THE TAXONOMY AND NOMENCLATURE OF THE GENUS
AEROMONAS KLUYVER AND VAN NIEL 1936

Part I. Suggestions on the taxonomy and nomenclature
of the aerogenic Aeromonas species

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SUMMARY: Three aerogenic Aeromonas species
are recognized:

Aeromonas punctata (Zimmermann 1890) Snieszko 1957

Aeromonas hydrophila (Chester 1901) Stanier 1943

Aeromonas salmonicida (Lehmann and Neumann 1896)

Griffin, Snieszko and Friddle 1953

A description of these three species is given.
The nomenclatural status of the earlier species
descriptions brought into connection with
aerogenic aeromonads, is critically reviewed.

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A. Introduction

During the past years the results of several investigations
were published on the characteristics of bacterial species
classified as members of the genus Aeromonas Kluyver and
van Niel (1936), Schubert (1960), Ewing, Hugh and Johnson
(1961) and Eddy (1960/61). In spite of many efforts these
studies did not always lead to a nomenclature in accordance
with rules as laid down in the International Code of Bacteria
and Viruses (1958). In the present contribution an attempt
is made to establish the taxonomy of the described strains
of organisms which have been brought into connection with
aerogenic species of Aeromonas and to analyse critically
the nomenclatural status of the earlier species descriptions.
The systematic position of the anaerogenic aeromonads will
be discussed separately. The chapter on the genus Aero-
monas prepared by S. F. Snieszko, Bergey's Manual (7 Ed.),
is used as basis for the following reflections. In this classi-
fication four species are recognized:

1. Aeromonas liquefaciens (Beijerinck 1900) Kluyver and van Niel 1936.
2. Aeromonas punctata (Zimmermann 1890) Snieszko 1957.
3. Aeromonas hydrophila (Chester 1901) Stanier 1943.
4. Aeromonas salmonicida (Lehmann and Neumann 1896) Griffin, Snieszko and Friddle 1953.

The only species well defined by morphological and biochemical properties is Aeromonas salmonicida. It was described by Emmerich and Weibel (1894, 17) but given a vernacular name only. It was placed in the genus Aeromonas by Griffin, Snieszko and Friddle (1953). The species description was emended by Griffin, Snieszko and Friddle (1953), Ewing, Hugh and Johnson (1961) and Schubert (1961). According to the description given in Bergey's Manual (7 Ed.) the other three species cannot be differentiated on the basis of their morphological and biochemical properties; Snieszko himself admitted that a clear separation of the species was not yet established. In the key to the genus these species are distinguished only by source, habitat and pathogenicity. In the more recent literature (cf the suggestions for classification by Eddy (1960/61)) these three names are considered to be synonyms.

On the other hand the writer's investigations (Schubert 1964a) on bacterial cultures commonly designated as A. hydrophila, A. punctata, A. liquefaciens and A. salmonicida and numerous freshly isolated strains resulted in the recognition of two previously named species in addition to A. salmonicida: A. hydrophila and A. punctata.

A. punctata differs from A. hydrophila by production of acetoin from glucose, the dehydrogenation of meso-2,3-butanediol to both acetoin and diacetyl and by fermentation of glycerol under production of gas.

The differentiation of these two species from A. salmonicida is based upon the low limit of growth temperature of A. salmonicida and a number of biochemical characteristics.

In the following a description is presented of the three species A. hydrophila, A. punctata and A. salmonicida. By adding some recently investigated properties the species description as given in Bergey's Manual (7 Ed.) is emended. The descriptions form the basis for a request to the Judicial Commission concerning the recognition of the suggested names to be given to the aerogenic species of Aeromonas and the designation of neotype strains. The official request

will be published at the end of this series of publications. An analysis of the species descriptions essential for the priority of nomenclature will be given at the end of this communication.

B. Descriptions of the species A. hydrophila,
A. punctata and A. salmonicida

Aeromonas hydrophila (Chester 1901) Stanier 1943.

Bacillus hydrophilus fuscus Sanarelli, Cent. f. Bakt. 9,
1891, 222.

Bacterium hydrophilum Chester, Manual Determ. Bact.
1901, 235.

Proteus hydrophilus Bergey et al., Manual 1st ed., 1923,
211; Stanier, J. Bact., 46, 1943, 213; Schubert Zbl.
f. Bakt. I. Orig. 193, 1964, 482.

hydrophila. Gr. noun hydōr water; Gr. philos loving;
M. L. adj. hydrophilus waterloving.

Rods 0.6-1, 1 by 1.3-3.0 μ , occurring singly and in short chains. Motile, with a single polar flagellum. Gram-negative.

Agar colonies: whitish, raised, moist, stippled.

Agar slant: thin, whitish, glassy, spreading, becoming yellowish and opalescent.

Broth: turbid, with fine pellicle.

Potato: yellowish brown, moist, slightly raised.

Horse and sheep blood agar colonies: 2 to 3 mm in diameter, round, entire, raised, smooth, moist, semi-translucent, grayish white, forming a dirty brown-yellow coloration after 3 to 5 days at room temperature; marked hemolysis after 1 day's incubation, aberrant strains occur.

Gelatin colonies: small, circular, gray, translucent, stippled.

Gelatin stab: napiform liquefaction.

Casein digested.

Löffler's serum: growth abundant, digestion often slowly.

Litmus milk: acid, coagulated, peptonized.

Starch hydrolyzed.

Phosphatase: positive.

Lipase: positive.

Egg-yolk reaction (lecithinase): positive.

Indol produced.

Nitrites and ammonia produced from nitrates.
Uric acid and asparagine may serve as sources of nitrogen.
Urea not attacked.
Sodium malonate is not utilized.
Growth on ammonium glucose, aberrant strains occur.
Most strains utilize sodium citrate as sole source of carbon.
Growth on Møller's KCN medium, aberrant strains occur.
Hydrogen sulfide not produced in Kligler's medium.
Hydrogen sulfide produced in peptone water.
Methylene blue reduced.
Catalase produced.
Cytochrome oxydase reaction: positive.
Oxydase reaction: positive.
Arginine dehydrogenase reaction: positive.
Ornithine decarboxylase reaction: negative.
Glutamic acid decarboxylase reaction: negative.
Lysine decarboxylase reaction: variable, weak positive reactions occur.
Phenylalanine deaminase reaction: variable, about 1/5 of the strains produce weak positive reactions.
Acid and gas production from starch, dextrin, glycogen, maltose, trehalose, glucose, mannose and glycerol.
Some strains ferment galactose, mannitol and fructose with a delayed production of gas or they fail to produce gas.
The fermentation of raffinose, lactose, sucrose, cellobiose, arabinose, rhamnose, salicin, sorbitol and esculin is variable.
Inulin, melicitose, xylose, inositol, dulcitol and adonitol are not attacked.
Methyl red reaction: variable.
Production of acetylmethylcarbinol and 2,3-butanediol from glucose. Voges-Proskauer reaction positive; aberrant strains occur. 2,3-butanediol dehydrogenase reaction positive.
Aerobic, facultative.
Optimal growth temperature 30°C; some biochemical properties must be tested at 20°C. Good growth at 37°C; most strains do not grow at temperatures above 41°C.
Produces a characteristic black-rot in hen eggs.
Pathogenic for frogs, salamanders, fish, mice, guinea-pigs and rabbits, causing hemorrhagic septicemia. Causes a hemorrhagic septicemia in snakes. In this case the disease is probably transmitted by mites (Camin, Jour. Parasitol. 34:345. 1948).

Source: Isolated from frogs dead of septicemia (red leg).

Habitat: water and infected fresh-water animals.

Proposed neotype strain: ATCC 7966.

Aeromonas punctata (Zimmermann 1890) Snieszko 1957

Bacillus punctatus Zimmermann 11. Bericht der Naturwissenschaftlichen Gesellschaft zu Chemnitz 1890
p. 86-87;

Bacterium punctatum Lehmann and Neumann, Bakt.
Diagn., 1; Aufl., 2, 1896, 238;

Pseudomonas punctata Chester, Man. Determ. Bact.
1901, 147; Schubert Zbl. f. Bakt. I. Orig. 193, 1964,
482.

punc ta'ta L. noun punctum a point, a small hole;
M. L. adj. punctata full of points.

Rods, 0.67-1.0 by 1.3-3.3 μ , occurring singly, in pairs and
in chains. Motile with a single polar flagellum. Gram-
negative.

Colonies on nutrient agar: round thin, gray, semi-trans-
lucent with smooth, moist surface.

Agar slant: gray, smooth, filamentous.

Broth: turbid with sediment and delicate pellicle.

Potato: brownish yellow to brownish red color.

Sheep blood agar: not all strains hemolytic, colonies like on
nutrient agar.

Gelatin colonies: small, circular, gray, erose to filamen-
tous, punctiform. Gelatin stab: crateriform liquefaction.
No pellicle.

Casein digested.

Löffler's serum: growth abundant, digestion often slowly,
some strains show no digestion.

Litmus milk: acid, coagulated; peptonized.

Starch hydrolyzed.

Phosphatase: positive.

Lipase: positive.

Egg-yolk reaction (lecithinase): positive.

Indol produced.

Nitrites and ammonia produced from nitrates.

Uric acid and asparagine may serve as sources of nitrogen.

Urea not attacked.

Sodium malonate is not utilized.

Growth on ammonium glucose.

No growth on ammonium citrate.

Growth on Møller's KCN medium.
Hydrogen sulfide not produced in Kligler's medium.
Hydrogen sulfide produced from peptone water.
Catalase produced.
Cytochrome oxydase reaction: positive.
Oxydase reaction: positive.
Arginine dehydrogenase reaction: positive, aberrant strains occur.
Ornithine decarboxylase reaction: negative.
Lysine decarboxylase reaction: different, weak positive reactions occur.
Phenylalanine deaminase reaction: variable, few weak positive reactions occur.
Acid and gas production from starch, dextrin, glycogen, maltose, trehalose, glucose, mannose, salicin and fructose. Some strains ferment galactose without or with a delayed production of gas.
Fermentation of raffinose, lactose, sucrose, cellobiose, arabinose, rhamnose, sorbitol, esculin and mannitol is variable.
Inulin, melecitose, xylose, inositol, dulcitol and adonitol are not attacked.
Methyl red reaction: variable.
No production of acetylmethylcarbinol and 2, 3-butanediol from glucose. Voges-Proskauer reaction negative.
2, 3-butanediol dehydrogenase reaction negative.
Aerobic, facultative.
Optimal growth temperature between 25° and 30° C. Growth at 37° C.
Source: from Chemnitz tap water (Zimmermann).
Habitat: found in surface water supplies.
Proposed neotype strain: NCMB 74.

Aeromonas salmonicida (Lehmann and Neumann 1896)

Griffin, Snieszko and Friddle 1953.

Bacillus der Forellenseuche, Emmerich and Weibel,
Arch. f. Hyg. 21, 1894, 1;

Bacterium salmonicida Lehmann and Neumann, Bakt.

Diag., 1 Aufl., 2, 1896, 240; see Mackie, Arkwright,
Pryce-Tannatt, Mottram, Johnson and Menzies, Final
Report of the Furunculosis Committee, H. M. Station-
ery Office, Edinburgh, 1935; Griffin, Snieszko and
Friddle. Trans. Amer. Fish. Soc. 82 (1952) 1953,
129; Schubert, Zbl. f. Bakt. I. Orig. 183, 1961, 485.

sal mo ni'ci da L. noun salmo, salmonis salmon;
L. v. suffix -cida from L. v. caedo to cut, kill;
M. L. fem. n. salmonicida salmonkiller.

Rods, 1.0 by 1.7 to 2.0 μ , with rounded ends, occurring singly in pairs or in chains. Nonmotile, Gram-negative.

Agar colonies: circular, punctiform in 24 hours and 1 to 2 mm in diameter in 4 to 5 days, convex, entire, semi-translucent. Colonies and medium turn brown in old cultures.

Agar slant: growth abundant, butyrous, glistening, filiform, opaque to transparent, odorless, colorless. A soluble brown pigment forms in 3 to 5 days. A bright salmon-pink color develops when β -2-thienylalanine is present (Griffin, Snieszko and Friddle, J. Bact. 65, 1953, 658).

Broth: moderate to strong clouding; no ring or pellicle; moderate, flocculent sediment. Medium may clear in the upper layers and some growth may adhere to walls of test tubes of older cultures.

Sheep blood agar: hemolysis after 2 days, colonies like on nutrient agar. Gelatin stab: crateriform to infundibuliform liquefaction in 1 to 3 days; complete liquefaction in 7 days. Growth filiform, beaded, best at top. Medium turns light brown near the surface of old cultures.

Casein is digested.

Löffler's serum: growth abundant, digestion often slow.

Litmus milk: slight and temporary acidification. Complete peptonization in one week.

Starch hydrolyzed.

Phosphatase: positive.

Lipase: positive.

Egg-yolk reaction (lecithinase): positive.

Indol not produced.

Nitrites produced from nitrates.

Ammonia produced in tryptic digest of casein-yeast extract medium.

Urea not attacked.

Sodium malonate is not utilized.

Ammonium glucose: no growth.

Ammonium citrate: no growth.

Møller's KCN broth: no growth.

Hydrogen sulfide not produced in Kligler's medium.

Hydrogen sulfide not produced from peptone water.

Catalase produced.

Cytochrome oxydase reaction: positive.

Oxydase reaction: positive.

Arginine dehydrogenase reaction: positive (tested at 20°C).

Ornithine decarboxylase reaction: negative.

Glutamic acid decarboxylase reaction: negative.

Lysine decarboxylase reaction: negative.

Phenylalanine deaminase reaction: negative.

Acid and gas production from starch, dextrin, glycogen, maltose, trehalose, glucose, fructose, galactose, mannose, arabinose, salicin, esculin, glycerol, and mannitol.

Raffinose, inulin, melecitose, lactose, sucrose, cellobiose, rhamnose, xylose, adonitol, sorbitol, dulcitol and inositol not attacked.

Methyl red reaction: positive.

No production of acetylmethylcarbinol and 2,3-butanediol from glucose. Voges-proskauer reaction negative. 2,3-butanediol dehydrogenase reaction positive.

Arginine and methionine are essential for growth; asparagine and leucine are highly stimulative while lysine is only moderately so (unpublished data, Griffin).

Temperature relations: optimum, between 20° and 25° C; minimum, 6° C; maximum, 34.5° C.

Pathogenic for most fresh-water fish, particularly those belonging to the Salmonidae.

Source: from dead fish, of the family Salmonidae, taken from a fish hatchery in southern Germany.

Habitat: found in fresh-water lakes, streams, rivers and fish ponds throughout Europe and also in the United States and Canada. Causes a furunculosis in infected fish; also occurs in apparently normal fish.

Proposed neotype strain: NCMB 1102.

C. Discussion

The suggestion concerning the nomenclature of the aerogenic Aeromonas species, A. hydrophila and A. punctata are based on the following historical analysis:

a) Aeromonas punctata

The first valid description of a species later transferred to the genus Aeromonas was given by O. E. R. Zimmermann under the designation of Bacillus punctatus (1890).

Zimmermann isolated the organism from the water of the city of Chemnitz; in the following a brief summary of the most important data of his description is given; Gram-

negative rods, motile, not capable of producing endospores; saccate liquefaction of gelatin with diffuse turbidity and white sediment. Growth on agar media; growth on nutrient broth with sediment and thin pellicle which by gentle agitation is disrupted to small slowly sedimenting flakes. Growth better at 30°C than at 20°C. Brownish flesh-colored growth on potato, which gets darker on longer incubation.

Lehmann and Neumann emended the description adding several essential properties:*

Motile by means of a single polar flagellum. Litmus milk coagulated, the coagulum is later liquefied. Acid and gas from glucose, strong production of hydrogen sulfide and weak production of indol.

This description contains all the essential morphological and biochemical properties of the later genus Aeromonas. It does not, however, include those characteristics which would allow with certainty its allocation to either of the two species Aeromonas punctata or A. hydrophila.

b) Aeromonas hydrophila

Sanarelli described a Bacillus hydrophilus fuscus (1891) but the name is illegitimate. The description was emended by Russel (1898) and the organism effectively named Bacterium hydrophilum by Chester (1901).

Sanarelli described his Bacillus hydrophilus fuscus (1891) with the following main characteristics:

Gram-negative rods, motile, strong liquefaction of gelatin and Löffler's serum. Growth in broth producing turbidity and a fine whitish pellicle; grey-white colonies on nutrient agar; production of gas in glycerol agar. Russel (1898) emended the description: motile by means of a single polar flagellum. Production of gas in glucose agar, litmus milk coagulated.

The species defined and designated as A. hydrophila by Schubert (1964a) corresponds in all properties with the description of Bacillus hydrophilus fuscus. In particular this

* Through a paper of Burckhardt (1917) it is known that K. B. Lehmann's collection in the Würzburg Institute of Hygiene contained a Bacillus punctatus strain originally isolated by O. E. R. Zimmermann. The strain showed polar single flagella. Thus in emending the description of "Bacterium punctatum" Lehmann and Neumann obviously investigated Zimmermann's original strain besides the newly isolated strains from the "Main river."

species includes only strains that ferment glycerol with production of gas. Moreover, strains A. hydrophila are likely to cause the red-leg-phenomenon in the frog. This frog sickness was described by Sanarelli (1891), Russel (1898) and others. Thus there can be no doubt about the identity of Bacillus hydrophilus fuscus Sanarelli (1891), Bacterium hydrophilum Chester (1901) and the more adequately defined species Aeromonas hydrophila (cf. Schubert 1964a).

Summarizing this, the opinion is expressed that the species A. punctata defined and distinguished from A. hydrophila by Schubert (1964a) corresponds in all properties with the description of Bacterium punctatum (Zimmermann 1890) emend. Lehmann and Neumann (1896). The recent emendation of the species description does not change the priority of the name (Rule 17a) (Schubert 1964a).

The following species description and the names need not be considered for considerations of priority:

In 1888 Legrain isolated a bacterium causing gangrenous septicemia in frogs. In his paper no suggestions are given as to the nomenclature. The organism produced an ascending necrosis of the phalanges, a process which is weeks in developing, causing the loss of the whole extremity and terminal septicemia. The description of the pathological symptoms does not correspond with the red-leg-phenomenon. According to Legrain's description (1888) this bacterium cannot be included in the genus Aeromonas. It possibly belongs to the genus Pasteurella.

In 1889 G. C. Frankland and P. F. Frankland isolated Bacillus liquidus from water. In the following a brief summary on the essential data of the description is given:

Short, thick "bacillus," cells often in pairs, not capable of producing endospores, very motile. Liquefaction of gelatin in form of a funnel along the whole stab with formation of a pellicle on the surface. Growth in broth with turbidity, pellicle and sediment. Reduction of nitrate to nitrite. Growth on nutrient agar; growth on potato with flesh-coloured layer. The description is incomplete. No data are given concerning the mode of flagellation and the action upon carbohydrates, no data on the Gram staining. The organism cannot be identified and is therefore incertae sedis. Even if one refers to the following questionable emendations of the original description, this strain cannot be included in the genus Aeromonas. According to Chester (1901) Bacillus liquidus (Frankland's strain?) is said to be polarly flagellated. In Bergey's Manual (1 Ed.) Achromobacter liquidum

(Frankland's strain?) is described as Gram-negative and with a polar flagellum, with no production of indol and no change of litmus milk. In Bergey's Manual (6 Ed.) this description was not altered. But the mode of flagellation was not quoted. In later editions the bacterium is mentioned only in the annex to the chapters on Pseudomonas and Achromobacter.

In 1890 Ernst described a Bacillus ranicida causing an epidemic frog-disease. In the following a brief summary of this description is given:

Rods 1-2.5 μ long, not capable of producing endospores. Crateriform liquefaction of gelatin with fine pellicle and formation of green (not fluorescent) sediment. Light brown growth on potato with dirty green discoloration. Good growth at 8°C, 22°C and 10°C; no growth at 38°C.

The description of this species is incomplete—no data on the flagellation and the ability to split carbohydrates are given. Its belonging to one of the species A. punctata and A. hydrophila can be excluded because of the low limit of growth temperature. Many authors (Lehmann and Neumann (1927), Weldin (1927) and others) assumed that Bacillus ranicida and Bacillus hydrophilus fuscus were the same species. From the differences between the pathological action caused by these organisms as outlined in the following, it appears unlikely that they are identical.

According to Ernst (1890) his agent kills frogs only if they are kept at low temperature (below 20°C) during the experiment or have been kept at this temperature until immediately prior to inoculation. Attempts to infect frogs in summer constantly failed. These experimental conditions have not been described by Sanarelli, although they should have been more evident in his work in Siena than in Ernst's experiments in Heidelberg. Contrary to Ernst (1890) and in accordance with Emmerson and Norris (1905), Schubert (unpublished data 1964) observed that at 6-8°C the disease of the frogs does not only take a much slower course than at a room temperature of 20°C, but also that animals succumb faster to the infection in the incubator at 30°C as compared to animals at 20°C. Furthermore, it may be mentioned that the disease of the frogs as described by Ernst exhibits a pathologico-anatomical pattern different from that described by Sanarelli (1891), Russel (1898), Emmerson and Norris (1905) and others.

According to Sanarelli (1891) and Russel (1898) the pathological changes caused by Bacillus hydrophilus fuscus in the

frog are characterized by hemorrhagic exudations in the abdominal and pericardial cavity, "hyperemic spots" in various muscles and internal organs, severe inflammatory reactions at the site of infection, for instance dirty wine-red discoloration of the normally pearl-white appearing muscles following infection of the thigh.

Histological examinations show a loss of striation in the muscle cells partially with granular decomposition, in between masses of bacteria. Ernst (1890) does not mention anything about all these changes. He repeatedly points to the growth of bacteria and their accumulation in clumps in the spleen, the liver, the kidney and the skin. But nowhere does one find a hint for the occurrence of inflammatory reactions and regressive processes and decomposition of the muscle at the site of infection.

As Ernst (1890) preferred the infection of the lymphatic sac, the same mode of infection uncommon today was used by the writer (1964) for reasons of comparison. In accordance with Sanarelli (1891) it was observed that in lymphatic sac infections a higher infective dose is necessary as compared to injections in the thigh. The back of animals shows intensive swelling, apparently the lymphatic system fills up with fluids and a strong inflammatory reaction sets in, causing a dirty red discoloration of the skin in the caudal areas. At autopsy the entire back muscle appears as a wine-red, edematous-greasy, decomposed mass. A comparison of the pathologico-anatomical findings excludes a red-leg disease of the frogs infected with Bacillus ranicida by Ernst.

In 1900 Beijerinck gave a description of a new genus Aerobacter including several new species. One of these, the polarly flagellated Aerobacter liquefaciens, was designated by Kluver and van Niel (1936) as type species for the newly proposed genus Aeromonas.

Beijerinck (1900) isolated Aerobacter liquefaciens in a medium obtained from an infusion of rhizomes of Althaea officinalis which were cut into pieces, suspended in water and left in glass tubes for one to two days at 28°C. This resulted in the formation of a thick slime which was strongly fermented. From this material several varieties of Aerobacter aerogenes and particularly of Aerobacter liquefaciens were isolated after subculture on wort gelatin plates. Beijerinck (1900) occasionally found Aerobacter liquefaciens during the process of indigo fermentation.

Considering Beijerinck's description of the common properties of the genus Aerobacter and the species description

of Aerobacter liquefaciens it is concluded that Beijerinck's Aerobacter liquefaciens could not have been a member of the genus Aeromonas.

To the author's knowledge subcultures of the original strain unfortunately do not seem to be available in the recognized culture collections. Beijerinck (1900), however, states that his strain did not hydrolyse starch (production of diastase). In the author's investigations of hundreds of strains, so far no Aeromonas strain was found lacking this property. Beijerinck's strains reduced nitrate to nitrite but not to ammonia; the writer observed in recent experiments with the proposed neotype strains of A. hydrophila (ATCC 7966), A. punctata (NCMB 74) and other Aeromonas strains, that they produce ammonia from nitrate (unpublished data 1964). According to Beijerinck the growth is "very much inflicted or even stopped" at an incubation temperature of 37°C whereas in the writer's experience the majority of A. hydrophila and A. punctata strains even grow at a temperature of 41°C in the water bath (Schubert 1960). Most of the Aeromonas strains tested by the author could not attack indoxyl- β -glycoside at all. The few strains which break down the glycoside belong to A. punctata. Only one of the tested A. hydrophila strains fermented indoxyl- β -glycoside (Schubert 1964a).

In recent suggestions on the classification of aerogenic Aeromonas species the writer (Schubert 1964a) does not recognize "Aeromonas dourgesi" proposed by Leclerc (1961) as a species. In his thesis Leclerc mentioned nonmotile Aeromonas strains fermenting lactose and sucrose. He combined these strains into a species "A. dourgesi" and separated them from A. hydrophila. There seems to be little justification for this step; for one-third of all A. hydrophila strains tested, fermented the two carbohydrates simultaneously as well. The writer considered, therefore, the aerogenic "dourgesi" strains as nonmotile members of the species A. hydrophila (Schubert 1964a). In addition there is some doubt whether Leclerc's species designation has been validly published, since according to rule 11 of the Code it is questionable whether a species description which has been printed in a thesis only, is effectively published and has standing in nomenclature.

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