SEROLOGICAL RELATIONSHIPS AMONG MENINGOCOCCI

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THE MENINGOCOCCUS

Interest in the meningococcus has waxed and waned with the epidemics due to this microorganism. During waves of cerebrospinal fever, intensive study of the incriminated organism has been made, whereas, during the years between, other emergencies have crowded such studies into the background. Each wave of meningococcus meningitis has brought substantial contribution to knowledge, but continuity was lacking, and there has been little consolidation of the information gained. These troughs between the peaks of interest in the meningococcus are probably responsible, in part, for the tendency of new groups of workers in the field to overlook the background of information accumulated during past years by their predecessors. Long known fundamental facts are sometimes reported as new and sometimes disregarded altogether, whereas undue emphasis may be placed upon relatively unimportant recent observations. In no phase of this situation is the lack of coordination more evident than in the confusion which surrounds the classification of the meningococcus. Recent work has added new information, and some increase in the incidence of meningococcus infection has again awakened interest in this microorganism. Hence, an attempt to clarify the relationship among meningococci, and especially to correlate with each other the various classifications that have been proposed, seems timely. Literature in this field is voluminous, and a brief review may aid in orientation of the confused worker.

Serological differences among meningococci were reported first by Dopter in 1909 (20) when he found some nasopharyngeal strains that were not agglutinated by his meningococcus antiserum although they did give complement fixation. He designated these as parameningococci. Later Dopter and Pauron (21), in 1914, separated these by agglutinin absorption into *alpha*, *beta* and *gamma* parameningococci, *alpha* being most commonly and *gamma* least commonly encountered.

During the years of World War I meningococcus meningitis had wide spread incidence, and the case fatality rate was very high, especially among the armed forces of the countries involved. Flexner (26), 1913, reported serum treatment in thirteen hundred cases, and Wollstein (70), in 1914, recommended that Dopter's parameningococcus be included among the meningococci used in production of therapeutic serum as it was different from those which she had described as "normal" and "irregular". Hence, the 1914–1918 period brought intensive research on the classification of the meningococcus with the end in view of improving treatment.

British workers did a large share of this work. During 1915 Gordon and Mur-

ray (29) described the separation of meningococci recovered from spinal fluids into Types[1] I, II, III and IV by means of the absorption of agglutinins. In a later report Gordon (30) stated that 98% of 350 strains fell into these four types although absorption of agglutinins was often necessary to distinguish them. Tulloch (67) found that 66% of 354 strains could be placed in the four Gordon-Murray types by simple agglutination; the remainder required absorption.

Not all British investigators working with meningococci agreed with this four type classification. Others considered it sufficient to recognize two broad main groups of meningococci, which could be clearly separated by simple agglutination. Arkwright (3), in 1915, described two main groups of meningococci which he considered to be the same as those of Dopter. Ellis (22), also in 1915, designated his two groups as Type I and Type II, stating that Type I occurred more frequently than Type II during the epidemics that he had encountered, and that he believed Type II to be identical with the parameningococcus of Dopter. Griffith (32), 1916, divided his strains from spinal fluid into two serological groups, and in a later communication (33), 1918, reported that nasopharyngeal strains also fell into these Groups I and II. He found that nasopharyngeal strains were more often of Group II, whereas spinal fluid strains were about evenly divided between the two groups. Working independently, Scott (63), 1916, made studies similar to those of Griffith with comparable findings. In a second report, 1918, (64) he stated that by means of absorption of agglutinins he found many more than four types, but that all fell into two main groups. Andrewes (2), 1917, in an historical review, summarized the work of Griffith and Scott, as well as that of others, and offered the hypothesis that the meningococcus contains two antigenic components that are rarely evenly balanced; thus, two primary Groups I and II emerge. Both Gordon and Andrewes considered Group I strains to be more pathogenic than those of Group II. Fildes (25), 1920, obtained similar results by way of a different approach to this problem. He used a polyvalent serum for classification by absorption of agglutinins and on this basis placed his meningococci into two broad groups. He found Gordon and Murray's Types I and III to be so closely related that when monovalent sera, used for agglutination, were prepared from standard strains, a change in standards could result in an apparent change of type.

Workers in the United States quickly adopted the Gordon-Murray four type classification. Hitchens and Robinson (37), 1918, used monovalent sera prepared from Gordon-Murray strains to type their cultures of meningococci. Although they referred to performance of absorption agglutinations, they did not state how often such a procedure was necessary. Butterfield and Neill (15), 1920,

[1] Considerable confusion has attended the designation of subdivisions of the meningococcus as "groups" and "types", some workers even using, or rather misusing, the terms interchangeably. According to the International Code of Nomenclature adopted in 1947 (38), the term "group" should be reserved for primary serological divisions. Serological subdivisions within the group should be designated as types. Although this code was not formulated until recent years, the principles involved have been followed from the beginning of the serological classification of the meningococcus and no confusion need result if these fundamental definitions are kept in mind.

at the old Hygienic Laboratory typed 90% of their spinal fluid cultures on the basis of standard strains checked by Dr. Gordon. They found that Types I and III were often very difficult to separate. Wadsworth, Gilbert, and Hutton (69), 1921, applied the Gordon-Murray classification to a large group in their own strains. They found Types I, II, and III to correspond to the "normal", "para", and "irregular" types of Wollstein but did not find any strains corresponding to Gordon and Murray's Type IV.

Meanwhile, in France, Nicolle, Debains, and Jouan (47), 1918, described their classification of meningococci, placing their strains in 4 types which they designated as A, B, C, and D. Exchange of strains with the British workers indicated that Type A corresponded with Types I and III of Gordon and Murray and Group I of the other British workers, whereas Type B included Gordon-Murray's Types II and IV and the broad Group II of the other workers. Type IV was too rare to be studied adequately. The French C and D did not seem to correspond with any British types.

In his comprehensive monograph published in 1929, Murray (45) showed that all of the described classifications of the meningococcus could be correlated. He showed this correlation in tabular form including also the designations of serological subdivisions used by Pullon (unpublished) in South Africa and at the Rockefeller Institute in the United States (70). Murray urged that, since there was general agreement among all investigators, a conventional nomenclature be adopted to avoid confusion. He proposed a tentative division of meningococci into four main groups, A, B, C, and D, and a designation of types within the groups by roman numerals. The converse of this practical suggestion, made independently at the Paris Conference of the Health Section of the League of Nations (28), in 1922, recommended that groups be designated by roman numerals and types by added letters; as, *i.e.*, Ia, IIb, etc. This material was not published until 1935, and no international agreement was ever obtained.

During the years 1928–1941, which included two epidemic periods, Branham and her co-workers studied more than one thousand strains of meningococci recovered in the United States, chiefly from spinal fluids. They typed[2] the first 250 strains according to the Gordon and Murray scheme (7), using as a basis for this classification: (a) standard cultures originally obtained from the Rockefeller Institute, (b) standard type strains received from Dr. Murray, and (c) dried bacterial antigens of these type strains preserved *in vacuo* from Dr. Gordon. All of the living cultures of standards were old strains, having been maintained in the laboratories for at least a decade, but Dr. Gordon's antigens prepared from these same strains had been dried soon after their isolation. All of Branham's first 250 strains were placed in the four Gordon-Murray types except 6% which later proved to be *Neisseria flavescens* (6) and *not* meningococci. The Type II and Type IV cultures found at this time were easily identified by simple agglutination. On the other hand, Types I and III were so closely

[2] The word *type* has been used as a verb for so long a time to apply to the determination of serological subdivision, whether it be a group or a type within a group, that it seems inadvisable to try to substitute another word for it.

related that, not only was absorption of agglutinins usually necessary, but a change in strains from which the serum was prepared often resulted in a switch in types, especially with the broader overlapping strains (8). The conclusion was inevitable that Types I and III should be considered together as a group, first called Group I–III, and later merely Group I. Dividing Group I into Types I and III by absorption of agglutinins revealed interesting serological patterns and epidemiological trends not of enough practical importance to justify the labor involved in doing this as a routine procedure (9). During later studies, *i.e.*, after 1930, the designation Group I was used to include both Type I and Type III, and Type II was called Group II (10). Branham's study brought together data which showed that in all epidemics in the United States, for which typing records are available, Group I has been predominant, comprising 95–96% of the strains examined during the peak of the outbreaks, whereas Group II was responsible for most of the cases during nonepidemic years (9). This latter finding is well illustrated by the study of Silverthorne and his co-workers (65); they found 50 of 51 sporadic cases in children during the 1931–38 period to be due to meningococci of Group II.

Adequate discussion of the classification of the meningococcus is impossible without consideration to some extent of its epidemiology. Outstanding work was that of Rake whose intensive study of an outbreak and especially of the carrier state (59, 61) gave additional evidence of the role of Group I in epidemics. He showed that Group I carriers are apt to be transient and few during endemic years, whereas chronic carriers most commonly harbor Group II strains which they may retain for years. Miller's use of gastric mucin (40) in producing meningococcus infections in mice gave Rake a tool which he used (60) to show that the virulence of Group II strains was, as a rule, lower than that of Group I strains. During these studies Rake described three additional types of meningococci: Type V, related to Group I, and Types VI and VII, related to Group II (59). Unfortunately, cultures representing these new types were not preserved, and other workers had no opportunity to examine them.

Several contributions to knowledge of the meningococcus which have aided classification were made during this period. Rake (56), 1931, following the technique of Baker (4), pointed out the occurrence of capsules on some freshly isolated strains as compared with the lack of capsules on old stock strains and suggested the association of the capsules with a specific polysaccharide. Rake and Scherp actually found (58) such a specific substance and showed it to be a sodium salt of a polysaccharide acid (62). The identity of this substance from Type I and Type III strains offered additional evidence of their unity as Group I. This specific polysaccharide is responsible for the "haloes", first described by Petrie (50), 1932, as being formed on immune serum agar plates by virulent smooth meningococci of the homologous group, and which indicate virulence and antigenicity of meningococcus cultures as well as the presence of specific antibody in the immune serum. During the later days of serum therapy, such a "halo" technique was a valuable tool in choosing a good serum for a given meningococcus strain as well as an aid in preliminary standardization (11, 52) of serum.

Rake emphasized that incubation of agglutination tests at 37 C for 2 hours gave a true group specific flocculation, whereas the older method of incubating at 56 C overnight resulted in so much agglutination that crossing obscured specific reactions (57). Now agglutination could be made more clear-cut by using smooth specific strains for preparation of antisera by short term immunization and by employing 37 C as the temperature for incubation. Capsule swelling with specific sera was introduced for typing by Clapp (16), in 1935, was described at greater length by Beckler (5) and by Milner and Shaffer (44) and has come into wide use since then. An advantage of this capsule swelling method of typing is its speed and its economy of materials; a drawback is that it cannot identify Group II strains since no capsules on strains of this group have been demonstrated.

During the epidemic of 1935–37 a hitherto unrecognized group of meningococci became common in the United States. Since these strains were obviously not of Group I, they were at first considered to be atypical members of Group II. Cohen reported these first in 1940, (17). Later Branham (13), 1942, designated these strains tentatively as Group II *alpha*, following the precedent set by Dopter (21) when he described his *alpha*, *beta* and *gamma* groups of parameningococcus. Because of this designation many bacteriologists have concluded that these strains formed a type within Group II. Those who have worked with these microorganisms believe that they form a definitely independent group in themselves and are not a type within Group II. Group II *alpha* strains are good antigens, usually virulent for mice, and have a specific capsular substance which is distinct from that of Group I but which has not yet been chemically identified.

Reference has been made earlier in this paper to the status of knowledge at the beginning of World War I when laboratory workers were just beginning to be aware that serological differences among meningococci existed. The beginning of World War II brought out conspicuously the great advance in knowledge and the improvement in tools and techniques for the bacteriologist in this field. These advances grew out of the efforts of many people so that it is difficult to attribute many of them to individual workers. The intensive work of both Miller and Rake over a long period of time aided in establishing the soundness of many of these procedures although numerous others contributed.

Some of these useful technical aids were: recognition of the importance of using fresh smooth cultures (56), methods of keeping them in such a state, as with the "lyophile" apparatus (27), criteria for judging their antigenicity and specificity as with "halo" formation (11, 50, 52), and their virulence as with the mouse-mucin technique (40); the use of young 5–6 hour cultures for antigen suspensions (41); incubation of agglutination tests at 37 C for 2 hours to get specific results instead of at 55 C for 18 hours as had been done in former times (41, 57); the rapid agglutination technique described by Noble (48) which facilitated typing in the field as well as aiding quick diagnosis in the hospital laboratory; and the capsule swelling (5, 16, 44) technique which made typing possible, even at the bedside, in infections due to Groups I and II *alpha*.

Added to these technical advances was the knowledge gained about the carrier state: that it is not so much the number of carriers that constitute a menace, as it is the nature and virulence of the meningococci that are being carried. For example, during an epidemic due to Group I, a few group I carriers would be much more significant than many harboring strains representing Group II. Observations of Laybourn (39) were particularly significant in this field.

With the advent of World War II, the usual increase in meningococcus infection again appeared, the highest incidence occurring during 1942 and 1943. Reports from France (54, 68), from Great Britain (24), and from Chile (53), as well as from the United States (36, 66), indicated that Group I was again overwhelmingly predominant. According to Phair and Schoenbach (51) 91.6% of the cases of meningococcus infection in the U. S. Army during this time were due to Group I. In an intensive study in a large army camp they found 92.9% of their subjects to be carriers of meningococci at some time during the investigation, 53.5% of whom carried Group I, the remainder being divided almost evenly between II *alpha* and II.

Introduction of the sulfonamides and discovery of antibiotics reduced the case fatality rate dramatically during these war years. According to Daniels (19) there were, during World War I, 2,466 soldiers with meningococcus infection admitted to hospitals in the United States, with a case fatality rate of 33% in the U. S. A. and 39% for both home and abroad. During World War II the total hospital admissions for meningococcus infections in the Armed Forces of the United States were 14,504 with a case fatality rate of only 3.8%. Daniels stated that, even with this reduction, meningococcus infection killed more soldiers than any other infectious disease. Hence, it is still a foe with which to reckon.

Since the last period of high incidence during 1942–1944, Group I meningococci have become increasingly less common, and during the endemic years since 1946 they have been rarely encountered. During 1951 and 1952, although the incidence of meningococcus infection has increased only slightly, a relatively larger number of the strains received have been associated with fatal cases of a fulminating type, sometimes showing typical Waterhouse-Friderichsen syndrome. The meningococci recovered from most of these cases have been of Group II. Since Group II meningococci are generally less uniform in susceptibility to sulfonamides or antibiotics than are those of Group I, one must deplore the fact that difficulty in obtaining diagnostic antisera has led many hospital laboratories to abandon the determination of serological group, thus failing to get information of significance.

Early in 1948 a Subcommittee of the Nomenclature Committee of the International Association of Microbiologists was formed for the purpose of investigating the taxonomy and nomenclature of the genus *Neisseria*. Bacteriologists working with the *Neisseria* welcomed such a step since confusion as to groups and types and their relations to each other seemed to be increasing. In a preliminary report before the Section on Classification and Nomenclature of Microorganisms at the Fifth International Congress of Microbiology in Rio de Janeiro

during August of 1950 (55), this Subcommittee[3] proposed a classification of the meningococcus into four Groups, A, B, C, and D; this followed Rule 7, Recommendation 8a of the International Code of Nomenclature (38) which suggests that groups be designated by capital letters and types within the groups by arabic numerals. It is interesting that this recommended scheme is very similar to the one proposed by Murray in 1929 (45) although members of the Subcommittee had overlooked this fact at the time the recommendation was made.

A correlation of this proposed classification with the other previously described classifications is shown in the accompanying table 1. Examination of

TABLE 1

Relationship among the various classifications of meningococci

DOPTER AND PAURON, 1914	ROCKEFELLER INSTITUTE (WOLLSTEIN, 1914)	GORDON AND MURRAY, 1915	GRIFFITH AND SCOTT, 1916	FULLON, 1917	NICOLLE, DEBAINS, AND JOUAN, 1918	EVANS, 1920 (TROPINS)	COMMON USE SINCE 1940	RECOMMENDED BY COMMITTEE 1950
Meningococcus	Normal	I	I	C	A	R	I	A
	Irregular	III		A				
Parameningococcus	Parameningococcus	II	II	B	B	S	II	B
α, β, γ		IV	II		B	Z	IV	D
					C		II *alpha*	C
					D*			

* Relation of this D to other groups is unknown.

this table reveals that no major complications are introduced by the proposed nomenclature and that many relationships are clarified. Groups A and B cor-

[3] At the time that these recommendations were made the membership of this Subcommittee was:

Dr. E. G. D. Murray, *Chairman*	Montreal, CANADA
Lt. Col. H. J. Bensted	London, ENGLAND
Miss Sophia M. Cohen	Albany, New York
Dr. M. H. Gordon	East Moseley, Surrey, ENGLAND
Dr. Ralph St. John-Brooks	Dublin, IRELAND (formerly Washington, D. C.)
Dr. C. Phillip Miller	Chicago, Illinois
Dr. Michael J. Pelczar	College Park, Maryland
Dr. Th. Thjötta	Oslo, NORWAY
Dr. Sara E. Branham, *Secretary*	Bethesda, Maryland

Since this report was made, additional members of the Committee have been appointed as follows:

Dr. A. R. Prévot	Paris, FRANCE
Dr. S. T. Cowan	London, ENGLAND

respond clearly with Groups I and II of present common usage. At first the Committee had some reservations about the designation of Group II *alpha* as Group C, thinking that there might be confusion with the old French Type C (47) which had never been correlated with any other classification because of the lack of available strains for study. This objection was overcome when three strains representing the French C were received by the author in 1951 from Dr. J. L. Chevé of the Pasteur Institut Annex in Dordogne, France, and three others, through Dr. Hauduroy of the Lausanne catalog, from Dr. Thibault of the Pasteur Institute in Paris. Dr. Chevé's strains proved to be essentially identical with Group II *alpha*, and those from Dr. Thibault were closely related to it (14). Designation as Group C will be especially useful in clearing the misunderstanding which has led some bacteriologists to consider II *alpha* strains as a type within Group II instead of an independent group. This II *alpha*, or C, group is not entirely homogeneous. Individual strains may show a tendency to cross agglutinate with either Group I or Group II.

There is, admittedly, uncertainty about the relationships of the group designated as D, which corresponds to that which has been referred to as IV. The rarity of strains of this group has precluded an adequate study. The literature abounds with statements that the Gordon and Murray Types II and IV are related, some even claiming this relationship to be as close as between Types I and III. Murray (46), however, does not consider that such a relationship ever actually existed, and the original report of Gordon and Murray does not contain such a statement (29).

Some degree of cross agglutination with Type II serum must have occurred with some of the earlier found British strains of "Type IV". The rarity of these IV strains would tend to make any relation which they shared especially conspicuous so that apparently, this cross agglutination rapidly snowballed into the idea of a II–IV group that has persisted in the literature to this day. Murray's view concerning the independence of the IV group is in agreement with all of the American findings. The strains of IV found in the United States by Butterfield and Neill before 1920 and by Branham during 1928 and 1929, although very closely related to Gordon's IV, showed no cross agglutination with II sera (7, 15). They were quite narrowly specific and formed an independent group. Six strains found by Cohen during 1933–1935 showed little or no cross agglutination with Group II serum (18). To the author's knowledge, no strains of IV have been recovered since that time, and the few remaining in collections have become rough and are unsuitable for study. No strains of the old French Type D have been available for comparison. Thus, the designation of the old Type IV as Group D, although arbitrary, is made because available evidence points to its independence.

The various classifications considered thus far have been made on the basis of agglutination. In 1920 Alice Evans proposed a classification on an entirely different basis, that of bacteriotropins (23). The exacting technique used by Evans did not attain wide use, but the classification was a valid one, the tropin groups corresponding to the agglutination groups of other workers. Hence,

Evans' tropin groups are included in this table in order that its correlation with other classifications can be seen.

Examination of this table shows that the classification of meningococci into broad groups is real and that essentially the same findings have been obtained by all workers during 4 decades. There is a fundamental basis for such grouping other than that found in serological test tubes. Group I (or proposed A) apparently has been responsible for all of the widespread waves of clinical meningococcus infection in the United States for which there are records of typing. There is evidence that a similar situation existed during the epidemics occurring in France and England during the years of World Wars I and II (2, 22, 24, 30, 54). Thus, Group I is often referred to as the "epidemic Group". This does not mean that other Groups are never involved in outbreaks, for such do occur though they are apt to be limited. For example, a small outbreak of 28 cases due to Group IV occurred in Chicago during 1928 (7), during a widespread wave due to Group I.

Sporadic cases of meningococcus infection that occur during nonepidemic times are most commonly due to Group II (proposed B) (65) although strains of other Groups may also be found. Actually, it has seemed to the author on the basis of cultures submitted for typing over a number of years that the incidence of Group II infections is fairly constant, and that epidemic waves due chiefly to Group I occur at intervals and are superimposed on the level of Group II cases. Hedrich (34, 35) has estimated that these epidemic waves are apt to occur at intervals of 6 to 12 years with an average of about 8. During nonepidemic times most chronic carriers harbor Group II. According to Phair and Schoenbach (51) the number of carriers of all serological groups increases greatly during a wave of meningococcus infection, and strains other than those of Group II may be persistent. In their studies during such a time they found persistent carriers of Group I to be greater in number than those of II *alpha*, although less than those of II.

No specific capsular substance has been demonstrated for Group II meningococci, and it is generally considered to be less virulent than either I or II *alpha*. Often Group II infections take the form of low grade septicemias with a pronounced petechial rash, and meningeal symptoms never develop. Diagnosis of such cases in nonepidemic times may be confusing. The incidence in meningococcus infections and in case fatality rate as well has been slowly increasing during the last few years, as has been pointed out by Hedrich (35). Cultures from cases that have come to the author's attention have been of Group II. A number of these recent cases have been a fulminating fatal type, showing a typical Waterhouse-Friderichsen syndrome; cultures from these have shown a high virulence for mice. It is evident that Group II strains are not always associated with mild infections. Group II is less homogeneous than Group I; this heterogenicity was recognized as early as 1914 when Dopter and Pauron (21) described α, β, and γ parameningococci. Indications of three subdivisions of II were reported later by Gordon (30), by Tulloch (67), and more recently by Miller (42). All of these workers found these subgroups to be very poorly de-

fined. Experience has shown that a serum prepared with a broad representative strain will usually agglutinate all Group II strains, but that narrower strains are much less inclusive. There is often some degree of crossing among all groups of meningococci, and this occurs more commonly with Group II strains and sera since this group is more heterogeneous than others and apparently lacks a specific capsule. Even the gonococcus is frequently well agglutinated by Group II sera.

Not only are Group II meningococci less homogeneous serologically than Group I, they are less uniform in their response to sulfonamides as well as to serum (12). These differences are innate for the strain and are not identical with the "drug fastness" or "serum fastness" sometimes developed. Determination of the serological group of an infecting meningococcus may be of practical clinical value. Variations in response to various antibiotics have not yet been adequately studied. Miller has found that some meningococci acquire resistance to, and even dependence upon, streptomycin (43). There is no evidence that such "fastness" or "dependence" is a property of any serological group.

These first and second broad groups (I or A, and II or B) account for the greater number of the meningococci encountered. The old French "Type C" was uncommon, and the American Group II *alpha* (proposed C), presently our third group, has been recognized for little more than a decade so that although this group has been encountered rather frequently during these years, both in acute infections and in carriers, epidemiological data have been slow to accumulate. The presence of capsules, the accompanying antigenicity and virulence for mice, and its occasional association with the Waterhouse-Friderichsen syndrome give some indication of its importance.

The fourth group (IV, or proposed D) is least known and most rarely encountered. Its relationships to the old French Type D are completely unknown. Occasional single strains of Group IV have been found over the years. But most of the cultures that have been available for study have been recovered from spinal fluids during small, sharp, well localized outbreaks which have occurred during an epidemic wave of meningitis due chiefly to Group I. One outbreak of this type was described by Gordon in 1918 (31). Another of a similar character occurred in Chicago during 1928 (7).

Within all of these groups some shifting of serological patterns has occurred from time to time. Determination of types within the groups is not clear-cut and has depended upon the choice of standards, whether "broad" or "narrow" in serological range. More often, perhaps, this variation in relationship among "subgroups" and "types" depends upon a change in serological patterns as certain individual strains become widespread. This is what Amoss has called "fashions" among meningococci (1). Examples of such "fashions" would be the cross agglutination found by Tulloch between "Types" II and IV in 1918 and the complete absence of such a relationship in the United States then or later; an epidemic in Detroit in 1928 which Norton (49) described as being due to Gordon and Murray's "Type III"; a trend toward "Type I" in the epidemic of 1936; or the disappearance of the old French Type D and of Group IV. Sero-

logical patterns may be followed as a wave of meningococcus infection spreads, whereas strains recovered from sporadic cases may exhibit marked individuality.

SUMMARY

This paper outlines briefly some of the many efforts made to bring serological order to the meningococcus and to determine the significance of the differences found. These various classifications reveal a striking correlation when they are arranged in tabular form.

Meningococci fall into four broad serological groups, no matter what the designation of these groups may be. This division into groups is fundamental and does not depend upon arbitrary or artificial standards. Each group has its own epidemiological significance.

The terminology proposed by the Subcommittee of the International Committee on Bacteriological Nomenclature is included here with a suggestion that bacteriologists become familiar with it since it brings much needed clarification to an unnecessarily confused nomenclature.

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