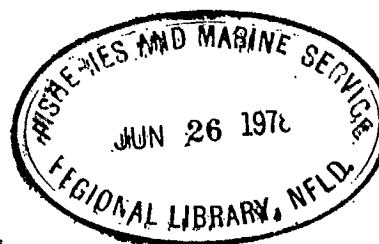


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by G. P. Kalina



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Aeromonas - taxonomy and nomenclature

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(Submitted 24 November 1975)

Aeromonads are widely distributed marine microorganisms which are, at present, attracting attention as possible human and lower mammalian pathogens [3]. Instances of children being afflicted with enterocolitis caused by Aeromonads have been described in the USSR [4]. /15*/

Numerous representatives of this genus have been described since the end of the nineteenth century under different names and in various families and genera: Bacillus, Bacterium, Proteus, Escherichia, Paracolobactrum, Achromobacter, Flavobacterium, Pseudomonas. Despite the fact that in 1936 Kluver and van Niel [25] isolated a new taxonomic group in the family Pseudomonadaceae - the genus Aeromonas, these bacteria continued to be assigned primarily to the genus Pseudomonas until as late as the middle sixties.

*Numbers in the right-hand margin indicate pages in the original.

In 1952-1953 Griffin and coauthors [19, 20] showed that Aeromonas salmonicida has a positive reaction to the cytochrome oxidase test, while in 1960 Ewing and Johnson [17] and in 1961 Steel [56] extended this test to the entire Aeromonas genus as well as to other representatives of the family Pseudomonadaceae and the genera Vibrio and Alcaligenes. In 1953 Hugh and Leifson [23] introduced an oxidation-fermentation test which made it possible to differentiate the genus Aeromonas from the genera Pseudomonas and Alcaligenes. In this way reliable and stable criteria were obtained for distinguishing aeromonads from representatives of other families and genera with which it has common properties and characters, in addition to the essential morphological character of a polarly located flagellum or flagella. Combination of these principal characters made it possible to include the genus Aeromonas in the family Vibrionaceae [15, 57], which also includes the genera Vibrio, Pleisiomonas, Photobacterium, and Lucibacterium [53]. Differentiation of these genera presents well known difficulties; in any event, the list of characters presented by Shewan and Varon does not provide reference points for reliable differentiation other than determining sensitivity to the vibriostatic O/129 (2,4-diamino-6,7-dihydropropylpteridine) [10, 42, 51, 52]. More distinct differences are presented in the schemes proposed by Carpenter and coauthors [7] and Bain and coauthors [6]. In addition to the differentiating characters of these schemes we can add the penicillin test, sensitivity to 200 Units/ml, in vibrios and resistance to 400 Units/ml in aeromonads, plesiomonas, and other genera of this family [9]. /16/

Until recently there has been no well-founded intra-genus classification of aeromonads. It was only in 1957 that Sniezko [55] isolated 4 taxons in the genus Aeromonas: A. liquefaciens, A. punctata, A. hydrophila and A. salmonicida. The properties listed in the descriptions (7th edition of

Table 1. Differentiating characters of cytochrome oxydase-positive, gram-negative bacteria which do not produce gas during the fermentation of glucose (after Carpenter and coauthors [7])

ТАБЛИЦА 1. Дифференциальные признаки цитохромоксидазо-положительных, грамнегативных бактерий, не продуцирующих газа при ферментации глюкозы (по Carpenter и соавт. [7])

а-	Признак	<i>V. cholerae</i> , <i>V. eltor</i>	б- Непатогенные вибрионы	<i>V. parahaemolyticus</i>	<i>Aeromonas formicans</i>	<i>Pseudomonas shigatoidea</i>
с-	Ферментация лактозы	(+)	+/-	-	s- различно	+
д-	маннита	+	s- +	+	+	-
е-	сахарозы	+	различно	-	s- +	-
ф-	салицина	-	s- -	s- различно	различно	+/-
г-	арабинозы	-	различно	+	+/-	-
h-	маннозы	+	различно	+	+	-
и-	Гидролиз крахмала	+	+	+	+	-
j-	Ферментация инозита	-	-	-	s- -	+
к-	Образование индола	+/-	+/-	+	s- различно	+
л-	сероводорода	(+)/-	(+)/-	(+)	-	-
м-	Реакция с метиловым красным	s- различно	s- различно	+	+	+
н-	Образование ацетонна	->	->	-/+	-	-
о-	Рост в средах с цитрат- ными солями, как един- ственным источником углерода	s- +/-	s- +/-	+	+/-	-
р-	Гидролиз глюконата	различно	различно	-	-	-
q-	Рост в присутствии KCN	->	->	+	+/-	-
r-	Гидролиз желатина	+	+	+	+	-

a - character; b - nonpathogenic vibrios; c - fermentation of lactose; d - fermentation of mannite; e - fermentation of sucrose; f - fermentation of salicin; g - fermentation of arabinose; h - fermentation of mannose; i - hydrolysis of starch; j - fermentation of inositol; k - formation of indole; l - production of hydrogen sulfide; m - reaction with methyl red; n - formation of acetoin; o - growth in media with citrate salts as the sole source of carbon; p - hydrolysis of gluconate; q - growth in the presence of KCN; r - hydrolysis of gelatin; s - various.

Note. Characters common to all: acid without gas in glucose, no fermentation of dulcitol, xylose, adonitol, absence of urease activity, utilization of sodium malonate and phenylperuvic acid, reduction of nitrates. + is a positive reaction, (+) is a low positive reaction, +/- is a reaction more often positive than negative, -/+ is a reaction more often negative than positive, (+)/- is a slow reaction more often than a negative reaction, - is a negative reaction.

Bergey's Manual of Determinative Bacteriology), however, do not provide a basis for demarcating these species, with the exception of *A. salmonicida* [8, 16].

At the same time, even in 1936 Scherago [32, 33] and in 1954 Crawford [11]

described a gasless aeromonad species, initially assigning it to the genus

Pseudomonas (*Ps. caviae*, *Ps. formicans*, and which is listed in the 7th edition

of the Manual as Ps. formicans). Classification of this species within the genus Aeromonas was established by Pivnick and Sabina [30] and Liu [28].

In 1947 Ferguson and Henderson [18] described a unique microorganism (C27), a characteristic feature of which was the presence of antigenic structures in common with Shigella sonnei, as well as its predominant presence during intestinal dysfunctions [1, 2, 31]. In 1954 Bader assigned this species to the genus Pseudomonas and gave it the type designation Ps. shigelloides [5]. Sakazaki and coauthors [31] called this species Ps. michigani. In 1969 Ewing and Johnson [17] showed that, from the combination of properties, it should be under the genus Aeromonas and in the classification of Ewing and coauthors [16] it appears as Aeromonas shigelloides. Sebold and Veron [50] proposed that this species be classified in a new genus Fergusonia, while Habs and Schubert [21] proposed it be classified in the new genus Plesiomonas. In 1971 Hendrie and coauthors [22], on the basis of the greater similarity of the characters of this species to those of vibrios than to those of aeromonads, recommended that it be included in the genus Vibrio. In 1961 Leclerc [26] described yet another aeromonad species - A. dourgesii, which is nonmotile and ferments lactose but which differs from A. salmonicida by a series of characters, particularly its ability to grow at 37-42°.

/17/

In 1960 Eddy [13] proposed a different classification system for the aeromonads which, however, did not include all of the species mentioned above and in which A. liquefaciens, A. formicans and A. salmonicida were classified as independent species. This classification was based on the ability to produce indole and acetone, release of gas during fermentation of carbohydrates, and motility. In 1962 Eddy [14] changed the nomenclature of his proposed species, being guided by considerations of priority: A. liquefaciens Beijerinck (1900) - to A. punctata Zimmermann (1890), A. formicans Crawford (1954) - to A. caviae Scherago (1936).

Table 2. Differentiating characters of cytochrome oxidase-positive motile (polarly located flagella) bacteria after Bain [6].

ТАБЛИЦА 2. Дифференциальные признаки цитохромоксидазоположительных подвижных (полярное расположение жгутиков) бактерий по Bain [6]

	Вибрионы патогенные для человека a	Вибрионы, патогенные для пойкилотермных животных b	Водные вибрионы c	V. parahaemolyticus	Люминесцентные вибрионы d	Aeromonas shigelloides	Aeromonas hydrophila	Aeromonas salmonicida	Aeromonas fishicida
e- Чувствительность к O/129	+	+	+	+	+	+	-	-	-
f- Образование газа при разложении глюкозы	-	+	+	+	+	+	+	+	+
g- Подвижность	+	+	+	+	+	+	+	-	+
h- Образование коричневого пигмента	-	-	-	-	-	-	-	+	-
i- Рост при 37°	+	-	+	+	-	+	+	-	+
j- Образование аргинин-дегидролазы	-	+	-	-	-	-(+)	+	+	+
k- Образование лизин-декарбоксилазы	+	-	+	-	(+)	+	-/(+)	r- различно	-
l- Ферментация инозита	-	r- различно	-	-	-	+	-	-	-
m- Гидролиз желатина	+	+	+	+	-	-	+	+	+
n- Рост в отсутствие NaCl	+	+	+	-	-	+	+	+	+
o- Рост в присутствии 7,5% NaCl	-	-	-	+	+	-	-	-	-
p- Люминесценция	-	-	-	r- различно	+	-	-	-	-
q- Чувствительность к новобиоцину	+	+	+	+/-	?	-	-	-	-

a - vibrios pathogenic to man; b - vibrios pathogenic to poikilothermic animals; c - aqueous vibrios; d - luminescent vibrios; e - sensitivity to O/129; f - production of gas during decomposition of glucose; g - motility; h - formation of brown pigment; i - growth at 37°; j - formation of arginine dehydrogenase; k - formation of lysine decarboxylase; l - fermentation of inositol; m - hydrolysis of gelatin; n - growth in the absence of NaCl; o - growth in the presence of 7.5% NaCl; p - luminescence; q - sensitivity to novobiocin; r - various.

Ewing and coauthors [16] combined all of the above aeromonad species into the single species A. hydrophila, demarcating only A. salmonicida and A. shigelloides. They proposed that gasless and other varieties of aeromonads be considered biotypes of A. hydrophila.

The last species to be discovered in the genus *Aeromonas* was *A. proteolytica* in 1964 [29]. This is a halophilic microbe which has been isolated from salt water and which develops only in media prepared with seawater or containing a high content of peptone and NaCl.

In a series of communications from 1960 to 1967 Schubert described how he had subjected a large number of aeromonad strains to careful analysis and had clarified the complex of characters which are typical of the genus *Aeromonas* [40, 43]. Findings were presented on *A. salmonicida* [41], anaerogenic [45] and /18/ acetoin-negative [44] aeromonads. Schubert [44, 46] proposed the 2,3-butanediol-dehydrogenase reaction: some strains of aeromonads are capable of producing 2,3-butanediol [28] during the fermentation of glucose and of dehydrogenating the former with the formation of acetoin, other strains lack the ability to produce this intermediate product and for this reason do not give a positive reaction to acetoin, but when 2,3-butanediol is introduced into the medium it is dehydrogenated and acetoin is produced; the third group of aeromonads is not capable of dehydrogenating butanediol and consequently does not produce a reaction to acetoin. The scarcity of this reagent (the author had to order it from Holland) for the present makes this test prohibitive, although Schubert did make it the basis of his proposed taxonomic scheme. For aerogenic aeromonads the butanediol test may be replaced by the ability of this group of aeromonads to ferment glycerine at 22^o with the evolution of gas, but for anaerogenic strains this characteristic does not apply.

Schubert based a new classification system for aeromonads on the results of his research [34, 36-39, 47-49]. In addition to *A. hydrophila* he set apart the special species *A. punctata* on the basis of its inability to dehydrogenate butanediol or to produce gas during the fermentation of glycerine. In both species he demarcated anaerogenic subspecies (Subsp. *anaerogenes* and

Table 3. Differentiation of the genus *Aeromonas* after Schubert (1974).

ТАБЛИЦА 3. Дифференциация рода <i>Aeromonas</i> по Schubert (1974)		Дифференциация трех видов и их подвидов						
a- Признак	A. hydrophila			A. punctata		A. salmonicida		
	hydrophila	algicola	proteolytica	punctata	caviae	salmonicida	achromogenes	masoucii
c- Рост при 37°	+	+	+	+	+	-	-	-
d- Образование коричневого пигмента	-	-	-	-	-	+	-	-
e- Рост в аммонийно-глюкозной среде	+	+	+	+	+	-	-	-
f- Рост в среде с аргинином, как единственным источником углеродного питания	+	+	+	+	+	-	-	-
g- Рост в среде с аспарагином, как единственным источником углеродного питания	+	+	+	+	+	-	-	-
h- Рост в среде с гистидином, как единственным источником углеродного питания	+	+	+	+	+	-	-	-
i- Рост в среде с глутаминовой кислотой, как единственным источником углеродного питания	+	+	+	+	+	-	-	-
j- Рост в среде с серином, как единственным источником углеродного питания	+	z- различно	+	+	+	-	-	-
k- Рост в среде с аланином, как единственным источником углеродного питания	z- различно	»	+	z- различно	+	-	-	-
l- Рост в присутствии 7,5% NaCl	-	-	+	»	+	-	-	-
m- Образование бутанаedioльдегидрогеназы	+	+	+	+	-	+	+	+
n- Образование газа в среде с глюкозой	+	-	-	+	-	+	-	+
o- Образование газа в среде с глицерином при 22°	+	-	-	-	-	+	-	+
p- Образование индола в бульоне с 0,1% триптофана	+	+	+	+	+	-	+	+
q- Образование сероводорода в реакции с уксуснокислым свинцом	+	+	+	+	+	-	-	-
r- Образование лизин-декарбоксилазы	-	-	+	-	-	-	-	+
s- Образование ацетона	+/-	+/-	+	-	-	-	-	+
t- Окисление глюконата	+/-	+/-	»	+	+	+	+	+
u- Ферментация галактозы	+	+	-	+	+	+	+	+
v- Ферментация сахарозы	+/-	+	-	+/-	+	-	+	+
w- марины	z- +	+	-	+/-	+	+	-	+
x- арабиноса	z- различно	z- +	-	z- различно	+	+	-	+
y- Гидролиз желатина	»	z- различно	-	»	+	+	-	+

a - character; b - differentiation of three species and their subspecies; c - growth at 37°; d - formation of brown pigment; e - growth in an ammonium-glucose medium; f - growth in a medium with arginine as the sole source of carbon; g - growth in a medium with asparagine as the sole source of carbon; h - growth in a medium with histidine as the sole source of carbon; i - growth in a medium with glutamic acid as the sole source of carbon; j - growth in a medium with serine as the sole source of carbon; k - growth in a medium with alanine as the sole source of carbon; l - growth in the presence of 7.5% NaCl; m - formation of butanedioldehydrogenase; n - production of gas in a medium containing glucose; o - production of gas in a medium containing glycerine at 22°; p - formation of indole in a broth with 0.1% tryptophan; q - production of hydrogen sulfide in a reaction with lead acetate; r - formation of lysine decarboxylase; s - formation of acetoin; t - oxidation of gluconate; u - fermentation of galactose; v - fermentation of sucrose; w - fermentation of mannite; x - fermentation of arabinose; y - hydrolysis of esculin; z - various.

Subsp. *caviae*), included Subsp. *proteolytica* as a subspecies, and divided *A. salmonicida* into the three subspecies Subsp. *salmonicida*, Subsp. *achromogenes* Smith [54] and Subsp. *masoucida* Kimura [24]. Schubert rejected Smith's suggestion [54] to classify *Necromonas salmonicida* as an independent genus and denies the existence of *A. doourgessii*, the species described by Leclerc [26].

Schubert's classification is presented in its final form in the chapter written by him for the 1974 edition of *Bergey's Manual of Determinative Bacteriology* [35] and is presented as a table of differentiation characteristics (Table 3).

Consequently, two taxonomic solutions may be used in the classification of aeromonads: the classification of Ewing and coauthors [16], which restricts the genus *Aeromonas* to three species - *A. hydrophila*, *A. salmonicida* and *A. shigelloides*, and the classification of Schubert [35], which makes use of differences in individual properties for subdivision into species and subspecies and which classifies *A. shigelloides* in the special genus *Plesiomonas*.

There are assuredly variants within the confines of the genus *Aeromonas* which can be classified as independent genera. The classification of *A. shigelloides* in the genus *Plesiomonas* is well founded, especially in view of the fact

Table 4. Differentiating characters of the three main species of aeromonads.

ТАБЛИЦА 4. Отличительные признаки трех основных родов аэромонад			
а- Тест	Аеромо- наз	Несромо- наз	Плетомо- наз
b- Образование газа в среде с глюкозой	+/-	+	-
c- >> в средах с другими углеводами	+/-	+	-
d- Ферментация лактозы	-/+	-	+
e- > сахарозы	+	-	-
f- > маннита	+	+	-
g- > инозита	-	-	+
h- Образование индола	+	-	+
i- Рост в аммонийно-глюкозной среде	+/-	-	+
j- Гидролиз желатина	+	+	-
k- > крахмала	+	+	-
l- Образование лизин-декарбоксилазы	-	-/+	+
m- > аргининдегидролазы	+/-	-	+
n- Подвижность	+/-	-	+
o- Рост при 37°	+	-	+

a - test; b - production of gas in a medium with glucose; c - production of gas in media with other hydrocarbons; d - fermentation of lactose; e - fermentation of sucrose; f - fermentation of mannite; g - fermentation of inositol; h - formation of indole; i - growth in an ammonium-glucose medium; j - hydrolysis of gelatin; k - hydrolysis of starch; l - formation of lysine decarboxylase; m - formation of arginine dehydrogenase; n - motility; o - growth at 37°.

that even the guanine/cytosine ratio of this microorganism's DNA differs sharply from that of other aeromonads [50]. We should consider no less well founded the proposal to classify A. salmonicida in the special genus Necromonas [54], which Ewing and coauthors also accept [16]: they (A. salmonicida, G.K.) consist of completely homogeneous units, differing from A. hydrophila and C27 (A. shigelloides, G.K.) in terms of several important characters. Their classification in the genus Aeromonas is, to some extent, controversial. The differentiating characters of these three genera are presented in Table 4.

Six characters differentiate A. shigelloides from A. hydrophila, and eleven from A. salmonicida; three absolute and four relative characters differentiate A. salmonicida from A. hydrophila. We should also take into account the absence in A. salmonicida of gluconate oxidation [54], the inability to utilize the amino acids arginine, asparagine, histidine, serine, alanine and glutamic acid, as well as the absence of growth in a medium containing KCN [47]. All of the above permits us to concur with Smith's proposal to introduce the genus *Necromonas*. The subspecies *salmonicida*, *achromogenes* and *masoucida* should not be regarded as subspecies in the manner of Schubert [49]. On the basis of a significant number of differentiating characters they can be classified as independent species, which supports the independent status of the genus *Necromonas*. These conclusions are also supported by ecological differences: A. hydrophila is an aqueous microorganism which is only rarely found in the human and lower animal organisms; *Plesiomonas*, as a rule, is found in the body of man or lower animals and is often an intestinal pathogen [1, 2, 18, 31]; *Necromonas*, on the other hand, is isolated almost exclusively in the presence of necrotic processes in fish and amphibians (numerous papers, beginning in 1894, which have been correlated in a number of reviews [8, 13, 16, 19, 41]).

/20/

If we accept the proposal to classify A. shigelloides and A. salmonicida in separate genera then in the classification of Ewing and coauthors there is left a single species A. hydrophila and in Schubert's classification we have the species A. hydrophila with the subspecies *hydrophila* and *proteolytica* and A. punctata with the subspecies *punctata* and *caviae*. A. proteolytica, of all these subspecies, has the right to independence as a species (Markel and coauthors [29]), inasmuch as it differs in at least 7 significant characters.

The greatest doubt is aroused by Schubert's proposal to divide the genus *Aeromonas* into two species - *A. hydrophila* and *A. punctata* (the latter is even singled out as a type species on the basis of its priority status) and the separation of the subspecies *anaerogenes* and *caviae* into different species despite their general basic similarity - the absence of gas production. Differentiation of the two species (and consequently the subspecies) is in effect based only on butanedioldehydrogenase. The second differentiating character - production of gas during the fermentation of glycerine, cannot be used for anaerogenic subspecies of either species. The priority status of the term *punctata* is also doubtful: the set of characters proposed by Schubert for describing *A. punctata* is almost wholly absent in the initial description of *B. punctata* Zimmermann (1890), in the description of Lehmann and Neumann (1896), and in the statement of the properties of this species in the 7th edition of Bergey's Manual of Determinative Bacteriology [55]. In effect, Schubert gives the description of a new species [35] and consequently the priority status of this species is very questionable. From Zimmermann's description of 1890 this species could equally as well be classified in the genera *Pseudomonas*, *Proteus*, and *Serratia* [16], while its subsequent more detailed description by Lehmann and Neumann was made only in 1896, i.e. after Sanarelli *B. hydrophilus* - the first prototype of *A. hydrophila*, which has terminological priority.

The question of the existence as an independent species, or at least a biotype (subspecies), of nonmotile aeromonads (*dourgesii*, Leclerc [26]) is also in need of analysis. The lack of motility is one of the most important characteristics of *A. salmonicida* and, as such, does not arouse doubts in anyone. The presence of this character in aeromonads which correspond in other respects to *A. hydrophila* has given rise to objections [40]. Among

the other taxonomic reference points, the morphological ones have always had predominant significance in biology, and if we also take into account the relatively high percentage of nonmotile aeromonads isolated from water (up to 28% [27]) then the independence of A. douorgesii cannot give rise to doubts.

We present for discussion the following draft classification of aeromonads, plesiomonads and necromonads: /21/

Genus *Aeromonas* Kluver and van Niel (1936)

species A. hydrophila Stanier (1943)

biotype *Hydrophila* Stannier (1943)

" *Anaerogenes* Schubert (1967)

" *Punctata* Schubert (1967)

" *Dourgesi* Leclerc (1961)

species A. proteolytica Merkel and coauthors (1964)

Genus *Necromonas* Smith (1963)

species N. salmonicida Griffin and coauthors (1953)

" N. archromogenes Smith (1963)

" N. masoucida Kimura (1969)

Genus *Plesiomonas* Habs and Schubert (1962)

Species Pl. shigelloides Habs and Schubert (1962)

Note. The names of the biotypes are written with capital letters in accordance with the proposal of Edwards and Ewing [12].

This scheme differs from Schubert's classification on the following points:

- 1) the species A. punctata (only an aerogenic subspecies) is presented as the biotype *A. hydrophila*; 2) the subspecies *proteolytica* is demarcated as an independent species; 3) the new biotype *Dourgesi* is introduced; 4) the species A. salmonicida is elevated to the position of the genus *Necromonas*; 5) the three subspecies of A. salmonicida are presented as independent species.

General characters: cytochrome oxidase +, O/F +/+, xylose -, not sensitive to C/129 and 400 Units/ml of penicillin.

I. Hydrolyze gelatin and starch, ferment mannite, grow in media prepared with fresh or distilled water, do not grow in media with 7.5% NaCl.

A. Grow at 37^o, ferment sucrose - Aeromonas hydrophila

1. Motile

a - produce gas during fermentation of glucose at 22 or 30^o

b - produce gas in glycerin, do not dehydrogenate butanediol -
biotype Hydrophila

bb - do not produce gas in glycerin, do not dehydrogenate
butanediol - biotype Punctata

aa - do not produce gas during fermentation of glucose - biotype
Anaerogenes

2. Nonmotile - biotype Dourgesi

B. Do not grow at 37^o, do not ferment sucrose

1. Form a brown pigment on tryptic soy agar - Necromonas salmoni-
cida

2. Do not form a brown pigment on tryptic soy agar

a - produce gas and glycerine in glucose at 22^o, decarboxylate
lysine - Necromonas masoucida

aa - do not produce gas in glycerine and glucose, do not de-
carboxylate lysine - Necromonas achromogenes

1.1 Grow only in media prepared with seawater, resistant to
7.5% NaCl - Aeromonas proteolytica

II. Do not hydrolyze gelatin and starch, do not ferment mannite -
Plesiomonas shigelloides

References

1. Al'dova, E., Rakovskii, Ya., Khovaikova, A. Journal of hygiene and epidemiology, Prague, 1966, vol. 10, p. 430.
2. Geizer, E., Kopetskii, K., Al'dova, E. Ibid., p. 102.
3. Kalina, G.P. Journal of microbiology, 1974, No. 10, p. 105.
4. Lyiv, Kh.D. In: Materials of the 15th congress of epidemiologists, microbiologists and infectious disease specialists. vol. 1, Tbilisi, 1970, p. 195.

ЛИТЕРАТУРА. 1. Альдова Е., Раковский Я., Ховаикова А. — «Ж. гиг. эпидемнол. (Прага)», 1966, т. 10, с. 430. — 2. Гейзер Е., Копецкий К., Альдова Е. — Там же, с. 102. — 3. Калина Г. П. — «Ж. микробиол.», 1974, № 10, с. 105. — 4. Лыв Х. Д. — В кн.: Материалы 15-го Съезда эпидемиологов, микробиологов, инфекционистов. Т. 1, Тбилиси, 1970, с. 195. — 5. Vader B. — «Z. f. Hyg.», 1954, Bd 140, S. 450. — 6. Bain N., Shewan J. —

In: Identification Methods for Microbiologists. Pt. B. London, 1968, p. 79—84. — 7. Carpenter P., Hart J., Hartfield J. et al. — Ibid., p. 9—18. — 8. Caselitz F. Pseudomonas-Aeromonas und ihre humanmedizinische Bedeutung. Jena, 1966. — 9. Caselitz F., Krebs D., Maas W. — «Z. Tropenmed. Parasit.», 1961, Bd 12, S. 325. — 10. Collier H., Campbell N., Fitzgerald M. — «Nature», 1950, v. 165, p. 1004. — 11. Crawford I. — «J. Bact.», 1954, v. 68, p. 734. — 12. Edwards P., Ewing W. Identification of Enterobacteriaceae. Minneapolis, 1972. — 13. Eddy B. — «J. appl. Bact.», 1960, v. 23, p. 216. — 14. Idem. — Ibid., 1962, v. 25, p. 137. — 15. Eddy B., Carpenter K. — Ibid., 1964, v. 27, p. 96. — 16. Ewing W. et al. Studies on the Aeromonas group. Atlanta, Communicable Disease Atlanta, Georgia, 1961, 1974. — 17. Ewing W., Johnson J. — «Int. Bull. bact. Nomencl.», 1960, v. 10, p. 223. — 18. Ferguson W., Henderson N. — «J. Bact.», 1947, v. 54, p. 179. — 19. Griffin T., Sniezko S., Friddle S. — «Trans. Am. Fish. Soc.», 1952, v. 82, p. 129. — Idem. — «Vet. Med.», 1953, v. 48, p. 280. — 21. Habs H., Schubert R. — «Zbl. Bakt. Abt. I, Orig.», 1962, Bd 186, S. 316. — 22. Hendrie M., Shewan J., Veron M. — «Int. J. system. Bact.», 1971, v. 21, p. 25. — 23. Hugh R., Leifson E. — «J. Bact.», 1953, v. 66, p. 24. — 24. Kimura T., Urr. Schubert. — 25. Kluyver A. v. Niel C. — «Zbl. Bakt. Abt. 2», 1936, Bd 94, S. 369. — 26. Leclerc H. Etude de bacille a gramnegativ. Lille, 1961/62. — 27. Leclerc H., Buttiaux R. — «Ann. Inst. Pasteur», 1962, v. 103, p. 97. — 28. Liu P. — «J. Bact.», 1962, v. 83, p. 750. — 29. Markel J., Traganze E., Mukherjee B. et al. — Ibid., 1964, v. 87, p. 1227. — 30. Pivnick H., Sabina L. — Ibid., 1957, v. 73, p. 247. — 31. Sakazaki R., Namioka S., Nakaya R. et al. — «J. Jap. med. Sci. Biol.», 1959, v. 12, p. 355. — 32. Scherago M. — «J. Bact.», 1936, v. 31, p. 83. — 33. Idem. — «J. infect. Dis.», 1937, v. 60, p. 245. — 34. Schubert R. — «Arch. Hyg. (Berl.)», 1967, Bd 150, S. 681. — 35. Idem. — In: Bergey's Manual of Determinative Bacteriology. Baltimore, 1974, p. 345. — 36. Idem. — «Int. J. system Bact.», 1967, v. 17, p. 23. — 37. Idem. — Ibid., p. 273. — 38. Idem. — Ibid., 1968, v. 18, p. 1. — 39. Idem. — Ibid., 1971, v. 21, p. 87. — 40. Idem. — «Zbl. Bakt. Abt. Orig.», 1960, Bd 180, S. 310. — 41. Idem. — Ibid., 1961, Bd 183, S. 485. — 42. Idem. — Ibid., 1962, Bd 184, S. 560. — 43. Idem. — Ibid., 1963, Bd 188, S. 62. — 44. Idem. — Ibid., 1964, Bd 193, S. 482. — 45. Idem. — Ibid., 1964, Bd 193, S. 343. — 46. Schubert R., Hexel G. — Ibid., Bd 194, S. 130. — 47. Schubert R. — Ibid., 1969, Bd 211, S. 403. — 48. Idem. — Ibid., S. 409. — 49. Idem. — Ibid., S. 413. — 50. Sebald M., Veron M. — «Ann. Inst. Pasteur», 1963, v. 105, p. 897. — 51. Shewan J. A. — «J. appl. Bact.», 1960, v. 23, p. 379. — 52. Shewan J., Hodgkiss W., Liston J. — «Nature», 1954, v. 173, p. 208. — 53. Shewan J., Veron M. — In: Bergey's Manual of Determinative Bacteriology. Baltimore, 1974, p. 340. — 54. Smith I. — «J. gen. Microbiol.», 1963, v. 33, p. 263. — 55. Sniezko S. — In: Bergey's Manual of Determinative Bacteriology. Baltimore, 1957, p. 189. — 56. Steel K. — «J. gen. Microbiol.», 1961, v. 25, p. 297. — 57. Veron M. — «C. R. Acad. Sci. (Paris)», 1965, v. 261, p. 5243.