obtain living bacilli in large numbers at the end of from four to nine weeks, and isolated colonies after thirteen to sixteen weeks; after sixteen weeks they could never be cultivated. From membrane dried on pieces of linen

and kept in the dark at room temperature, Roux and Yersin¹ were able to obtain numerous colonies at the end of three and four months. Abel¹ demonstrated living bacilli on a toy six months after the child was infected. The latter also has found bacilli sixty-five days after the disappearance of the membrane. Diphtheria bacilli have been found on pillows and bed-clothes (W. H. Park¹), on a sweeping-broom (Wright and Emerson¹), on a drinking-glass in common use (Forbes¹), and on a sucking-bottle (Weichard¹).

SUMMARY

Diphtheria of the skin may occur in several forms, in addition to the false-membrane type, the ulcerative, gangrenous, eczematous, impetiginous eczema-like, pustular, impetiginous, ecthymatous, vesicular (varicella-like), bullous, dermatitis herpetiformis-like, tumors and abscesses. Our two cases were of the bullous impetigo type, one terminating fatally.

Inoculation of the skin occurs by auto-inoculation, by means of infected articles, and from one person to another. It may occur primarily on the integument, remain limited to it, spread to the mucous membranes, or, more commonly, is secondary to throat, nasal or laryngeal diphtheria.

In cases of diphtheria of the skin the Klebs-Loeffler bacillus always has to be distinguished from the pseudodiphtheria bacillus (Hofmann's bacillus).

These two organisms differ somewhat morphologically, culturally and in animal inoculations. The diphtheria bacillus is particularly distinguished by the metachromatic granules (polar bodies), as shown best with the Neisser stain, by the acid-producing qualities, and by the fatal results on inoculating animals.

Diphtheria bacilli are grouped according to the Westbrook, Wilson and McDaniel classification.

These diphtheritic skin-lesions are a constant source of contagion, because they are frequently unrecognized for a considerable period. They may last over a long period or run a rapidly fatal course.

We wish to express our thanks to Dr. C. Y. White for assistance in the bacteriologic study and to acknowledge our indebtedness to the excellent chapters of G. S. Graham-Smith, in "The Bacteriology of Diphtheria," by G. H. F. Nuttall and G. S. Graham-Smith.

2022 Spruce Street—3944 Aspen Street.

ABSTRACT OF DISCUSSION

DR. HENRY C. BAUM, Syracuse: In a case bearing on this subject, the patient, a boy 11 years old, was admitted to our orthopedic ward with a discharging sinus of the hip-joint, near which were a number of vesicles and vesicopustules. When my attention was called to the case, a few days after admission, there was some elevation of temperature, and a culture made from the contents of the vesicles showed the Klebs-Loeffler bacillus. Throat cultures were negative, but we learned that the boy had been taking care of his little brother, who was suffering from laryngeal diphtheria. A number of cases of diphtheria subsequently developed among the children in the orthopedic ward. I have never made a search of the literature with regard to this subject, but have no doubt that diphtheria of the skin is of more frequent occurrence than is generally supposed, and probably some of us have overlooked such cases in the past.

DR. MARTIN F. ENGMAN, St. Louis: The subject of diphtheria of the skin is very important when one considers the number of cases that probably occur after diphtheria. Not only immediately, but possibly some little time after an attack of diphtheria the patient is probably a diphtheria bacillus carrier, and various methods have been devised to

destroy the local foci in these carriers. I have seen several cases of impetigo-like and eczema-like eruptions after diphtheria in which the bacilli were found in the skin lesions. Some years ago possibly ten, a very sad case came under my observation. A child had recovered from diphtheria and shortly afterwards developed an aural discharge, with some eruption about the ear. A child played with this patient, was stricken with diphtheria and died. The discharge from the eruption about the ear was then examined, and was found to contain the Klebs-Loeffler bacilli. These eruptions are observed not only after diphtheria, but also after many catarrhal conditions of the nose and throat, and after measles and grip, and it is well to examine bacteriologically any eruption about the mouth or ears. This bacillus varies so widely in its morphology and virulence, that the subject is really important from many points of view.

DR. M. HAASE, Memphis: What was the duration of the skin lesions in the two cases reported? If they occurred immediately after an attack of diphtheria, it was not surprising to find the bacilli in the skin eruption.

DR. A. RAVOGLI, Cincinnati: Before the introduction of Behring's antitoxin, I frequently saw cases of diphtheria eruption of the skin, especially about the lips and mouth, and sometimes near the genitals, but since the use of antitoxin I do not recall a single case of this kind. In the cases I formerly saw we used Monsell's solution with excellent results.

DR. H. N. COLE, Cleveland: Drs. Knowles and Frescoln justly laid much stress on the presence of the pseudo-diphtheria bacillus in a number of cases. In a series of several hundred routine cultures in cases of eczema, impetigo and dermatitis of the skin, this organism was encountered a number of times and it is very important to differentiate it from the diphtheria bacillus. The Neisser stain is the only one by which the distinction can be made.

DR. LEONARD D. FRESCOLN, Philadelphia: The cultures from the throat and from the skin were practically identical and one could not tell which was which. In connection with this subject of properly diagnosing possible infective lesions of the skin, three classes of skin infections should be kept in mind: First, those due to the Klebs-Loeffler bacillus; second, chancroidal infections in various parts of the body, and, third, deep ring-worm lesions. The possibility of a patient being a diphtheria carrier should not be lost sight of. In one case that came under my observation, the patient, a hospital nurse, made some complaint of her nose, and with the postnasal mirror a patch of diphtheritic membrane, typical in appearance and containing Klebs-Loeffler bacilli, was found. That nurse was certainly a diphtheria carrier.

DR. FRANK CROZER KNOWLES, Philadelphia: In one of the two cases we reported, the lesions had been present for four or five days before the patient came under our observation and in the other case only one day. We recently had an interesting pseudodiphtheria case at the Pennsylvania Hospital. The patient had an eczematous eruption on the back of the neck and shoulders, and on taking a culture, we found a pseudodiphtheria bacillus. An autogenous vaccine was made and injected and the patient recovered within a week.

Price of Radium.—According to Thomas Stephenson (*The Prescriber*, July, 1914), the price of radium, which has recently stood at about £20 (about \$100) per milligram, has shown signs of being reduced. Stephenson states that he was informed on good authority quite recently that radium salts could be obtained at £13 (about \$65) per milligram, but the strength of these is not stated. As the value of radium salts depends on the amount of the element radium they contain, the price must be reckoned not only on the degree of purity of the salt but also on the combining weight of the element with which the radium is combined. Thus pure radium bromid is worth less per milligram than pure radium chlorid because the bromid contains a smaller percentage of radium because of the greater atomic weight of bromin as compared with chlorin.