CONSERVATION OF THE GENERIC NAME
CHROMOBACTERIUM AND DESIGNATION
OF TYPE SPECIES AND TYPE STRAINS

Request for an Opinion

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To the Judicial Commission:

I. The status of the generic name
Cromobacterium Bergonzini.

1. The name Cromobacterium was used by Bergonzini (1879) to include the pigmented species of the genus Bacterium Cohn (1872). Bergonzini divided each of Cohn's genera which contained pigmented bacteria--thus Micrococcus was divided into Micrococcus for nonpigmented species and Cromococcus for pigmented species and Bacillus into Bacillus and Cromobacillus. Bergonzini wrote (1879, p.38) "Il Gen: Bacterium come il gen. Micrococcus puo venir diviso in due sezioni:

Bacteri incolori (Bacterium)
Bacteri colorati (Cromobacterium)"

He listed four species of Cromobacterium with descriptions. These are, in order:

- (1) Cromobacterium syncyanum (sic) (pro synonym. Bacterium syncyanum Schroet., Vibrio syncyanus Ehr.).
- (2) Cromobacterium aeruginosum (pro synonym. Bacterium aeruginosum Schroeter).
- (3) Cromobacterium brunneum (pro synonym. Bacterium Brunneum Schroet.).
- (4) Cromobacterium xanthinum (pro synonym. Bacterium xanthinum (sic) Schroet., Vibrio synxanthus Ehr.).

The references are evidently to Schroeter (1872) and Ehrenberg (1840). Cromobacterium brunneum is unrecognisable, but species 1, 2, and 4 are now usually classified in the genus Pseudomonas, (being the bacilli of blue milk, of green pus, and of yellow milk, respectively). The second is the type species of the genus Pseudomonas nomenclavandum (Judicial Commission, 1952; Editorial Board, 1953a). The name Cromobacterium appears to be validly published in 1879 since it is accompanied by a description and by a redescription of Cohn's genus viz. "Bacteri lineari diritti Bacterium." It is uncertain whether the name ranks as a genus or a subgenus, but these are co-ordinate in nomenclature.

2. In 1880, Bergonzini added another species, the violet bacterium which he discovered and named Cromobacterium (sic) violaceum (the last letter of the generic name is a misprint, and the name is spelt with a final m on p. 37 Parte ufficiale). He specifically stated that it was a new species and was not Bacteridium violaceum Schroeter, 1872 (Micrococcus violaceus Cohn 1872) which Bergonzini (1879 p. 37) called Cromococcus violaceus. Following is his diagnosis: Cromobacterium violaceum - "Elementi cellulari cilindrici per lo più isolati, 2 a 3 volte così lunghi come larghi dotati di movimento oscillante, colorate in violetto da una sostanza speciale insolubile nell'acqua, - Grossezza da 0,6 a 1 μ ; lunghezza da 2 a 3 μ . Vegetano specialmente nelle soluz. d'albume d'uovo." The name is validly published.

3. The spelling of the generic name was corrected to the form Chromobacterium in a review of Bergonzini's second paper (anonymous, 1881). Bergonzini's spelling was evidently the usual Italian transliteration of the Greek root, but was clearly intended as a Latin form; it is presumably an orthographic variant. The emended spelling has been generally followed since then (Grove, 1884; de-Toni and Trevisan, 1889; and Buchanan, 1918). The exact date of Bergonzini's second paper is doubtful; the title page of the volume is dated 1881, but there is no indication of whether it was issued in parts during 1880. The paper was read to the Society on 22nd June, 1880. Another review (Zimmermann, 1880) appeared in Section 49/50 of the Botanische Centralblatt, 1880, but the day or month of issue are not given on the Sections.

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4. In 1918, Buchanan revived the name Chromobacterium as a genus, emending the description so as to include virtually only the violet chromogenic bacteria of the Bacterium violaceum group. His description was as follows: "Rod-shaped bacteria, without spores, aerobic, producing a violet chromoparous pigment soluble in alcohol, but not in chloroform, motile or non-motile, Gram-stain variable. The type species is Chromobacterium violaceum Bergonzini." This designation of the type species is illegitimate under Rule 9 (2) c 2 of the Revised International Code of Bacteriological Nomenclature (Ed. Bd., 1953b, p.42; Jud. Com., 1953, p.145; Intl. Com., 1953, Min. 6, p.158) since the type must be one of the species included in the first publication of the name.

5. The genus Chromobacterium Bergonzini emend. Buchanan may therefore be illegitimate on one or more of the following grounds: a) It may be a synonym of Pseudomonas nom. conserv. b) It has as type species a species which is not permissible as type species. c) The type species is unrecognisable and, being probably based on a mixed culture, may be a nomen confusum (see III, 2 below).

6. Enlows (1920, p.74) gives Pseudomonas violacea Migula 1894 (which belongs to the Bacterium violaceum group) as the type species of Pseudomonas by monotypy, but the name of this species was not validly published in 1894 (see Editorial Board, 1951). Although this species is one of those listed in Pseudomonas Migula 1895, it is not the type species and is now generally considered not to belong to that genus. Gieszczykiewicz (1939) gives the type species of Chromobacterium as C. prodigiosum; this is illegitimate under Rule 9 (2) c 3 (Editl. Bd., 1953b, p.42; Judl. Comm., 1953, p.145; Internatl. Comm., 1953, Minute 6, p.158).

7. If Chromobacterium Bergonzini emend. Buchanan is illegitimate, then either it can be conserved, or a new generic name can be created. Conservation would be in accord with the principle of fixity of names, and a new name would cause confusion, since this generic name has been in general use since 1918. As explained below (III, 2) the type species is unrecognisable, and conservation would therefore have to be accompanied by the designation of a recognisable type species and preferably of a neotype strain.

8. It would be more in accord with the principles of nomenclature to conserve the name Chromobacterium Bergonzini 1880 emend. Buchanan 1918 rather than Cromobacterium Bergonzini 1879, since the former is closer to the concept of the genus as it is used today. Cromobacterium Bergonzini 1879 should then be placed in the list of nomina genera rejicienda.

9. An Opinion of the Judicial Commission is requested on the correct citation of the generic name, if it is conserved, and to whom it should be ascribed.

II. Summary of taxonomy and synonymy.

1. There has been little work on the taxonomy of the genus, the most valuable being that of Cruess-Callaghan and Gorman (1935). Their classification has not proved wholly satisfactory. A recent study of thirty-eight strains (Sneath, 1956) showed that they fell into two distinct groups, which are here referred to as the mesophilic and psychrophilic groups. The mesophilic strains grow at 37° but not at 4°, are markedly proteolytic and are facultatively anaerobic. The psychrophilic strains grow at 4° but not at 37° and are poorly proteolytic and strictly aerobic. A number of other characteristics were also correlated with this division.

2. The two groups appear to be closely related; they both form the same pigment, violacein, and show both polar and peritrichate (lateral) flagella. They should be regarded as two species within the genus Chromobacterium.

3. The usage of Topley and Wilson (1929), who include in the genus the Bacillus prodigiosus group (Serratia) and various yellow chromogens, does not now seem justified. However, none of the proposals submitted here will make it confusing for those who subscribe to such an opinion.

4. Most of the early descriptions of blue and violet chromogenic bacteria are too poor for recognition of the genus or the species to which the organisms belonged.

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Bacteria of this genus which are recognisable with a fair degree of certainty as mesophils, with their synonymy, are:

- (i) Bacillus violaceus Eisenberg, 1888 p.8. (Violetter bacillus Eisenberg, 1886 Tab.2, No.4. Bacillus violaceus Eisenberg, 1891 p.91; de Lagerheim, 1891 p.77 in part.)

- (ii) Bacillus violaceus Laurentius Jordan, 1890 p.838, Pl.IV, Fig.10. (Bacillus violaceus Laurentius Roux, 1892 p.308; Lustig, 1893 p.103; Voges, 1893 p.302; Sternberg, 1893 p.631; Kruse in Flügge, 1896 (ii) p.312; Matzschita, 1902 p.136; Calderini, 1925 p.767; Godfrin, 1934 pp.90, 231. Bacillus violaceus laurentius Dyar, 1895 p.372. Bacillus Violaceus Laurentius Horrocks, 1901 p.68. Bacterium violaceus (sic) Laurentius (sic) Chester, 1897 p.117. Bacterium Laurenti (sic) Enderlein, 1925 p.281. Bacillus violaceus Chester, 1901 p.262. Pseudomonas Laurentia Migula, 1900 p.944; Migula, 1901 p.384. Pseudomonas janthina Chester, 1901 p.317 in part. Chromobacterium violaceum laurentium Ford, 1927 p.470.)

- (iii) Bacterium ianthinum Lehmann and Neumann, 1896 (i) Taf.27, (ii) p.264. (Bacterium violaceum Lehmann and Neumann, 1899 (i) Tab.23, (ii) p.262; Cunningham and Raghavachari, 1924 p.1285. Chromobacterium violaceum Bergey et al., 1939 p.92, 1948 p.231 in part.)

- (iv) Bacille bleu van der Sleen, 1894 No.26, Pl.VII, Fig.26.

- (v) Bacillus violaceus Manilae Wooley, 1904 p.1. (Bacillus violaceus Manilae Wooley, 1905 p.89. Chromobacterium violaceum Manilae Ford, 1927 p.471. Chromobacterium violaceum var. manilae Schattenberg and Harris, 1942 p.509.)

- (vi) Bacillus violarius acetonicus Bréaudat, 1906 p.879. (Bacillus violarius acetonicus Godfrin, 1934 pp.91, 232. Bacillus violaceus (sic) acetonicus Lehmann and Neumann, 1920 (ii) p.476; Calderini, 1925 p.772. Bacillus violaceus acétonicus Guillerin, 1929 p.38.

Aerobacillus violarius Donker, 1926 p.141 quoted in Bergey et al., 1948 p.720. Variety of Bacillus polymyxa Bergey et al., 1938 p.720.)

- (vii) Bacille violet pathogène Gauducheau, 1907 p. 278. (Bacille violet pathogène de Gauducheau Godfrin, 1934 pp.104, 238.)
- (viii) Bacillus violaceus (sic) Minett, 1913 p.44.
- (ix) Bacterium violaceum Cunningham and Raghavachari, 1924 p.1285.

Bacteria of this genus which are recognisable with fair certainty as psychrophilic, with their synonymy, are:

- (i) Bacillus janthinus Plagge and Proskauer, 1887 p.464. (Bacillus lividus Eisenberg, 1891 p.81; Roux, 1892 p.303; Germano, 1892 p.517; Voges, 1893 p.303; Sternberg, 1893 p.621; Chester, 1901 p.262; Matzuschita, 1902 p.140; Calderini, 1925 p.769; Godfrin, 1934 pp.97, 235. Bacterium lividum Migula, 1900 p.339 in part. Bacterium lividus (sic) Chester, 1897 p.117. Bacillus violaceus Lustig, 1890 p.88, 1893 p.75 in part; Matzuschita, 1902 p.50 in part. Bacillus Berolinensis Chester, 1901 p.305 not Bacillus Berolinensis Migula, 1900 p.856, not Bacillus berolinensis Macé, 1913 (ii) p.411. Bacillus violaceus Berolinensis Kruse in Flügge, 1896 (ii) p.311 in part. Bacillus Violaceus Berolinensis Horrocks, 1901 p.68 in part. Pseudomonas violacea Pribram, 1933 p.49. Chromobacterium lividum Holland, 1920 pp.219,222; Bergey et al., 1923 p.119, 1925 p.124, 1930 p.158, 1934 p.170.)
- (ii) Bacillus janthinus Macé, 1889 p.528. (Bacille violet Macé 1888. Bacillus janthinus Macé, 1897 p.585, 1901 p.920, 1913 (ii) p.414.)
- (iii) Bacillus janthinus Zimmermann, 1890 pp.84 (36), 140 (92). (Bacillus janthinus Zimmermann, 1893 Taf.2 Fig.13; Voges, 1893 p.303; Lustig, 1893 p.76 in part; Godfrin, 1934 pp.95, 234 in part; Pseudomonas ianthina Migula, 1900 p.941 in part.)

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- (iv) Bacillus membranaceus amethystinus Eisenberg, 1891 p.421. (Bacillus membranaceus amethystinus Germano, 1892 p.516; Voges, 1893 p.302; Sternberg, 1893 p.634; Frankland and Frankland, 1894 p.474; van der Sleen, 1894 No.25, Pl.VII, Fig.25; Miquel and Cambier, 1902 p.695; Godfrin, 1934 pp.99,236. Bacterium membranaceum amethystinum Cruess-Callaghan and Gorman, 1935 p.216. Bacillus amethystinus Kruse in Flügge, 1896 (ii) p.312; Matzuschita, 1902 p.238; Calderini, 1925 p.769; Macé, 1897 p.856. Bacterium amethystinum Migula, 1900 p.491; Chester, 1901 p.179; Enderlein, 1925 p.281. Bacterium amethystinus (sic) Chester, 1897 p.117. Bacillus Amethystinus Horrocks, 1901, p.69. Chromobacterium amethystinum Holland, 1920 pp.217,222; Bergey et al., 1923 p.121, 1926 p.161, 1934 p.173, 1939 p.94, 1948 p.232.)
- (v) Bacillus membranaceus amethystinus mobilis Germano, 1902 p.516. (Bacillus membranaceus amethystinus mobilis Miquel and Cambier, 1902 p.690; Bacillus amethystinus mobilis Kruse in Flügge, 1896 (ii) p.313; Matzuschita, 1902 p.138; Calderini, 1925 p.770. Bacillus Amethystinus Mobilis Horrocks, 1901 p.69. Bacterium amethystinus (sic) mobilis Chester, 1897 p.117. Pseudomonas amethystina Migula, 1900 p.94, 1901 p.385. Bacillus amethystinus Chester, 1901 p.262. Bacillus membranaceus amethystinus var. "mobilis" Godfrin, 1934 p.99. Bacterium violaceum var. amethystinum Pribram, 1919 p.7.)
- (vi) Bacillus lividus Zimmermann, 1893 p.94. (Bacterium lividum Migula, 1900 p.339 in part. Bacillus Lividus Horrocks, 1901 p.68. Bacillus pseudolividus Matzuschita, 1902 p.168; Calderini, 1925 p.769.)
- (vii) Bacillus violaceus diffusus Ajtai, 1897 p.666. (Stamm violaceus diffusus Aitay (sic) Bampton, 1913 p.134.)
- (viii) Violet bacillus Ward, 1898 p.59, Figs.1-10.
- (ix) B. membranaceus amethystinus Stamm I Bampton, 1913 p.135. (Bacillus membranaceus amethystinus (sic) I Godfrin, 1934 pp.102,237. Chromobacterium

membranaceum Bergey et al., 1923 p.119, 1926 p.125, 1930 p.159, 1934 p.171. Chromobacterium membranaceum amethystinum I Ford, 1927 p.472.

- (x) B. membranaceus amethystinus Stamm II Bampton, 1913 p.137. (Bacillus membranaceus amethystinus (sic) II Godfrin, 1934 pp.103, 237. Chromobacterium bamptonii Bergey et al., 1923 p.119, 1926 p.124, 1930 p.159, 1934 p.171. Chromobacterium membranaceum amethystinum II Ford, 1927 p.473.)

- (xi) Chromobacterium cohaerens Grimes, 1930 p.383.

- (xii) Bacillus janthinus var butyricus Deshusses and Novel, 1939 p.7.

Bacteria probably belonging to the genus
but species incertae sedis.

Bacillus violaceus Schröter, 1886 p.157; bacille violet Macé, 1887 p.354 (Bacillus violaceus Lutetiensis Kruse in Flügge, 1896 p.311); Bacteridium violaceum Schroeter, 1872 pp.124, 126 (Micrococcus violaceus Cohn, 1872 p.157); Chromobacterium hibernicum Grimes, 1930 p.382; Bacterium violaceum Trelease, 1885 p.205, Pl.12, Fig.9; Cromobacterium violaceum Bergonzini, 1880 p.153; Pseudomonas pseudo-violacea Migula, 1900 p.943; violetter Bacillus Maschek, 1887 p.71; Bacterium violaceum Wolff, 1911 p.643; Bacillus violaceus Frankland and Frankland, 1889 p.394; Bacillus violaceus Zimmermann, 1890 pp.82(34), 140(92); Bacterium ianthinum Zopf, 1883 p.68; Bacteria violada de Lagerheim, 1891 p.74; violetter Bacillus Hueppe, 1884 p.365; Bacillus janthinus Wright, 1895 p.450; Bacillus janthinus Voges, 1893 p.312; Bacillus janthinus Flügge, 1886 p.291; Bacillus ianthinus Lustig, 1893 p.76; Bacillus janthinus Tils, 1890 p.311; Bacillus membranaceus amethystinus van der Sleen, 1894 No.25, Pl.VII, Fig.25; Bacillus violaceus Lustig, 1890 pp.88, 89; Groups VI and VII Calderini, 1925 p.779; Bacillus janthinus Jordan, 1890 p.840, Pl.XII, Fig.12.

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Bacteria not belonging to the genus Chromobacterium
or of doubtful relationship, but liable to be
confused with Chromobacterium.

- (i) Bacteria not belonging to Chromobacterium
(Gilman, 1953; Sneath, 1956).

Chromobacterium viscosum Grimes, 1927 p.368; Chromobacterium chocolatum Gilman, 1953 p.48 (Chromobacterium chocolatum, Chromobacterium organum of Lasseur et al., 1944 p.293, Pl.10, Figs.1-3 ex Knutsen); Chromobacterium ianthinum Gilman, 1953 p.48; Chromobacterium iodinum Davis, 1939 p.273; Pseudomonas aeruginosa (Schroeter, 1872 pp.122, 126) Migula, 1900 p.884).

- (ii) Bacteria possibly related to Chromobacterium viscosum Grimes.

Bacterium cyaneum Leonard, 1904 p.398; Bacterium coelicolor Müller, 1908 p.195; Bacterium visco-fucatum Harrison and Barlow, 1905 p.97; Bacillus coeruleofaciens McFarlane, 1895 p.935; Bacillus budapestinensis α and β Ajtai, 1897 pp.659, 662; Bacillus violaceus sacchari Agar, 1894 p.265.

- (iii) Probably Pseudomonas spp.

Bacillus Le Monnieri Lasseur, 1913 p.47; Pseudomonas cattleyaecolor Marchal and Lotz, 1953 p.37; Pseudomonas syncyanea (Ehrenberg, 1840 p.202) Migula, 1895 p.29; B. cyaneofluorescens Zangemeister, 1895 p.321; Bacterium anthocyaneum Reiss, 1912 p.129; Bacillus caryocyaneus Dupaix 1930 ex Beijerinck (see Dupaix, 1933 p.13); Pseudomonas Beijerinckii Hof, 1935 p.152; Pseudomonas mildenbergii Bergey et al., 1948 p.96 (Blaubacillus Mildenberg 1922).

- (iv) "Indigo bacteria."

Bacillus indigoferus Zimmermann, 1893 p.92 (Indigo bacillus of Claessen 1890); Bacillus indigoferus Voges, 1893 p.307; Pseudomonas indigofera var. immobilis Elazari-Volcani, 1939 p.350, Fig.3; Bacillus pavoninus Forster apud van der Sleen, 1894 No.59; Bacillus coeruleus Smith, 1887 p.758: Bacille bleu IV Macé quoted in Godfrin, 1934 pp.72, 226.

(v) Genus uncertain.

Micrococcus cyanogenus Pammel and Combs, 1896 p.136; Bacteridium cyaneum Schroeter, 1872 pp.122,126 (Micrococcus cyaneus Cohn, 1872 p.156 in part); Micrococcus pseudo cyaneus Schroeter, 1886 p.145 (Micrococcus cyaneus Cohn 1872 in part); Bacillus Lacmus Schroeter, 1886 p.158; Blauer Coccus Maschek, 1887 p.67; Actinococcus cyaneus Beijerinck, 1913 p.198; Bacterium cyaneus (sic) White, 1906 p.16; Bacillus Violaceus Flavus, McFarlane 1895 p.939; Violetter Coccus Maschek, 1887 p.68; Bacillus violaceus sacchari Dyar, 1895 p.369; Merismopedia violacea Kützing, 1849 p.472; Pigmentbildender Diplococcus Klamann, 1887 col. 1347; Bacillus coeruleus Eckstein, 1894 p.14; Bacillus bruntzii Nepvau, 1920 p.742; Bacillus polychromogenes Thiry, 1900 p.9; Bacillus cyaneo-fuscus Beijerinck, 1891 p.308; Halobacter innocens violet var. Anderson, 1954 p.267. Chromobacterium marismortuae Elazari-Volcani 1940, pp. VII, 76; Bacillus caeruleus Voges, 1893 p.303; Bacterium h Rosenberg, 1886 p.458; Bacillus of Günther and Spitta, 1899 p.108; Blaugrüner Bacillus Maschek, 1887 p.78; Bacterium cristallino violaceum Cholkevitch, 1922 quoted by Godfrin, 1934 pp.93,233; Bacillus coeruleus Wright, 1895 p.451; Bacillus lilacinus Macé, 1913 (ii) p.416; Mikrococcus sublilacinus Matzuschita, 1902 p.222 (Coccen 26, Lembke 1896 p.317); Chromobacterium nubile Ford, 1927 p.472 (Bacillus nubilis Frankland and Frankland, 1889 p.386.)

(vi) Probably belonging to the genera listed below.

Micrococcus: Micrococcus purpurifaciens Lehmann and Neumann, 1920 p.755; (Coccus of Dudschenko 1914);

Cornyebacterium: Aplanobacter insidiosum McCulloch, 1925 p.497;

Bacillus: Thermobacillus violaceus Feirer, 1927 p.52;

Klebsiella: Bacillus indigogenus Eisenberg, 1891 p.364; (bacille indigène Alvarez 1887); Bacillus azureus Zimmermann, 1893 p.100.

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- (vii) Bacteria which were possibly Chromobacterium strains, but which are doubtful on account of discrepant features.

Bacillus violaceus sartoryi Waeldele 1938, quoted in Bergey et al., 1948 p.233 (see Sartory, Meyer and Waeldele 1938a, 1938b); Violet Lecoq de Boisbaudran 1882; violet bacillus Hartley 1913.

III. The designation of a type species
and neotype strain.

1. Bergonzini's description of Cromobacterium violaceum shows that it was quite certainly one of the Bacterium violaceum group, since the pigment was almost certainly violacein from its chemical properties. It was soluble in alcohol but not in water; in ether it dissolved slightly, giving a solution of a more red hue than that of an alcoholic solution; hydrochloric acid turned it green, and potassium hydroxide made it reddish. These properties agree well with those of violacein (see Sneath, 1956).

2. The species of Bergonzini's organism is not recognisable for the following reasons: a) it formed a tough violet zoogloea on an unsterile solution of white of egg exposed to the air during experiments on putrefaction, while none of my thirty-eight strains grows well in white-of-egg solution (prepared as described by Bergonzini, but aseptically) and none forms a pellicle even after six months at room temperature: b) the temperature in Bergonzini's experiments would have allowed about equal growth of mesophilic and psychrophilic strains: c) it was never grown on any other medium: d) some subcultures gave a white membrane which was only violet in small patches, suggesting contamination: e) the culture could scarcely be uncontaminated with other bacteria, whose effect on the violet bacterium cannot be assessed: f) the violet bacterium may have come from the water used to make the medium or from the air, and the size of its cells affords no evidence as to its species.

3. In selecting a type species for Chromobacterium nom. conserv. prop., a number of courses are possible. The

most simple would be to re-establish Cromobacterium violaceum Bergonzini 1880, as the type species although its species is unrecognisable, and to attach the name to a recognisable species and to a neotype culture. In favour of this course are the facts that it need not be conserved over earlier names, and that it is the best-known name in the genus. Other possibilities would be to establish a different type based on (a) the first description recognisable as to species, (b) the first validly-named description recognisable as to species, (c) the first description bearing the epithet 'violaceum' which is recognisable as to species, or (d) the species which generally has had the epithet 'violaceum.' Possibilities a, b, c, and d would raise more problems of nomenclature and would not seem to be any more in accord with the principles of nomenclature, than the simpler solution. The species which would be the type under the four possibilities a - d given above appear to be: (a) Violetter bacillus Eisenberg 1886 syn. Bacillus violaceus Eisenberg 1888 (a mesophil), (b) Bacillus janthinus Plagge and Proskauer 1887 (a psychrophil), (c) Bacillus violaceus Eisenberg 1888 (a mesophil), and (d) probably a mesophilic bacterium. With the possibilities a - d, the combinations resulting from the union of the epithets with the name Chromobacterium would be illegitimate, as they would be later homonyms of combinations based on different, unrecognizable or incompatible types. Thus (a) and (c) Chromobacterium violaceum (Eisenberg), a mesophil, would be a later homonym of Cromobacterium violaceum Bergonzini and of Chromobacterium violaceum Bergey et al. 1939, a psychrophil, (a) Chromobacterium janthinum (Plagge and Proskauer), a psychrophil, would be a later homonym of Chromobacterium ianthinum (Zopf 1883) Bergey et al. 1939, a mesophil; (d) if ascribed to any author other than Bergonzini would be a later homonym.

4. All these names appear to be illegitimate as nomina ambigua since they have been used for both mesophilic and psychrophilic bacteria by various authors. The least disturbance would be caused by attaching Cromobacterium violaceum Bergonzini 1880 to a mesophilic bacterium as proposed below.

5. There seems to be no cogent reason why the type should be a mesophil or a psychrophil, but if Bergonzini's species

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is re-established as type, I propose that it should be a mesophil on the following grounds: (a) the epithet 'violaceum' is the commonest which was used by early authors for mesophilic strains, (b) mesophilic strains appear to have been more widely studied than psychrophils. Most of the oldest available cultures are mesophils, for instance those in the American Type Culture Collection, ATCC 553, 6357 and 7461.

6. I also propose that the name Chromobacterium violaceum Bergonzini 1880 be attached to the mesophilic strain MK(Sneath, 1956)(National Collection of Type Cultures 9757; American Type Culture Collection 12472) as neotype strain, since this was the most typical mesophilic strain I studied.

7. An Opinion of the Judicial Commission is requested on whether the correct citation of the proposed type species, if re-established, should be Chromobacterium violaceum Bergonzini 1880.

IV. The nomenclatural position after one species
has been designated as type species.

1. There are, in my opinion, two clearly distinguishable species within the genus. Although further work may show that they should be further divided, it is important to fix the valid names and set up neotypes of the two well-defined species at present recognisable.

2. The type species will bear the epithet which is approved by the Commission. The position of the other species is examined below.

2A. If the type species be a mesophil as proposed.

The earliest description of a psychrophilic bacterium of this genus appears to be that of Plagge and Proskauer (1887). This bacillus was from water, and liquefied gelatin very slowly. The authors did not make it clear in their description whether the pigment was blue or violet, but failure to distinguish between these hues is common, and in their discussion they make it plain that they were referring to violet organisms. Eisenberg (1891), who redescribed the bacillus, refers

to the pigment as blue-black and as violet-blue. Despite the poor description, Plagge and Proskauer evidently had noticed the difference between the mesophilic and psychrophilic types in gelatin cultures, and (unlike most authors) had studied both.

The epithet 'janthinum' would be illegitimate, as Chromobacterium janthinum (Plagge and Proskauer) would be a later homonym of Chromobacterium janthinum (Zopf 1883) Holland 1920 and of C. ianthinum Bergey et al. 1939 p. 93. The last named is a mesophil, so the name would also be a nomen ambiguum. The first available epithet is 'lividum' given to the bacterium by Eisenberg (1891), and the valid name for the psychrophilic species appears to be Chromobacterium lividum (Eisenberg 1891) Holland 1920. Holland cites it as Flügge — Proskauer which is evidently a misprint. The statement of Bergey et al., 1923, that the optimum growth temperature of C. lividum is 35° is not supported by the earlier authors or by the other features they describe. It may have been a misprint and should not make the name a nomen ambiguum.

2B. If the type species be a psychrophil.

The first available epithet for a mesophil which is not barred by the considerations mentioned above is 'laurentium.' The valid name for the mesophilic species would then be Chromobacterium laurentium Migula 1900) nov. comb. This is based on Bacillus violaceus Laurentius Jordan 1890 (syn. Pseudomonas Laurentia Migula 1900), which was undoubtedly a mesophil, since it grew at 37°, grew anaerobically, and liquefied gelatin rapidly.

3. If 'lividum' and 'laurentium' are rejected, the next available name for psychrophilic strains is Chromobacterium amethystinum (Kruse in Flügge 1896) Holland 1920, and for mesophilic strains it would be Chromobacterium violarium (Donker 1926) nov. comb.

4. If the Commission re-establishes Chromobacterium violaceum Bergonzini 1880, as type species and attaches it to a mesophilic bacterium, I propose for the psychrophilic species the name Chromobacterium lividum (Eisenberg 1891)

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Holland 1920, with strain HB (Sneath 1956) (National Collection of Type Cultures 9796; American Type Culture Collection 12473) as neotype.

V. Description of the proposed neotype cultures.

The techniques are fully described in Sneath(1956). When tested by these techniques, the strains have the features given below. The incubation temperature is 25° unless otherwise stated. The two strains are typical members of the mesophilic and psychrophilic groups and their features were always or frequently present in the other strains of the same group.

Mesophilic strain MK (Sneath,1956) (NCTC 9757, ATCC 12472).

Short rods with rounded ends, in young cultures averaging about 0.7 μ in breadth and 1.5 μ in length, arranged singly, or in pairs, showing bipolar staining and containing abundant fat globules, Gram-negative, not acid fast, no true metachromatic granules, no definite capsule, no spores. Motile, possessing a single polar flagellum (of length about 3 μ and wavelength about 2 μ) and in young agar plate cultures in addition several lateral flagella (of length 3 - 6 μ and wavelength about 1.2 μ).

Nutrient agar plate (2 days). Colonies about 1.5 mm in diameter, smooth, shiny, round, low convex, with entire edge, butyrous, easily emulsified, pale violet. Pigmentation commences in the centre of the colonies, and after 5 days the colonies are about 4 mm in diameter, violet-black, flat with lobate edge. Non-pigmented variants are uncommon. Plate cultures smell of hydrogen cyanide and of ammonia.

Gelatin plate (20°). On the second day the small round colonies sink into cups of liquefied gelatin.

Nutrient agar slope (2 days). Growth smooth, shiny, pale violet, slightly raised with finely lobate edge. Good pigment in 7 days, but consistency of growth not gelatinous.

Gelatin stab (20°). Filiform colourless growth along the stab, with button of surface growth. Liquefaction is rapid, infundibuliform, and is well marked in 7 days. A thick violet pellicle forms on the liquefied medium.

Nutrient broth (2 days). A fragile violet pellicle, easily sinking if disturbed, moderate turbidity and slight powdery deposit. After 4-5 days, a dark violet ring forms at the surface which is adherent to the glass, and is thin and powdery.

Löffler's serum slope (14 days). Moderate digestion of the medium causing furrowing or collapse. Pigmentation good.

Potato slope (7 days). A deep violet shiny growth, smooth and undulant.

The strain has the usual resistance of vegetative organisms to heat and phenol, and is penicillin resistant. It grows well anaerobically, between 10° and 37°, between pH7 and pH9, and on 3 per cent but not on 6.5 per cent NaCl agar. Single organisms often do not grow on the surface of agar media, and the inhibition is abolished by catalase. It utilises citrate slowly, but does not utilise malonate. Aerobic cultures produce hydrogen cyanide. The pigment (violacein) appears identical with that of strain HB, and is insoluble in water or chloroform, but is soluble in ethanol, in which solvent it shows maximum optical absorption near 580 m μ and minimum near 430 m μ .

Peptone water carbohydrates: acid without gas in glucose, fructose, mannose, and trehalose; doubtful acidity in maltose, sorbitol, glycerol, sorbose; no acid in sucrose, glycogen, lactose, L(+)arabinose, dextrin, starch, dulcitol, inositol, inulin, α -melibiose, adonitol, raffinose, melezitose, m-erythritol, salicin, mannitol, rhamnose, D(+)xylose, galactose.

Hugh and Leifson medium carbohydrates: acid without gas anaerobically in glucose, fructose, mannose, sorbitol; doubtful in maltose; no acid in inulin (unless it has been heat sterilized), L(+)arabinose, D(+)xylose, mannitol, sucrose.

Litmus milk (7 days). Slight alkalinity, moderate peptonization, sometimes a small clot. Indole -, NH₃ +, MR doubtful, VP -, H₂S doubtful, methylene blue reduction +, nitrate +, nitrite +, catalase +, urease -, phosphatase +, phenylpyruvate -, gluconate -, arylsulphatase -. Hydrolysis of aesculin -, of casein +, of gelatin +, of starch -. Haemolysis +, egg yolk reaction +. Chitinase (zone of clearing in plates of nutrient agar containing 0.5 mg/ml of colloidal chitin, after 7 days) +.

BACTERIOLOGICAL NOMENCLATURE
AND TAXONOMYPsychrophilic strain HB (Sneath, 1956)
(NCTC 9796, ATCC 12473).

Rods with rounded ends, sometimes slightly curved, in young cultures averaging about 1.0μ in breadth and 3μ in length, arranged singly or in pairs with occasional chains of 5 - 6 members, showing barred staining and containing scanty fat globules, Gram-negative, not acid fast, no true metachromatic granules, no definite capsule, no heat resistant spores. Motile, possessing a single polar flagellum (of length about 3μ and wavelength about 2μ) and in young agar plate cultures in addition several lateral flagella (of length 3 - 5μ and wavelength about 1.5μ).

Nutrient agar plate (2 days). Colonies 1 mm in diameter smooth, shiny, round, convex, edge entire, butyrous, whitish or pale violet. Pigmentation commences at the centre and after 5 days the colonies are 4mm in diameter, low convex or low conical, are jelly-like and can often be detached whole from the medium, and are difficult to emulsify. Nonpigmented and non-gelatinous variants are common; plate cultures have a sour smell.

Gelatin plate (20°). After 2 days the colonies are about 0.5 mm in diameter, round, low conical, smooth, with undulant edge, whitish or pale violet. After 7 days there may be softening of the gelatin, and pigmentation is good.

Nutrient agar slope (2 days). Growth is smooth, shiny, slightly raised, usually pale violet, edge entire or lobate. Pigment and gelatinous consistency are well marked after 7 days.

Gelatin stab (20°). Very slight growth along the stab, and a button of surface growth. No liquefaction in 14 days, or only slight softening beneath the growth.

Nutrient broth (2 days). A gelatinous pellicle occasionally forms. The fluid is slightly turbid with slight viscous deposit. After 4-5 days a violet ring forms at the surface which is adherent to the glass, and is thick and gelatinous, with small pale hanging fronds.

Löffler's serum alone (14 days). Digestion of the medium very slight; pigmentation good.

Potato slope (7 days). A deep violet-brown shiny growth, smooth, undulant, not gelatinous.

The strain has the usual resistance of vegetative organisms to heat and phenol and is penicillin resistant. It grows between 2° and 30° , does not grow anaerobically and grows

between pH6 and pH9. It grows on 3 per cent NaCl agar but not on 6.5 per cent NaCl agar. Single organisms often do not grow on the surface of agar media and the inhibition is abolished by catalase. It utilises citrate rapidly, but does not utilise malonate. Aerobic cultures produce no detectable hydrogen cyanide. The pigment appears to be identical with that of strain MK.

Peptone water carbohydrates: no definite acidity in any.

Hugh and Leifson medium carbohydrates: acid, but only aerobically, in glucose, fructose, mannose, L(+)arabinose, D(+)xylose, mannitol, sucrose, sorbitol, maltose; not in inulin or salicin.

Litmus milk (7 days). Alkaline, with partial bleaching of the litmus, no peptonization and usually a large clot.

Indole -, BH_3 +, MR -, VP -, H_2S -, Methylene blue reduction weak, nitrate +, nitrite +, catalase +, urease -, phosphatase +, phenylpyruvate -, gluconate +, arylsulphatase -. Hydrolysis of aesculin +, of casein -, of gelatin -, of starch -. Haemolysis -, egg yolk reaction -. Chitinase -.

VI. Proposals submitted.

The Judicial Commission is requested to give Opinions on the following proposals:

1. That the generic name Cromobacterium Bergonzini 1879 be placed in the list of nomina generum rejicienda.
2. That the generic name Cromobacterium Bergonzini 1880 be placed in the list of genera conservanda.
3. That the spelling Cromobacterium be recognised as an orthographic variant arising from faulty transliteration of the Greek, and that the accepted spelling be Chromobacterium.
4. That the type species of Chromobacterium be Chromobacterium violaceum Bergonzini 1880, and that this name should be attached to a mesophilic bacterium.
5. That the neotype culture of Chromobacterium violaceum Bergonzini 1880 be the strain MK (NCTC 9757, ATCC 12472).

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6. That the neotype culture of Chromobacterium lividum (Eisenberg 1891) Holland 1920 be the strain HB (NCTC 9796, ATCC 12473).

The Commission is also requested to give a ruling on the correct citation of the names of the genus and the type species.

REFERENCES

- Agar, L.C. A peculiar chromatogenic Bacillus. New York Med. Jour. 59:265. 1894.
- Ajtai, K.S.C. Néhány újabb chromogén bacteriumról. Hung. Med. Arch. 4:657-667. 1897.
- Alvarez, E. Sur un nouveau microbe déterminant la fermentation indigotique et la production de l'indigo bleu. C. R. Acad. Sci., Paris 105:286-289. 1887.
- Anderson, H. The reddening of salted hides and fish. Applied Microbiology 2:64-69. 1954.
- Anonymous. New coloured bacterium. J.R. Micr. Soc. n.s. 1:284-285, 495-496. 1881.
- Bampton, J.H. Ueber Violaceus und Membranaceus amethystinus. Zentr. Bakt. I Abt. I. Orig. 71:129-146. 1913
- Beijerinck, M.W. De legensgeschiedenis eener pigment bacterie. Verslagen Mededeelingen der Konink. Akademie van Wetenschappen Amsterdam (Naturkunde). 3^e reeks 8:307-315 (also Bot. Ztg. 49 (1891) and Arch. Néerl Sci. 25 (1892). 1891.
- _____. Ueber Schröter und Cohn's Lakmusmicrococcus. Folia microbiol. Delft 2:185-200. 1913.
- Bergey, D.H., F.C. Harrison, R.S. Breed, B.W. Hammer, and F.M. Huntoon. Bergey's Manual of Determinative Bacteriology. 1st ed. Baltimore, Williams and Wilkins pp. 119, 121. 1923.
- _____. Ibid. 2nd ed. London and Baltimore, Baillièrre Tindall and Cox and Williams and Wilkins. pp. 124-126. 1926.
- _____. Ibid. 3rd ed. London, Baillièrre, Tindall and Cox pp. 158, 159, 161. 1930.
- _____. R.S. Breed, B.W. Hammer, F.M. Huntoon, E.G.D Murray, and F.C. Harrison. Ibid. 4th ed. London, Baillièrre, Tindall and Cox. pp. 170, 171, 173. 1934.

- Bergonzini, C. I Bacteri. Annuario della Società dei Naturalisti in Modena, ser. 2 Anno 13, pp.19-100. 1879.
- _____. Sopra un nuovo bacterio colorato. Annuario della Società dei naturalisti in Modena, ser. 2 Anno 14, Parte Scientifica 149-158; Parte ufficiale 37. 1880.
- Breed, R.S., E.G.D. Murray, and A.P. Hitchens. Bergey's Manual of Determinative Bacteriology. 6th ed. London, Baillière, Tindall and Cox. pp.96, 231, 232, 720. 1948.
- Breaudat, L. Sur un nouveau microbe producteur d'acétone. Ann. Inst. Pasteur 20:874-879. 1906.
- Buchanan, R.E. Studies in the nomenclature and classification of the bacteria V. Subgroups and genera of the Bacteriaceae. Jour. Bact. 3:27-61. 1918.
- Calderini, M. Ricerche sui batteri violacei delle acque. Ann. Igiene (sper). 35:765-784. 1925.
- Chester, F.D. A preliminary arrangement of the species of the genus Bacterium. Rep. Del. Agric. Exp. Sta. pp. 53-145. 1897.
- _____. A Manual of Determinative Bacteriology. New York, MacMillan. pp.179, 262, 305, 317. 1901.
- Cohn, F. Untersuchungen über Bacterien I. Beitr. Biol. Pfl. I; (Heft 2), pp.127-224. 1872.
- Cruess-Callaghan, G., and M.J. Gorman. On the characteristics of Bacterium violaceum (Schröter) and some allied species of violet bacteria. Sci. Proc. R. Dublin Soc. n.s. 21:213-221. 1935.
- Cunningham, J., and T.N.S. Raghavchari. Note on the appearance of a violet producing organism in certain water supplies of the Madras Presidency. Indian Jour. Med. Res. 11:1285-1289. 1924.
- Davis, J.G. Chromobacterium iodinum (n.sp.). Zentr. Bakt. 2 Abt. 100:273-276. 1939.
- de Lagerheim, G. Las bacterias violadas. An. Univ. Ecuador, Ser. 5, No.39, pp.74-77. 1891.
- Deshusses, J. and E. Novel. Coloration anormale d'un buerre causée par une variété de B. janthinus. Mitt. Lebensm. Hyg., Berne 30:2-7. 1939.
- de-Toni, J.B. and V. Trevisan. Schizomycetaceae in Saccardo, P.A., Sylloge Fungorum omnium hujusque cognitorum. Patavii 8:978. 1889.
- Donker. Inaug. Dissertation, Delft. p.141, quoted in Bergey et al. 1948 p.720. 1926.

BACTERIOLOGICAL NOMENCLATURE
AND TAXONOMY

- Dudtschenko, I.S. Ein im alkalischen Gelatine Medium Purpurfärbung hervorufender Micrococcus. Zentr. Bakt. 2 Abt. 42:529-530. 1914.
- Dupaix, A. Trav. Labor. Microbiol. Fac. Pharm. Nancy Fasc. 3, quoted in Dupaix 1933. 1930.
- _____. B. caryocyaneus Beijerinck-Dupaix 1930, Étude Morphologique et Biologique. Recherches sur le mécanisme du phénomène de Charrin et Roger (Agglutination sérique des Bactéries). Paris, Le Francois. p.13. 1933.
- Dyar, H.G. On certain bacteria from the air of New York City. Ann. N.Y. Acad. Sci. 8:322-380. 1895.
- Eckstein, K. Untersuchungen über die in Raupen vorkommenden Bakterien. Z. Forst. u. Jagdw. 26 Jahrg. 3-20, 228-241, 285-298, 413-424. 1894.
- Editorial Board. Preliminary Statement. File No.7. Status of Pseudomonas Migula 1894 as a generic name. Internatl. Bull. Bact. Nomen. Taxon. I(1):41-42. 1951.
- _____. Summary of Opinions and Preliminary Statements. Internatl. Bull. Bact. Nomen. Taxon. 3:73-110. 1953a.
- _____. The International Bacteriological Code of Nomenclature. Proposals relative to emendation and publication. Internatl. Bull. Bact. Nomen. Taxon. 3:31-62. 1953b.
- Ehrenberg, C.G. Berichte über die zur Bekanntmachung geeigneten Verhandlungen der königlichen preussische Akadamie der Wissenschaften zu Berlin. pp.197-219. 1840.
- Eisenberg, J. Bakteriologische Diagnostik. 1^e Aufl., Hamburg and Leipzig, Voss. Tab. 2. 1886.
- _____. Bakteriologische Diagnostik. 2^e Aufl., Hamburg and Leipzig, Voss. p.8. 1888.
- _____. Bakteriologische Diagnostik. 3^e Aufl., Hamburg and Leipzig, Voss. pp.81,364,421. 1891.
- Elazari-Volcani, B. On Pseudomonas indigofera (Voges) Migula and its pigment. Arch. Mikrobiol. 10:343-358. 1939.
- _____. Studies on the microflora of the Dead Sea. Thesis, Hebrew University, Jerusalem. pp. vii,76. 1940.
- Enderlein, G. Bakterien-Cyclogenie. Berlin and Leipzig, de Gruyter. p.281. 1925.
- Enlows, E.M.A. The generic names of bacteria. Bull. U.S. Hyg. Lab., No.121, pp.1-115. 1920.
- Feirer, W.A. Studies on some obligate thermophilic bacteria from soil. Soil Sci. 23:47-56. 1927.

- Flügge, C. Die Mikroorganismen. 1^e Aufl., Leipzig, Vogel. p.291. 1886.
- Ford, W.W. Textbook of Bacteriology. Philadelphia and London, Saunders. pp.470,471,472,473. 1927.
- Frankland, G.C., and P.F. Frankland. Ueber einige typische Mikroorganismen im Wasser und im Boden. Z. Hyg. Infekt.-Kr. 6:373-400. 1889.
- _____, _____. Micro-organisms in Water. London, Longmans Green. p.474. 1894.
- Gauducheau, M.A. Sur un bacille violet pathogène. C. R. Soc. Biol., Paris 62:278-279. 1907.
- Germano, E. Der Bacillus membranaceus amethystinus mobilis. Zentr. Bakt. 12:516-519. 1892.
- Gieszczykiewicz, M. Zagadnienie systematyki w bakteriologii - Zur Frage der Bakterien - Systematik. Bull. Int. Acad. Cracovie (Acad. Pol. Sci.) (Classe Sci. Math. nat., Ser. B Sci. nat. I) No. 1-5, pp.9-27. 1939.
- Gilman, J.P. Studies on certain species assigned to the genus Chromobacterium. Jour. Bact. 65:48-52. 1953.
- Godfrin, P. Contribution a l'etude des Bactéries bleues et violettes. (Thèse, Fac. Pharm. Nancy) Nancy, Société d'Impressions Typographiques. passim. 1934.
- Grimes, M. An aerobic capsulated Bacterium chromogenic on sugar media. Zentr. Bakt. 2 Abt. 72:367-368. 1927.
- _____. A study of two new species of bacteria belonging to the genus Chromobacterium. Sci. Proc. R. Dublin Soc. n.s. 19:381-384. 1930.
- Grove, W.B. A Synopsis of the Bacteria and Yeast Fungi and Allied Species (Schizomycetes and Saccharomycetes). London, Chatto and Windus, p.26. 1884.
- Guillerin, J. La Stérilisation des eaux de boisson à Saigon et Cholon. Arch. Inst. Pasteur Indo-Chine No.10. pp.36-55. 1929.
- Günther, C., and O. Spitta. Bericht über die Untersuchung des Berliner Leitungswassers in der Zeit vom April 1894 bis December 1897. Arch. Hyg., Berl. 34:101-148. 1899.
- Harrison, F.C., and B. Barlow. A new chromogenic slime-producing organism. Proc. Roy. Soc. Canada 2nd ser. 11: Sect.4, pp.97-125. 1905.
- Hartley, W.J. On a violet colouring-matter and its production by a certain Bacterium. Sci. Proc. R. Dublin Soc. n.s. 14:63-73. 1913.

BACTERIOLOGICAL NOMENCLATURE
AND TAXONOMY

- Hof, T. Investigations concerning bacterial life in strong brines. *Rec. Trav. Bot. Neerl.* 32:92-173. 1935.
- Holland, D.F. Generic index of the commoner forms of bacteria. *Jour. Bact.* 5:215-226. 1920.
- Horrocks, W.H. An Introduction to the Bacteriological Examination of Water. London, Churchill, pp.68,69, 1901.
- Hueppe, F. Untersuchungen über die Zersetzungen der Milch durch Mikroorganismen. Mittheilungen aus dem Kaiserlichen Gesundheitsamte zu Berlin 2:309-371. 1884.
- International Committee. Minutes of the International Committee on Bacteriological Nomenclature 1953. *Internatl. Bull. Bact. Nomen. Taxon.* 3:155-161. 1953.
- Jordan, E.O. A report on certain species of bacteria observed in sewage. *Rept. Mass. Bd. Publ. Hlth. Report on Water Supply and Sewerage 1890*, part 2, pp.821-844. 1890.
- Judicial Commission. Opinion No.5. Conservation of the generic name Pseudomonas Migula 1894 and designation of Pseudomonas aeruginosa (Schroeter) Migula 1900 as type species. *Internatl. Bull. Bact. Nomen. Taxon.* 2:121-122. 1952.
- _____. Minutes of the Judicial Commission 1953. *Internatl. Bull. Bact. Nomen. Taxon.* 3:141-154. 1953.
- Klamann. Ueber einige Micro-organismen im Secret bei Rhinitis chronica atrophicans (Ozäna) nebst Bemerkungen über die Verschiedenheiten der Secrete. *Allge. Med. Zentr. Ztg.* 56 Jahrg. cols 1345-1348, 1659-1662, 1669-1681. 1887.
- Kruse, W. In Flügge, C. Die Mikroorganismen. 3^e Aufl. Leipzig, Vogel. 2:311-313. 1896.
- Kützing, F.T. *Species Algarum*. Lipsiae, Brockhaus p.47. 1849.
- Lasseur, P. Contribution a l'étude de Bacillus Le Monnier nov. spec. *C. R. Soc. Biol., Paris* 74:47-48. 1913.
- _____, A. Dupaix-Lasseur, and J. Melcion. Caractères antigéniques de Chromobacterium chocolateum (Knutsen) form violette et form orangée. *Trav. Labor. Microbiol., Fac. Pharm. Nancy Fasc.13*, pp.293-312. 1944.
- Lecog de Boisbaudran. Matière colorante se formant dans la colle de farine. *C. R. Acad. Sci., Paris* 94:562-563. 1882.
- Lehmann, K.B., and R.O. Neumann. *Atlas und Grundriss der Bakteriologie* 1^e Aufl. München, Lehmann. Vol. 1 Taf. 27, Vol. 2, p.264. 1896.

- _____, _____. Atlas und Grundriss der Bakteriologie. 2^e Aufl. München, Lehmann. Vol.1 Taf.23, Vol.2 p.262. 1899.
- _____, _____. Atlas und Grundriss der Bakteriologie. 6^e Aufl. München, Lehman. Vol.2 pp.476,755. 1920.
- Lembke, W. Beitrag zur Bacterienflora des Darms. Arch. Hyg., Berl. 26:293-328. 1896.
- Leonard, E.L. Bacterium Cyaneum: A new chromogenic organism. Johns Hopk. Hosp. Bull. 15:398-400. 1904.
- Lustig, A. Diagnostica dei batteri delle acque. 1st Ed. pp.88,89. Torino, Rosenberg and Sellier. 1890.
- _____. Diagnostik der Bakterien des Wassers. 2^e Aufl. (German translation), Jena, Fischer and Turin, Rosenberg and Sellier, pp.75,76,103. 1893.
- Macé, E. Sur quelques bactéries des eaux de boisson. Ann. Hyg. Publ., Paris 3^e sér 17:354-357. 1887.
- _____. L'analyse bactériologique de l'eau. Ann. Hyg. Publ. Paris 3^e sér 19:501-528. 1888.
- _____. Traité pratique de bactériologie. 1st Ed. Paris, Baillière. p.528. 1889.
- _____. Traité pratique de bacteriologie. 3rd Ed. Paris, Baillière. pp.855,856. 1897.
- _____. Traité pratique de bactériologie. 4th Ed. Paris, Baillière. p.920. 1901.
- _____. Traité pratique de bactériologie. 6th Ed. Paris, Baillière. 2:411,414,416. 1913.
- Marchal, J.G., and F. Lotz. Pigment produit par Pseudomonas cattleyaecolor et vitamine B₁. Trav. Labor. Microbiol. Fac. Pharm. Nancy Fasc.17, pp.31-48. 1953.
- Maschek, J. Bacteriologische Untersuchungen der Leitmeritzer Trinkwasser. 21^e Jahres-Bericht der Communal-Ober-Realschule in Leitmeritz pp. 3-85. 1887.
- Matzuschita, T. Bacteriologische Diagnostik. Jena, Fischer. pp.50,136,138,140,168,222,238. 1902.
- McCulloch, L. Aplanobacterium insidiosum n.sp., the cause of an alfalfa disease. Phytopathology 15:496-497. 1925.
- McFarlane, J. Some new conjunctival micro-organisms. Univ. Med. Mag. Penna. Univ. 7:932-940. 1895.
- Migula, W. Ueber ein neues System der Bakterien. Arb. Bact. Inst. Karlsruhe, 1, Heft 2, pp.233-238. 1894.
- _____. System der Bakterien. Jena, Fischer. 2:339,491, 856,884,941,944. 1900.

BACTERIOLOGICAL NOMENCLATURE
AND TAXONOMY

- _____. Compendium der bakteriologischen Wasseruntersuchung. Weisbaden, Nemnich. pp.384-385. 1901.
- Mildenberg, H. Über einen blauen Farbstoffbildenden *Bacillus* aus der Luft und seine Beziehungen zum *Bacillus* der blauen Milch. Zentr. Bakt. 2 Abt. 56:309-328. 1922.
- Minett, E.P. The frequency of *Bacillus violaceus* in the water and milk supplies of British Guiana. Brit. Guiana Med. Annu. (No.18, 1911), pp.44-46. 1913.
- Miquel, P. and R. Cambier. Traité de Bactériologie Paris, Naud. pp.690,695. 1902.
- Müller, R. Eine Diphtheridee und eine Streptothrix mit gleichem blauen Farbstoff, sowie Untersuchungen über Streptothrix arten im allgemeinen. Zentr. Bakt. 1 Abt. Orig. 46:195-212. 1908.
- Nepveux, F. Influence du fer sur le pouvoir chromogène de *Bacillus bruntzii* nov. sp. C. R. Soc. Biol., Paris 83: 742-743. 1920.
- Pammel, L.H., and R. Combs. Some notes on chromogenic bacteria. Proc. Iowa Acad. Sci. 3:135-140. 1896.
- Plagge and Proskauer, B. Bericht über die Untersuchung des Berliner Leitungswassers in der Zeit vom 1. Juni 1885 bis 1. April 1886. Z. Hyg. Infekt.-Kr. 2:401-490. 1887.
- Pribram, E. Der gegenwärtige Bestand der vorm. Kral-schen Sammlung von Mikroorganismen. Wien., published privately. p.7. 1919.
- _____. Klassifikation der Schizomyceten (Bakterien). Leipzig and Wien, Deuticke. p.49. 1933.
- Reiss, A. Studien ueber die Bakterienflora des Mains bei Würzburg inqualitativer undquantitativer Hinsicht. Verh. Phys.-Med. Ges. Würzb. 41:107-150. 1912.
- Rosenberg, B. Ueber die Bacterien des Mainwassers. Arch. Hyg. Berl. 5:446-482. 1886.
- Roux, G. Précis d'analyse microbiologiques des eaux. Paris Baillièrre. pp.303,308. 1892.
- Sartory, A., J. Meyer, and J. Waeldele. Étude d'une Bactérie chromogène nouvelle et de sa violacéine isolée à l'état cristallisé. Bull. Sci. Pharm. 45:302-306. 1938a.
- _____, _____, _____. Contribution a l'étude d'une violacéine obtenue a l'etat cristallisé et provenant d'un bacille violet isolé du pus d'un abcès dentaire. C. R. Acad. Sci., Paris, 206:950-953. 1938b.

- Schattenberg, H.J. and W.H. Harris. Chromobacterium violaceum, var. manilae as a pathogenic microorganism. Jour. Bact. 44:509-521. 1942.
- Schroeter, J. Ueber einige durch Bakterien gebildete Pigmente. Beitr. Biol. Pfl. Heft 2, pp.109-126. 1872.
- _____. Die Pilze Schlesiens in Kryptogamen-Flora von Schlesien, ed. F. Cohn, Breslau, Kern. Vol.3, 1 Halfte, pp.145,157,158. 1886.
- Smith, A.J. A new chromogenic bacillus - Bacillus coeruleus. Medical News, Philadelphia 51:758-759. 1887.
- Sneath, P.H.A. Cultural and biochemical characteristics of the genus Chromobacterium. Jour. Gen. Microbiol. (in press) 1956.
- Sternberg, G.M. A Manual of Bacteriology. New York, Wood. pp.621,631,634. 1893.
- Thiry, G. Bacille polychrome et Actinomyces modoré. Paris, Baillière. 1900.
- Tils, J. Bacteriologische Untersuchung der Freiburger Leitungswasser. Z. Hyg. Infect.-Kr. 9:282-322. 1890.
- Topley, W.W.C. and G.S. Wilson. The Principles of Bacteriology and Immunity. 1st Ed., London, Arnold. 1:398, 402. 1929.
- Trelease, W. Observation on several Zoogloae and related forms. Johns Hopkins University Studies from the Biological Laboratory 3:193-216. 1885.
- van der Sleen, N. Sur l'examen bactériologique qualitatif de l'eau, avec description de 80 espèces et 118 épreuves phototypiques. Arch. Mus. Teyler. Sér 2, 4:(3). 1894.
- Voges, H.M. A violet Bacillus from the Thames. Ann. Bot., London 12:59-74. 1898.
- White, G.F. The bacteria of the apiary, with special reference to bee diseases. Bull. U.S. Bur. Ent. Technical series No.14. 1906.
- Wolff, A. Bacterium fuchsinum und Bacterium violaceum n. sp. Zentr. Bakt. 2 Abt. 30:639-644. 1911.
- Woolley, P.G. Report on Bacillus violaceus Manilae: a pathogenic microorganism. Bull. Bur. Labs. Philippine Islands No.15. 1904.
- _____. Bacillus violaceus Manilae (A pathogenic microorganism). Johns Hopk. Hosp. Bull. 16:89-93. 1905.
- Wright, J.H. Report on the results of an examination of the water supply in Philadelphia, in J.S. Billings, The bacteria of river waters. Mem. Nat. Acad. Sci., Wash. 7: 422-474. 1895.

BACTERIOLOGICAL NOMENCLATURE
AND TAXONOMY

- Zangemeister, W. Kurze Mittheilungen über Bakterien der blauen Milch. Zentr. Bakt. 1 Abt. 18:321-324. 1895.
- Zimmermann, O.E.R. Bergonzini, Curzio. Sopra un nuova bacterio colorato. (Abstract) Bot. Zentr. 4:1528-1530. 1880.
- _____. Die Bakterien unserer Trink- und Nutzwasser, insbesondere des Wassers der Chemnitzer Wasserleitung. I Reihe. Ber. naturw. Ges. Chemnitz, 11^e Bericht, Abh. 3:53-154, and as a Separat-Abdruck (106 pp.). 1890.
- _____. Die Bakterien unserer Trink- und Nutzwasser, insbesondere des Wassers der Chemnitzer Wasserleitung. II Reihe. Ber. naturw. Ges. Chemnitz, 12^e Bericht, Abh. 9:79-168, also as a Separat-Abdruck. 1894.
- Zopf, W. Die Spaltpilze; in Handbuch der Botanik Ed. by W. Förster, et al. 1 Abtheil, 32 Lieferung) and as a Separat-Abdruck (1883). Breslau, Trewendt. p.68. 1883.