THE WIDE-SPREAD DISTRIBUTION OF DIPHTHEROIDS AND THEIR OCCURRENCE IN VARIOUS LESIONS OF HUMAN TISSUES.*

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PLATE 37.

The term diphtheroid is here used with the meaning employed by writers in recent literature, particularly as regards the description of organisms of supposed etiological significance. It is not our intention to classify the diphtheroids as a separate species. Many writers, however, suggest an intimate relation or even identity between diphtheroids and certain streptothrices, which may exist in some instances. The term pseudodiphtheria as applied to *Bacillus xerosis* or *Bacillus hoffmanni* would seem to represent a synonym, except that by a diphtheroid an organism outside of the diphtheria group is apparently meant. By a diphtheroid is indicated, therefore, a non-acid-fast, Gram-positive bacillus resembling morphologically, at least in one or more of its forms, the bacillus of diphtheria. The diphtheroids may present either bipolar granules, barred arrangement of the chromatin, or, as is usually the case, shapes corresponding to involution types of *Bacillus diphtheriæ; i. e.,* club, retort, mandolin, or other forms of unusual morphology.

In the problems of the etiology of such diseases as leprosy, Hodgkin's disease, and general paresis, there have been described organisms which are diphtheroidal in morphology and to which causal properties have been ascribed in whole or in part. In certain instances these organisms have fallen almost into oblivion since the true causal agents have been discovered, postulated, and accepted; in others they are held partly in abeyance; while in still others certain diphtheroidal bacilli are supported, although not finally accepted.

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There seems to be a tendency to view these diphtheroids, when found in the course of etiological investigation, from the standpoint of causal relation rather than from the more probable aspect of contamination. This is especially true of those organisms cultivated from tissues which are sterile as far as accidental contamination is concerned. Many strains grow but feebly, requiring special foodstuffs, while others cannot as yet be made to grow away from the original tissue, even under the most favorable conditions. It is a common practice to regard slow, delicate, or fastidious growth as indicative of pathogenicity, and to be incompatible with contaminating saprophytic properties. Therefore, it would seem that the widespread distribution of this type of organism in the human host and in nature as a whole is not fully realized. When the prevalent *Bacillus subtilis, Bacillus proteus,* staphylococcus, or other ordinary aerobic organisms are met with in bacteriologic work, they are discarded as irrelevant contaminators. However, should a diphtheroid be chanced upon, particularly if it be somewhat difficult to cultivate, one is apt to assume an etiological significance for this particular organism, and to undertake the establishment of such a property, without sufficiently considering the likelihood of its being present as an accidental or associated non-pathogen. Many diphtheroidal organisms of the acid-fast group, such as *Bacillus smegmatis,* are extremely difficult of cultivation, yet as far as is known they are non-pathogenic. The more rapidly and luxuriantly growing types of the group of diphtheroids are not easily mistaken, since they are so frequently encountered upon the skin surface, in the hair, and particularly in the protected natural cavities, the conjunctiva and genitalia. Even here, however, occasionally other types are encountered, which being apparently less saprophytic attract more attention.

In many instances organisms are obtained from fresh sterile human tissues which invite serious consideration as the causal factors of pathologic conditions on account of their source, their scarcity, their slow and often fastidious growth, and their diphtheroidal morphology. It need only be emphasized here that numerous workers have cultivated organisms from normal tissues. Wolbach and Saiki (1), after anesthetizing healthy dogs and searing the abdominal

walls with hot irons and employing instruments thoroughly flamed, succeeded in cultivating from the liver of these animals in twenty-one out of twenty-three instances an anaerobic spore-bearing bacillus. Nicholls (2) and Ford (3) have also shown that bacteria can be recovered from healthy organs by cultivation. Wrosczek (4) has demonstrated that bacteria can pass from the alimentary tract by feeding cultures of non-pathogenic, pigment-producing organisms to animals and recovering these from various organs.

The various conditions in which members of this group of organisms have been isolated and considered as causal factors embrace a large number of diseases. We wish briefly to discuss the more important of these conditions.

With the exception of the study of the diphtheroids of leprosy, there has been no attempt to confirm the findings of the different workers upon the various diseases in which such organisms have been described. Our purpose is to indicate the broad latitude of this large group, the scope of which seems to have been only partially realized in the past.

The Eye.—Probably one of the first conditions to be ascribed to a diphtheroid was what is known as xerosis conjunctivæ. From this condition an organism was repeatedly cultivated which was designated *Bacillus xerosis* by Kuschbert (5) and Neisser in 1884. Its presence, however, was later shown to be incidental and not connected with the production of the condition. Under the name of *Bacillus xerosis,* as pointed out by Park and Williams (6), observers have described organisms of widely varying characteristics, which serves to illustrate the general confusion concerning the majority of these organisms of the diphtheroid group as a whole.

Brain and Cerebrospinal Fluids.—The repeated recovery of an organism of a diphtheroid nature from the brains of general paretics led Robertson (7), Hoag (8), Robertson (9), McRae and Jeffry, and others to regard it as probable that this organism was the pathogenic factor, although no experiment furnished sufficient weight for the final acceptance of this hypothesis. Orr, Rows, and Robertson (10) considered that they had substantiated *Bacillus paralyticus* of Robertson by the experimental histopathological lesions produced in the rabbit. Gay and Southard (11), in the examination of cerebro-

spinal fluids removed post mortem from the brains of fourteen cases of general paresis, failed to obtain a diphtheroid in any instance. The demonstration of *Treponema pallidum* in the brains of such conditions by Noguchi and Moore (12), Noguchi (13), and by Nichols and Hough (14) has banished all thought of this factor. Here again we have a striking example of the mistaken impressions received concerning the part of the diphtheroids isolated from tissues. In this connection it should be noted that in the routine study of cerebrospinal fluids, diphtheroidal organisms are sometimes encountered, the significance of which seems to vary in different cases. To illustrate this fact we shall cite a few typical instances. One fluid which when freshly drawn was reported negative for bacteria was found to contain after two days' standing numerous thin, beaded, sharp-ended, Gram-positive diphtheroids, easily grown in pure culture. A second case, that of a four day infant, showed at autopsy a general purulent meningitis from extension of a *Staphylococcus aureus* infection of an ulcerated spina bifida sac. Twenty-four hour cultures made from the spinal meninges showed numerous staphylococci with a few colonies of a Gram-positive diphtheroid. In both cases the organisms were evidently contaminators. It is more difficult, however, to account for the organism found in a third case. This was an adult male with high temperature and opisthotonus. On lumbar puncture forty cubic centimeters of a slightly turbid fluid were removed, which upon immediate centrifugalization showed many pus cells and numerous large, irregular, Gram-positive bacilli, varying from solid coccoid forms to those simulating the large, barred, club forms of *Bacillus xerosis*. These were found to be still numerous in a specimen taken twenty-four hours later, but subsequently they diminished in number until they disappeared, and the case recovered about a week after the first puncture. Upon none of the ordinary media, aerobically or anaerobically, could more than a slight, temporary multiplication be obtained.

Blood Cultures.—In the course of routine blood culture work, diphtheroids occasionally have grown out on the medium employed either together with organisms such as *Bacillus typhosus* and *Streptococcus pyogenes* or in pure culture. Their occurrence in conjunction with known pathogens, together with the fact that refinement

of technique diminishes the frequency of their occurrence, stamps them as frank contaminators. Their isolation, therefore, in blood culture from diseases of unknown etiology, such as typhus fever (15), etc., must be regarded with due conservatism. The recovery of non-pathogenic, non-toxin-producing strains of supposed *Bacillus diphtheriæ* in cases considered to be diphtheria septicemia, in certain instances may be thus explained. That there may occasionally occur more or less generalized invasion of diphtheroids, however, is held probable. An instance suggesting this was encountered in a case of systemic blastomycosis which came to autopsy. In the purulent material from abscesses in the neck and pancreas and from cavities in the lungs which contained numerous yeast cells there were demonstrated in smears many Gram-positive diphtheroids. Cultures were obtained from these lesions which proved to be identical.

An interesting case that might be mentioned here was one in which pus was obtained upon aspiration of the chest, that showed in stained smears very numerous thin, non-acid-fast diphtheroids, easily grown in pure culture. The case subsequently recovered and was lost sight of.

Lymphoid Tissues.—During the past summer lymph nodes, usually inguinal or femoral, have been aspirated in approximately thirty cases presenting themselves at the Charity Hospital, in order to determine the possibility of *Bacillus pestis* infection. In several of these cases a few diphtheroids have been found in the smears obtained by puncture which with a simple stain were bipolar. As has been pointed out by one of us (16), it is important to bear this fact in mind in the study of simple stained smear preparations for the diagnosis of early plague infection. From three of these lymph node aspirations cultures of these confounding organisms have been recovered. It is worthy of note that their presence seems much more frequent in chronic hyperplasias than in acute infections of lymph nodes.

The lymphadenopathy which constitutes the lesion known as Hodgkin's disease has but recently been ascribed to a diphtheroidal type of organism. From the lesions Fraenkel and Much (17), de Negri and Mieremet (18), Bunting and Yates (19), Billings and Rosenow (20), Lanford (21), and others have reported the recovery

of diphtheroids of pigment- and non-pigment-producing varieties. Lanford reports the recovery of two strains of these bacilli from the spleen of splenic anemia. Bunting, Yates, and Kristjanson (22) have recently reported the cultivation of their *Bacillus hodgkini* from the spleen of so called splenic anemia. They argue from these findings a relation between this condition and Hodgkin's disease. We have cultivated diphtheroidal organisms from tuberculous glands, lymphosarcoma, and Hodgkin's disease, but have not attempted to carry out a comparative study of our cultures and those isolated from Hodgkin's disease by other workers. Strains of diphtheroids resembling those recovered from lesions of Hodgkin's disease have been cultivated by various workers from splenic anemia, lymphosarcoma, tuberculous adenitis, and other lesions. While lesions have been produced locally by the injection of these organisms, no general picture of the disease has resulted. Still it must be remembered that generalized lesions have been produced with known saprophytes intravenously injected in large amounts and at sufficiently frequent intervals. Again, in studies bearing upon the causation of hepatic cirrhosis de Vieche (23) by introducing certain bacteria into the intestinal tract, and Weaver (24) by subcutaneous injection of bacilli of the colon group obtained definite proliferation of the interstitial connective tissue of the liver. In this connection Hektoen's work (25) is of special interest, as he produced similar lesions with a pseudodiphtheria or diphtheroidal organism. Furthermore, we can here refer to the acid-fast group which forms a more striking analogue for confusion in the identification of the Hansen bacillus culture. Duval and Harris (26) and Machow (27) have produced definite generalized nodular lesions in rabbits and white rats with intravenous injection of such saprophytes as the bacillus of timothy hay, *Bacillus smegmatis,* and the dung bacillus of Moeller.

Tumors.—In order to ascertain whether diphtheroids were present in tumors, bits of tissue from six specimens, usually warm from the operating room, were planted on various media. These specimens included excised nodules of two cases of lymphosarcoma, two leiomyomata, one from the uterus and the other from the back, a fibroma removed from the pectoral muscle, and a necrotic area of an hepatic carcinoma obtained post mortem. In all cases the surface

of the tissue was thoroughly seared and the material for cultivation removed from the deeper levels. After periods ranging from three days to two weeks colonies of diphtheroids of different types appeared on or about certain of the planted bits from all these except the uterine leiomyoma. In three cases diphtheroids alone were cultivated; while from the tumor of the back the staphylococcus, and from the liver the colon bacillus were also obtained. In several instances the formation of the colony within the tissue fragment, its enlargement, and final eruption upon the surface were watched, thus eliminating the possibility of contamination through faulty technique.

In extension of this work several cultures of more or less rapidly growing diphtheroids were obtained from other tissues removed at surgical operation and planted upon nutrient media. One of these organisms is of particular interest since it belongs to the acid-fast group. From an unopened appendix, supposedly sterile, a bit of the meso-appendix was removed and planted upon blood serum. After two weeks there appeared upon the tissue itself a cadmium yellow colony. Smear preparations when stained showed a typical Gram-positive diphtheroid, which when stained by Gabbett's method proved to be strongly acid-fast. Subplants grew well upon the ordinary laboratory media and liquefied completely blood serum and gelatin. The culture has not been definitely identified, but is apparently one of the many saprophytic acid-fast strains. This isolation presents an instance of the liability of occasional contamination with a strongly acid-resisting saprophyte in cultivation experiments.

Leprosy.—Kedrowski (28), Bayon (29), Williams (30), Wolbach and Honeij (31), and others have isolated and cultivated from the leprosy lesion diphtheroids to which they have assigned definite causal properties, each regarding his culture as a stage in the life cycle of the Hansen bacillus. Kedrowski (32), in particular, reasons a mutation of the non-acid-fast diphtheroid cultivated by him from the tissue of lepra nodules, because upon injection into animals, he recovered only an acid-fast growth. Campana (33) and Babes (34), who separated non-acid-fast diphtheroids and streptothricial forms supposedly in pure cultures from leprous tissues, consider that Kedrowski was working originally with a contaminated culture. Throughout this experimental work upon the cultivation of *Bacillus*

leprœ, conducted by Duval and his assistants (35, 36), we have from time to time isolated similar non-acid-fast diphtheroids which when injected into animals have never shown evidence of having acquired acid-fast properties. These strains of diphtheroids have been maintained unchanged in culture for several years.

This confusion of acid-fast and non-acid-fast organisms recovered from the lesions of leprosy has a parallel in the following study of tuberculous tissues. For example, we have repeatedly recovered cultures of non-acid-fast diphtheroids from tissues, which by sections and smears have proved to be tuberculous. Several tissue bits were removed from a tuberculous axillary node. One of these was macerated and injected into a guinea pig that died of tuberculosis in five weeks. The remaining tissue fragments were planted in six tubes of various culture media and after incubating for one week, five of these showed staphylococci, either alone or mixed with diphtheroidal bacilli. In one tube the tissue appeared to have remained sterile. Smears from this, however, showed numerous small groups of diphtheroids, which were apparently in pure culture and subsequently became a comparatively free grower. The original tissue culture was later inoculated into a guinea pig, and after six weeks the animal showed signs of tuberculosis. From the lesions *Bacillus tuberculosis* was cultivated, but no non-acid-fast diphtheroid. In such an instance the contaminating diphtheroid and the specific acid-fast bacillus were known entities, and one cannot reason that the non-acid-fast diphtheroid is part of the life cycle of *Bacillus tuberculosis*. That Kedrowski (32) was handling a mixture of an acid-fast bacillus and a non-acid-fast diphtheroid, injection of which mixture into an animal occasioned the disappearance of the non-acid-fast diphtheroid and the recovery of the acid-fast organism, is suggested by this experiment.

For the purpose of ascertaining the liability of skin contamination in the leper, we obtained material from the Louisiana Leper Home. Nodules of tissue in the tubercular form were removed from areas which were previously sterilized with soap and water and tincture of iodin. Portions were planted upon agar, Loeffler's blood serum, and numerous special media. Surface cultures were made from the lesions of trophic types of the disease, as represented by cases with

contractures and atrophies and the partly or completely cicatrized areas of previous lesions. Similar cultures were made from macular lesions. As controls and to ascertain the prevalence of this type of organism upon the skin of lepers, similar cultures were made from uninvolved skin areas of eleven cases of various types of leprosy. Growths appeared in from one to ten days, and in many instances showed staphylococci and other contaminating organisms. In some the diphtheroids were so overgrown that they could not be recovered. The results are shown in table I.

TABLE I.

Leprosy.

No. and types of cases.	Media.	Results.
15 tissue bits, from 5 nodules excised from 4 patients with tubercular type	Tryptophane agar, tryptophane blood agar, tryptophane ascitic agar, and ordinary blood serum and nutrient agar	7 growths of diphtheroids from 4 cases. 3 heavy growers, one being dirty yellow, another dull red, and the third white. 4 slow growers, growth simulating that of *Streptococcus pyogenes*. All were non-acid-resisting.
5 plants from scrapings over nodules of 5 other cases with tubercular type	Blood serum and nutrient agar	2 growths of free growing diphtheroids. Non-acid-resisting.
10 plants from scrapings of macular lesions of 10 such cases	Blood serum and nutrient agar	No diphtheroids found.
12 plants from scrapings of lesions of 12 cases with trophic type	Blood serum and nutrient agar	9 growths of diphtheroids, 8 free growing, of which 4 were cream color and 4 white, 1 slow grower, streptococcus-like. 2 of these cultures showed streptothrices.
2 plants from conjunctival sac and 1 from a comedo	Blood serum and nutrient agar	All showed diphtheroids, those from the eye corresponding to *B. xerosis*.
11 plants from normal skin areas of 11 patients with various types	Blood serum and nutrient agar	6 growths of diphtheroids. Three were creamy, two lemon yellow, and one slow growing and streptococcus-like. 2 of these cultures showed streptothrices.

Summary.—From 45 different lepers presenting various forms of the disease, 27 growths of chromogenic, non-chromogenic, free growing, and slow growing diphtheroids were obtained. Six of these were from normal skin areas. It is noteworthy that none of these

organisms were acid-resisting when the ordinary standard methods of decolorization were employed.

All the various morphological characteristics of *Bacillus diphtheriæ* were represented in these cultures. Many of them were shown to be weakly acid-resisting, if the mineral acids used to decolorize were as dilute as 2.0 per cent.

These results indicate the prevalence of bacilli of the diphtheroid type and the possibility of encountering them where the cultivation of *Bacillus leprœ* is attempted.

Skin.—To determine the presence of diphtheroids in miscellaneous skin lesions, cases of pellagra, acne, marked comedones, etc., were selected. The skin areas were carefully cleansed with 95 per cent. alcohol, and the pus, parts of the scales, and the comedones were cultured on ordinary laboratory foodstuffs. Forty such plants were made, and while a large number contained staphylococci, twenty-five showed definite diphtheroidal bacilli, many of which were isolated in pure culture. Twenty-three were of a rapidly growing character, and two grew slowly and scantily. The majority of these diphtheroids presented a moist cream colored growth; one was salmon in color, one yellow, and some were quite white. All stained by Gram's method, and the salmon colored chromogenic strain was acid-resisting. This particular organism was recovered from a moist eczematous lesion of the neck. In two of the twenty-five tubes containing diphtheroids, unidentified streptothrices were found.

Various workers such as Castellani (37), Chalmers and O'Farrall (38), Chalmers and Stirling (39), and Johns (40) have cultivated from the hairs of trichonocardiasis a bacillus which they regard as an integral unit of the life cycle of the *Nocardia tenuis;* they also procured colonies of cocci. The bacillus from description and plates is of a distinctly diphtheroidal character. While, of course, we recognize that this type of organism might form a phase of higher plant life, still because of the presence of known irrelevant organisms in some of their cultures and in the light of the extensive presence of diphtheroids on the skin, the question of contamination is here again to be considered. We may mention particularly a case regarded by the dermatologist as probable sporotrichosis, which recovered rapidly with antisyphilitic treatment. Three nodular lesions were present,

one on the dorsum of the wrist and two on the forearm. After careful sterilization the skin was incised and several subcutaneous tissue bits were removed. These were planted in many tubes of various media, and after incubation for six days colonies appeared on the tissue bits in two of the tubes. Both were chromogenic. One was yellow, grew well in subplant, and presented chiefly short chubby bacilli, while the other was of a light yellow color and grew very feebly, showing marked pleomorphism.

The great liability of skin contamination by diphtheroids is again demonstrated by their cultivation from the various cutaneous disturbances selected for cultural study.

Air.—A series of eighteen plates measuring fourteen centimeters in diameter was exposed to the air for varying periods of time. Nine of these contained blood agar, and six contained blood serum. As an occasional liquefier destroys a plate of blood serum, blood agar was found to be preferable. Thirty minutes' exposure yielded a colony seeding which could be advantageously picked after the necessary incubation. Three different plates were exposed on different days so that the daily air currents would present different atmospheres for examination; likewise different rooms were chosen to form a varied environment of search. The plates were incubated for forty-eight hours, with results which are shown in table II.

TABLE II.

Aerobic Organisms.

Plates.	Time.	Results.
4 plates, 14 cm. (2 of blood agar and 2 of blood serum)	15 min.	3 colonies of diphtheroids.
10 plates, 14 cm. (8 of blood agar and 2 of blood serum)	30 min.	29 colonies of diphtheroids. 7 colonies distinctly acid-fast.
4 plates, 14 cm. (2 of blood agar and 2 of blood serum)	45 min.	6 colonies of diphtheroids.

Summary.—18 plates showed 45 colonies of diphtheroids. Of these, 7 were of an acid-fast nature. They were mostly chromogenic and varied as follows: 17 salmon, 7 chocolate brown (probably in part due to the pigment of the blood agar), 6 lemon yellow, 5 pink, 4 white, 3 distinctly red, and 3 were colorless and grew slowly.

The colonies varied in size from 0.5 mm. to 4 mm., averaging about 2.5 mm. They were round and were sharply defined in contour. All were moist with the

exception of the three small, colorless colonies which grew slowly in transplants and assumed the appearance of an influenza culture.

The results demonstrate that diphtheroidal bacilli are readily obtained from the atmosphere, and show the possibility of contamination through this means.

Aerobic diphtheroids have been recovered by McNaught (41) from water. We have also isolated them from urine and feces.

DISCUSSION AND SUMMARY.

It is evident from this work and from the work of others that organisms having diphtheroidal morphology are wide-spread in their distribution in the human body. They are readily isolated from miscellaneous skin lesions, probably thriving better in pathological soils as saprophytes than in normal skin, although they can be obtained quite easily from the latter. Various strains can also be cultivated from the air, at least in this environment.

Aside from the air and superficial parts of the human body, diphtheroids have frequently been isolated from the deeper regions. Hoag, working on general paresis and certain conditions of the lung, cultivated 199 diphtheroids, the majority of which were from the lungs and respiratory tract, also in some instances from the liver and spleen. He considered 146 of these isolations to be identical and classified them as organism x. Robertson, McRae, and Jeffry likewise in cases of dementia paralytica isolated what they considered an identical strain which was closely related to the Klebs-Loeffler bacillus, from the inflamed ileum, stomach, tonsils or pharynx, bronchi, lung, and brain. They differentiated their organism from *Bacillus hoffmanni* and *Bacillus xerosis.*

The fact that these organisms have a somewhat unusual morphology, resembling as they do an organism of known pathogenicity, namely, *Bacillus diphtheriæ,* should form no basis for assuming that they, too, are apt to possess these qualities. When we consider the number of simple bacillary contaminators analogous to such organisms as *Bacillus anthracis, Bacillus typhosus,* etc., we can readily see how frequently this occurs.

The majority of the diphtheroids isolated by us stain by Gram's

method; nearly all fail to resist the standard acid-fast methods, although use of the very low strengths of mineral acids allows the fixed stain to remain in whole or in part. There is consequently nothing unique in their tinctorial properties.

These bacillary strains differ considerably in their powers of cultivation. While the majority grow readily upon the ordinary laboratory foodstuffs, others require special products for their growth and still others cannot be grown even where special effort has been made. The fact that many strains grow slowly no doubt enhances their consideration as disease producers, as it seems to argue their difficult adaptation from their preëxisting site to an artificial environment. This reasoning does not apply when we consider the numerous causal agents that can so readily be cultivated directly from the diseased tissue, and again the fact that many saprophytes in their natural habitat are incapable of growth *in vitro* (figure 1).

The most striking of the biological features of these cultures is their wide range of pigment production. While many are white or creamy white, the majority range from a canary yellow to a distinct crimson, and one of the cultures recovered from a leper was a very deep dusky red or garnet. Numerous combined shades of yellow and pink, including such colors as salmon and orange, were present. Some cultures were distinctly pink, others varied in depth of color to a crimson. While many cultures of identical colors were obtained, the majority of strains showed some slight variance of shade.

While, of course, the inoculation of diphtheroidal cultures produces varying degrees of localized inflammation if employed in sufficient dosage, probably for the two-fold reason of acting as a foreign body and liberating proteolytic substances, still the diphtheroids isolated in the past have never been able to reproduce the clinical picture of the various diseases from which they were cultivated. The apparent reproduction of lesions in general paresis, in hepatic cirrhosis, and in leprosy does not form an ultimate postulate for the acceptance of organisms as specific etiological entities. This is evidenced by the fact that certain known saprophytic organisms when used as controls are capable of producing the same results.

It seems clear that organisms as broadly distributed as the diph-

theroids should be suspected as contaminators when met in experiments bearing upon etiology. They should be viewed primarily in the same light as the staphylococcus and the various known contaminating bacteria. It is apparent that this type of organism has been regarded too much from the standpoint of pathogenicity. It is, of course, probable that among this large group there may be a few pathogenic types.

CONCLUSIONS.

1. Diphtheroids are widely distributed in nature. They are present in the air, on the body surface, and at times through contamination or are indigenous in the deeper tissues.

2. Diphtheroids constitute a broader field of saprophytism than is generally appreciated. While some strains may represent pathogens, their aggregate is patently not of the disease-producing variety.

3. Diphtheroids can be cultivated from various pathological tissues to which they bear no etiological relation, such as lesions of tuberculosis, leprosy, blastomycosis, tertiary syphilis, and tumors of various types.

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EXPLANATION OF PLATE 37.

The illustration affords some idea of the growth and appearance of representative isolations in the chrome series.

Cultures D 17, D 29, and D 32 are from tumors, and D 21 is from an appendix removed at operation. Cultures D 74, D 75, D 76, D 79, D 81, D 85, and D 88 are chromes recovered from air. D 58 is from the feces of a case dead of *B.*

aërogenes capsulatus infection. D 52 was obtained from a blood culture. D 49 is one of the chromogenic strains cultivated from acne.

D 17, D 21, D 29, and D 52 present irregular, granular, wrinkled growths, somewhat dry in appearance. Culture D 21 imbeds itself slightly in blood serum, possessing to a minor extent a liquefying property.

D 49, D 58, D 79, D 81, and D 85 show a more or less smooth surface and are moist.

D 32, D 74, D 75, D 76, and D 88 grow very heavily, appearing quite thick; the surfaces are smooth and glistening, and the growths are extremely moist.

The chromes produced by these cultures are as follows: 17, a cream yellow; 21, pink; 29, deep orange; 32, red; 49, pink, but darker than 21, and its growth is smooth; 52, cream white or ivory; 58, a very dark pink approaching red; 74, salmon; 75, cadmium; 76, orange; 79, canary yellow; 81, cream; 85, yellow; 88, a pinkish salmon.

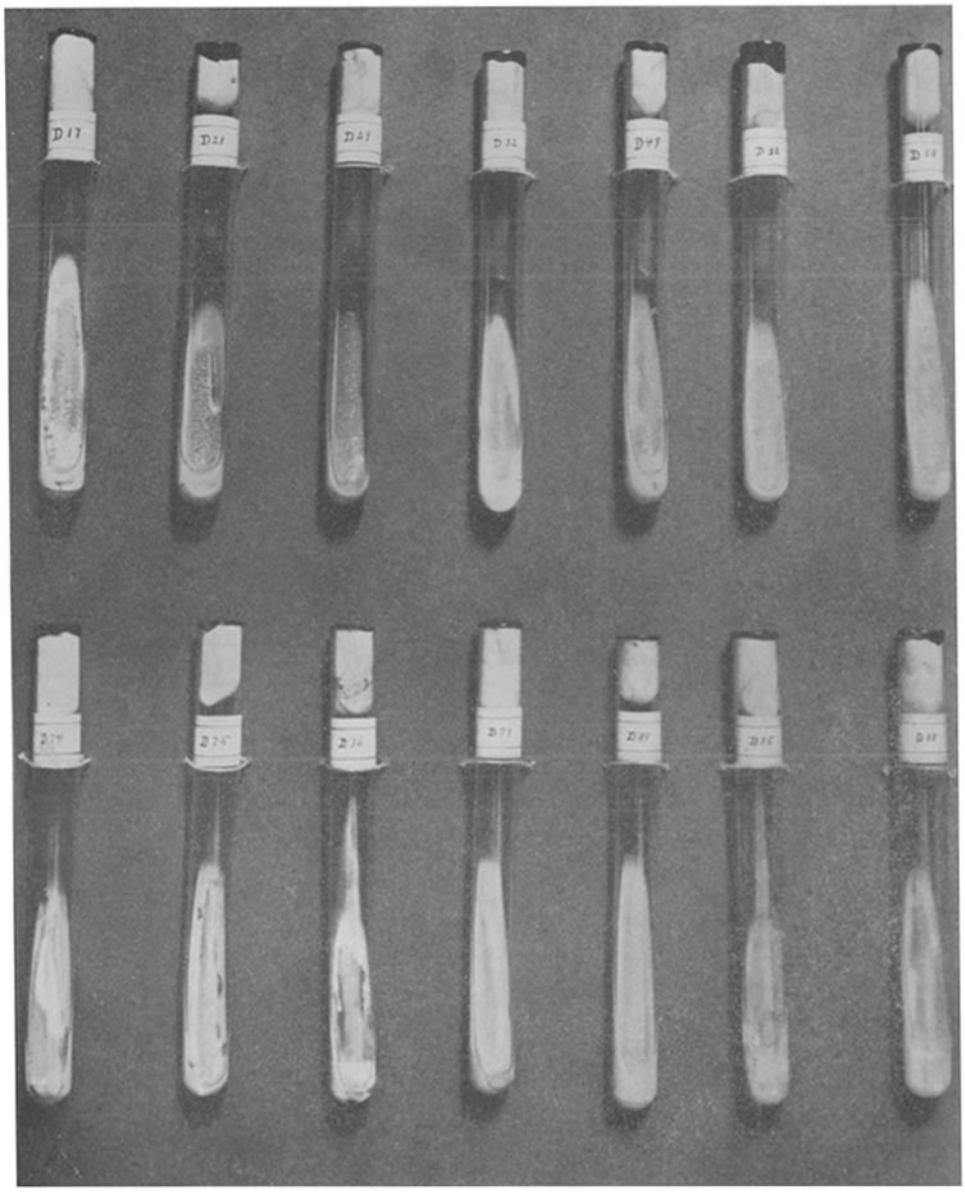

FIG. 1.

(Harris and Wade: Distribution of Diphtheroids.)