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PROGRESS REPORT
MICROORGANISM STUDY, CIT CONTRACT NO. 950783
Jet Propulsion Laboratory
Systematic Description and Key to Isolants
from Atacama Desert, Chile

Professor W. B. Bollen, Microbiologist
Fred Au and Karen M. Byers
Assistants in Microbiology
Oregon State University, Corvallis, Oregon

May 7, 1968

N68-24925

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Preface

The following report identifies 32 isolants from soils of the Chile Atacama Desert. Of the 32 isolants there are 5 molds, 1 yeast, 8 actinomycetes and 18 bacteria representing 15.6%, 3.1%, 25.0% and 56.3% respectively. In this report the yeast and mold isolants are disregarded. The actinomycetes are being studied by Sumie Nishikawa for identification.[1/] The remaining bacterial cultures are identified and presented in this report. A dichotomous key and a list of the isolants and species designations precedes the Descriptive Charts for each isolant. In addition to the Descriptive Charts for the viable isolants, photomicrographs of the non-viable isolants are included.

Of the 18 bacterial isolants 2 are Micrococcus spp., 4 are Mycococcus spp.[2/], 2 are "soil diphtheroids" and 10 are Bacillus spp., comprising 11.1%, 22.2%, 11.1% and 55.6% respectively.

1/ See report on Streptomyces, dated April 25, 1968.

2/ Two of the isolants, 268Aa and 268Bd, failed to grow; although, from microscopic examination of the original culture they appeared related to the Mycococcus.

LIST OF ISOLANTS AND SPECIES DESIGNATIONS

Code Number	Species Designation	Page
256Ba	*Bacillus subtilis*.	28
257Ba	Yeast.	
*257Ab	("Soil diphtheroid").	38
258Ba	Mold.	
259Aa	*Bacillus megaterium*.	18
259Ab	Mold.	
*259Bc	Actinomycete.	
260Aa	*Bacillus subtilis* var. *niger*.	30
260Ab	*Bacillus megaterium*.	20
260Bc	*Bacillus subtilis* var. *niger*.	32
260Bd	*Bacillus megaterium*.	22
260Ae	Actinomycete (*Streptomyces coelestis*).**	
260Af	Actinomycete (*Streptomyces coelestis*).**	
*261Ba	Actinomycete.	
261Bb	Mold.	

* Isolant would not grow upon original transfer.
** See report on *Streptomyces*.

266Aa	*Bacillus laterosporus*.	34
266Ab	*Bacillus megaterium*.	24
266Ac	*Bacillus laterosporus*.	36
*268Aa	(*Mycococcus sp.*).	38
268Bb	*Mycococcus albus* subsp. *albidus*.	12
268Ac	*Mycococcus albus* subsp. *albidus*.	14
268Bd	(*Mycococcus* sp.).	38
274Aa	Mold.	
275Aa	Actinomycete (*Streptomyces albus*).**	
275Ab	Actinomycete.	
277Ba	*Micrococcus* sp.	8
277Bb	Actinomycete (*Streptomyces parvulus*).**	
277Ac	"Soil diphtheroid."	16
278Ab	*Micrococcus* sp.	10
278Bc	Actinomycete (*Streptomyces longisporuber*).**	
278Bd	Mold.	
279Aa	*Bacillus licheniformis*.	26

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* Isolant would not grow upon original transfer.
** See report on *Streptomyces*.

DICHOTOMOUS KEY

I. Molds.

258Ba
259Ab
261Bb
274Aa
278Bd

II. Yeast.

257Ba

III. Actinomycetes.

*259Bc
260Ae (*Streptomyces coelestis*).**
260Af (*Streptomyces coelestis*).**
*261Ba
275Aa (*Streptomyces albus*).**
*275Ab
277Bb (*Streptomyces parvulus*).**
278Bc (*Streptomyces longisporuber*).**

---

* Isolant would not grow upon original transfer.
** See report on *Streptomyces*.

IV. Bacteria. Gram-positive.

A. Do not survive pasteurization.

1. Cocci.

a. Pigmented--Brite Peach.

277Ba	*Micrococcus* sp.	8

b. Non-pigmented.

278Ab	*Micrococcus* sp.	10

2. Rods.

a. Morphology of these isolants varies from coccoid, ellipsoidal and rod shapes to pleomorphic-rods; also, more refractive, larger spherical- to rod-shaped forms occur (possibly Krassilnikov's "involution forms").

(1). Isolants fail to grow.

268Aa	(*Mycococcus* sp.).	38
268Bd	(Mycococcus sp.).	38

(2). Isolants growing.

268Bb	*Mycococcus albus* subsp. *albidus*.	12
268Ac	*Mycococcus albus* subsp. *albidus*.	14

b. Typical "soil diphtheroid" morphology.

(1). Isolant fails to grow.

257Ab	"Soil diphtheroid."	38

(2). Isolant growing.

277Ac "Soil diphtheroid." 16

B. Survive pasteurization.

The remainder of the Dichotomous Key follows:

Smith, Nathan R., Ruth E. Gordon, and Francis E. Clark. 1952. Aerobic Sporeforming Bacteria. Agriculture Monograph No. 16. U. S. Department of Agriculture.

Breed, Robert S., E. G. D. Murray, and Nathan R. Smith. 1957. Bergey's Manual of Determinative Bacteriology. 7th ed. Baltimore, The Williams and Wilkins Company.

I. Sporangia not definitely swollen. Spores ellipsoidal to cylindrical, central to terminal. Spore walls thin and not easily stained. Gram positive.

A. Protoplasm of young cells grown on glucose agar vacuolated if lightly stained.
Diameter of vegetative rods is 0.9 micron or more.

1. Acid from mannitol with ammonium salts as source of nitrogen. Acetylmethylcarbinol not produced.

259Aa	Bacillus megaterium.	18
260Ab	Bacillus megaterium.	20
260Bd	Bacillus megaterium.	22
266Ab	Bacillus megaterium.	24

B. Protoplasm of young cells grown on glucose agar not vacuolated if lightly stained.
Diameter of vegetative rods is less than 0.9 micron.

1. Growth on glucose agar as good as or better than on agar. Good growth on soybean agar.

a. Growth in 7 percent NaCl agar.

b. Starch hydrolyzed. Nitrites produced from nitrates.

c. Good growth under anaerobic conditions in glucose broth; pH of cultures is 5.2 or below. Gas produced from nitrates under alkaline. anaerobic conditons.

279Aa *Bacillus licheniformis*. 26

cc. Scant if any growth in glucose broth under anaerobic conditions; pH of cultures is higher than 5.2. No gas produced from nitrates under alkaline, anaerobic conditions.

256Ba *Bacillus subtilis*. 28

d. Black pigment on tyrosine media only.

260Aa *Bacillus subtilis* var. *niger*. 30

260Bc *Bacillus subtilis* var. *niger*. 32

II. Sporangia definitely swollen. Spores ellipsoidal, rarely cylindrical, central to terminal. Spore wall thick and easily stained. Remnants of sporangium sometimes adhering. Gram-variable.

B. No gas from carbohydrates.

1. Saprophytic. Grow on ordinary media.

aa. Starch not hydrolyzed.

b. pH of glucose broth cultures is less than 8.0. Grow in glucose broth under anaerobic conditions.

c. Acid from glucose and mannitol with ammonium salts as source of nitrogen.

266Aa	Bacillus laterosporus.	34
266Ac	Bacillus laterosporus.	36

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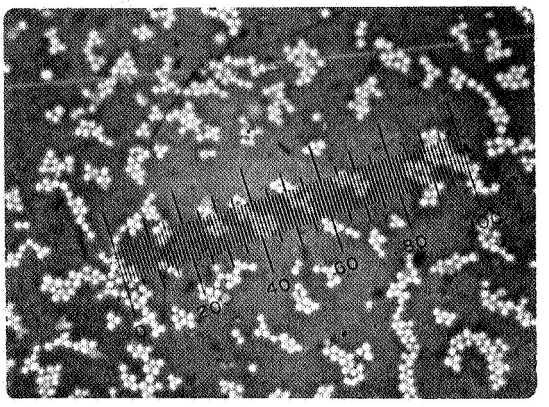
DEPARTMENT OF MICROBIOLOGY
(JPL–NASA)

Descriptive Chart

277Ba	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Micrococcus sp.*	28°C.	W.B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*



NIGROSIN:

MORPHOLOGY:

Form: *rods, ends*_____,
filaments, cocci, spirals,
branching _____.

Size: *average* – 0.90 x 1.03 μ.
range – 0.86 – 1.06 x 1.02 – 1.21 μ.

Irregular forms:

GRAM REACTION:

18 hrs: 100% POSITIVE.
24 hrs: 100% POSITIVE.
48 hrs: 90% POSITIVE.

PASTEURIZATION SURVIVAL (85°C, 10 minutes): NEGATIVE.

Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*

Endospores: *swollen, not swollen,.*

Position: *central,to excentric, terminal, subterminal.*

Shape: *spherical, ellipsoidal, cylindrical, oval.*

size: average –
range –

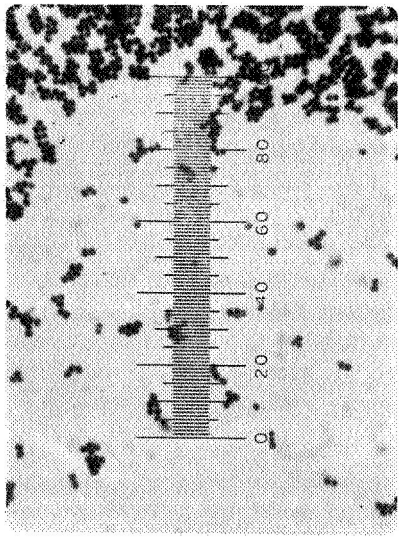
MOTILITY: age 1 DA. NEGATIVE.

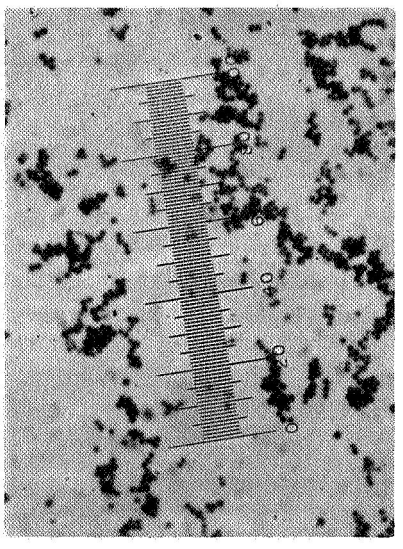
Flagella:

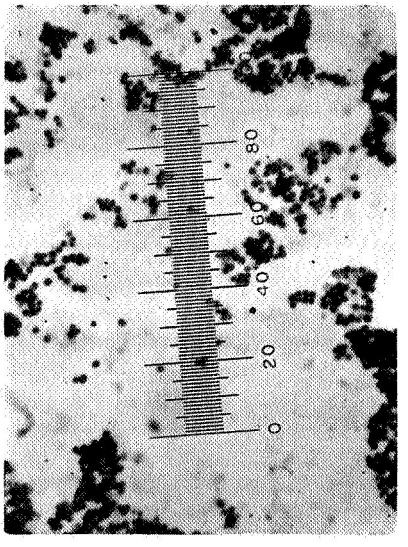
OTHER STAINS:

~~Acid fast:~~

18; 24; 48 hr. GRAM:







*resembling M. roseus.

II. CULTURAL CHARACTERISTICS

AGAR STROKE: age 3 DA.

Amount of growth: abundant, moderate, scant.

Form: aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.

Consistency: adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.

AGAR COLONIES: age 5 DA.

Macroscopic

Size: 5 mm.

Shape: filamentous, irregular, oval, puntiform, round.

Elevation: beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.

Topography: contoured, rough, smooth, striated, wrinkled.

Habit: compact, spreading.

Microscopic (100x)

Margin: Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.

Internal structure: amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.

Optical properties

Appearance by reflected light: dull, fluorescent, glistening, iridescent, opalescent.

Appearance by transmitted light: opaque, translucent, transparent.

Medium: blackened, blued, browned, grayed, greened, yellowed, unchanged.

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	BRITE PEACH	5ia
Potato slant	NONE	
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: abundant, moderate, scant.

Surface growth: none, flocculent, membranous, pellicle, ring.

Subsurface growth: none, granular, turbid.

Sediment: none, compact, flaky, flocculent, granular, viscid.

Odor: resembling NONE.

GELATIN STAB: age 18 DA.

Liquefaction: none, crateriform, infundibuliform, napiform, saccate, stratiform.

Rate: fast, moderate, slow.

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: GOOD

Fat agar:

Glucose-nitrate agar: NONE TO SCANT.

GLUCOSE · NUTRIENT AGAR: GOOD.

NUTRIENT AGAR: GOOD.

ANAEROBIC NITRATE BROTH: NO GAS.

ANAEROBIC GLUCOSE BROTH: GROWTH. pH 7.2.

DNA

G:C _____

G+C _____ moles %

III. PHYSIOLOGICAL CHARACTERISTICS

277Ba

RELATIONSHIP TO O_2: aerobic, anaerobic, facultative, microaerophilic.

CATALASE: positive, negative.

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 10°C. +, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. +.

SOLE CARBON SOURCE: age _____.

Glucose: positive, negative.	7 DA.
Sucrose: positive, negative.	9 DA.
Xylose: positive, negative.	7 DA.
Citrate: positive, negative.	7 DA.
NH_4^+ AS SOLE NITROGEN SOURCE: positive, negative.	7 DA.
–	

REDUCTIONS:

Nitrate: NO_2^- +, NH_4^+ ___, gas ___, negative.	8 DA.
Methylene blue: positive, negative.	16 DA.
Selenite: positive, negative.	___
Tellurite: positive, negative.	___
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: acid +, alkaline ___, neutral, gas.	7 DA.
Sucrose: acid +, alkaline ___, neutral, gas.	7 DA.
Lactose: acid +, alkaline ___, neutral, gas.	7 DA.
Xylose: acid +, alkaline ___, neutral, gas.	7 DA.
Mannitol: acid +, alkaline, neutral, gas.	7 DA.
–	

HYDROLYSIS:

Gelatin: positive, negative.	___
Casein: positive, negative.	12 DA.
Fat: positive, negative.	7 DA.
Starch: positive, negative.	17 DA.
Cellulose: positive, negative.	___
Urea: positive, negative.	___

TOLERANCES:

Salt: 2%—positive, negative.	7 DA.
7%—positive, negative.	
10%—positive, negative.	
pH: acid ___, alkaline ___.	___

LITMUS MILK REACTIONS:

Reaction: acid, alkaline, neutral.	20 DA.
Curd: acid, alkaline, absent, gas.	20 DA.
Peptionization: positive, negative.	20 DA.
Reduction: positive, negative.	20 DA.

OTHER REACTIONS:

H_2S from ___: positive, negative.	___
NH_4^+ from peptone: positive, negative.	7 DA.
Acetylmethylcarbinol: positive, negative.	15 DA.
Indol: positive, negative.	23 DA.
Methyl red: positive, negative.	15 DA.

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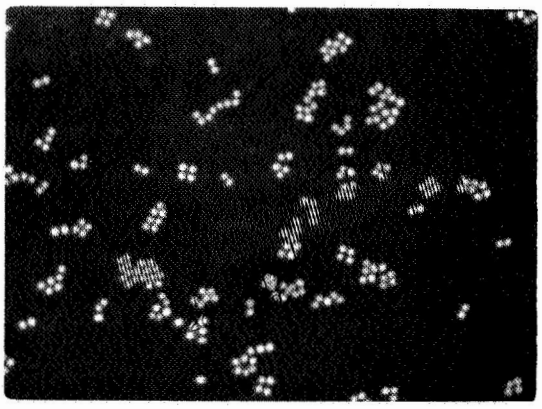
Descriptive Chart

278Ab	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Micrococcus sp.*	28°C.	W.B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*



NIGROSIN:

MORPHOLOGY:
Form: *rods, ends*_____,
filaments, cocci, spirals,
branching _____.
Size: *average* –0.88 x 1.08 μ.
range –0.78 - 0.98 x 0.97 - 1.18μ.
Irregular forms:

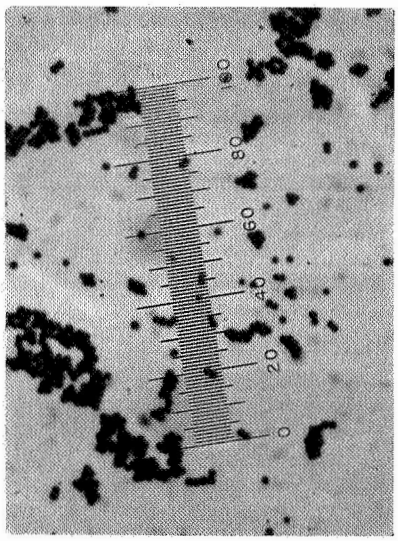
GRAM REACTION:
18 hrs: 100 % POSITIVE.
24 hrs: 100 % POSITIVE.
48 hrs: 100 % POSITIVE.

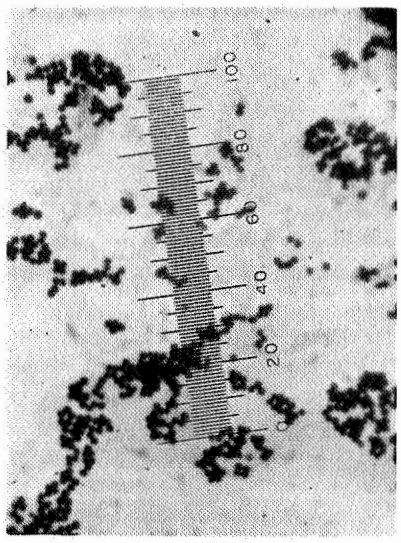
PASTEURIZATION SURVIVAL (85°C, 10 minutes): NEGATIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen,.*
Position: *central to excentric, terminal, subterminal.*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average –
range –

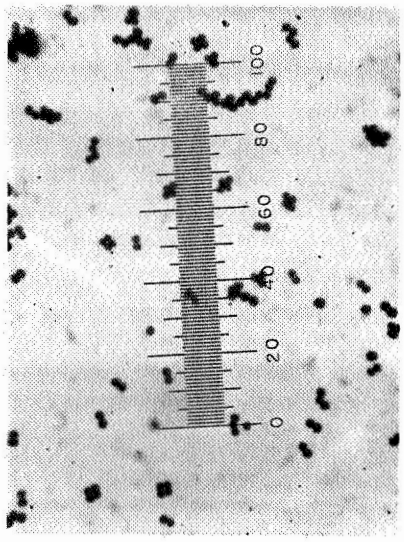
MOTILITY: age 1 DAY. NEGATIVE.
Flagella:

OTHER STAINS:
~~Acid-fast~~:

18; 24; 48 hr. GRAM:







* resembling M. conglomeratus.

278Ab

II. *CULTURAL CHARACTERISTICS*

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 2 DA.

Macroscopic

Size: 2 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	CREAM	1½ CA
Potato slant	CREAM	1½ CA
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling NONE.

GELATIN STAB: age 8 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: MODERATE

Fat agar:

Glucose-nitrate agar: NONE.

GLUCOSE-NUTRIENT AGAR: GOOD.
NUTRIENT AGAR: EXCELLENT.
ANAEROBIC NITRATE BROTH: NO GAS.
ANAEROBIC GLUCOSE BROTH: GROWTH. pH 6.8.

DNA

G:C _____

G+C _____ moles %

III. *PHYSIOLOGICAL CHARACTERISTICS*

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 35°C. +, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. +.

SOLE CARBON SOURCE: age 7 DA.

Glucose: *positive, negative.*	7 DA.
Sucrose: *positive, negative.*	7 DA.
Xylose: *positive, negative.*	7 DA.
Citrate: *positive, negative.*	7 DA.
NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.*	7 DA.
LACTOSE: POSITIVE.	7 DA.
MANNITOL: POSITIVE.	7 DA.

REDUCTIONS:

Nitrate: NO_2^- +, NH_4^+ ___, *gas* ___, *negative.*	1 DA.
Methylene blue: *positive, negative.*	16 DA.
Selenite: *positive, negative.*	___
Tellurite: *positive, negative.*	___
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Sucrose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Lactose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Xylose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Mannitol: *acid* +, *alkaline, neutral, gas.*	7 DA.
–	

HYDROLYSIS:

Gelatin: *positive, negative.*	___
Casein: *positive, negative.*	12 DA
Fat: *positive, negative.*	7 DA.
Starch: *positive, negative.*	17 DA.
Cellulose: *positive, negative.*	___
Urea: *positive, negative.*	___

TOLERANCES:

Salt: 2%—*positive, negative.*	7 DA
7%—*positive, negative.*	
10%—*positive, negative.*	
pH: *acid* ___, *alkaline* ___.	___

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.*	30 DA.
Curd: *acid, alkaline, absent, gas.*	30 DA.
Peptionization: *positive, negative.*	30 DA
Reduction: *positive, negative.*	30 DA

OTHER REACTIONS:

H_2S from ___: *positive, negative.*	___
NH_4^+ from peptone: *positive, negative.*	7 DA.
Acetylmethylcarbinol: *positive, negative.*	15 DA.
Indol: *positive, negative.*	23 DA
Methyl red: *positive, negative.*	15 DA

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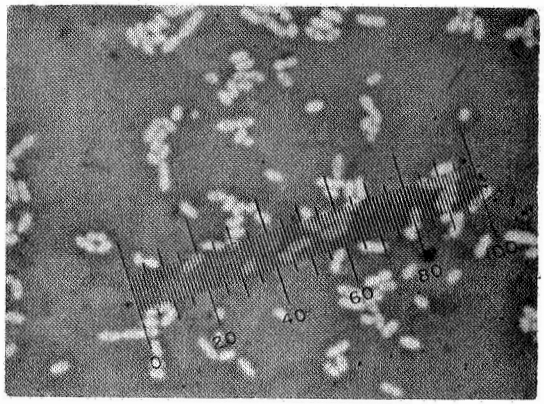
Descriptive Chart

268Bb	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Mycococcus albus subsp. albidus	28°C	W.B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*



MORPHOLOGY:

Form: *rods, ends* ROUND,
filaments, cocci, spirals,
branching _____.

Size: *average* – 1.26 x 2.42μ.
range – 1.12 - 1.43 x 1.92 - 3.12μ.

Irregular forms: COCCOID, ELLIPSOIDAL, PLEOMORPHIC RODS, "INVOLUTION FORMS."

NIGROSIN: 24 hr.

GRAM REACTION:
18 hrs: 100% POSITIVE.
24 hrs: 100% NEGATIVE.
48 hrs: 100% NEGATIVE.

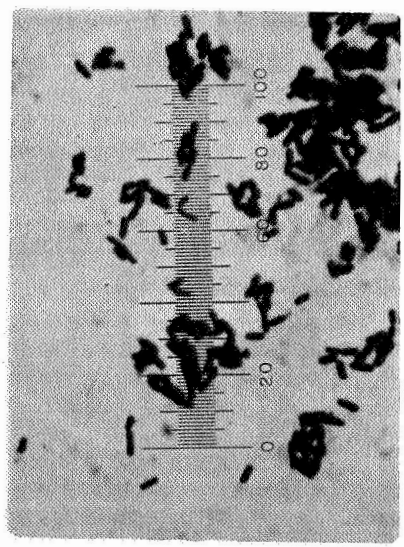
PASTEURIZATION SURVIVAL (85°C, 10 minutes): NEGATIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen,.*
Position: *central to excentric, terminal, subterminal.*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average –
range –

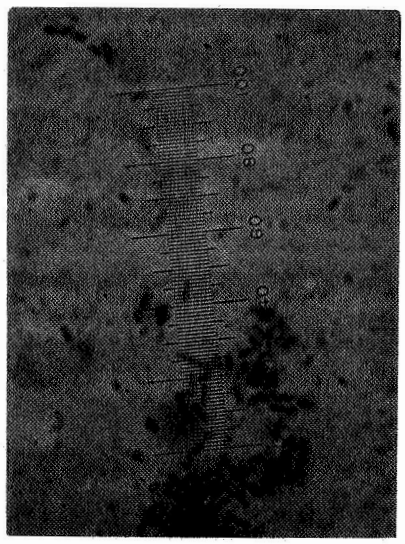
3 da.

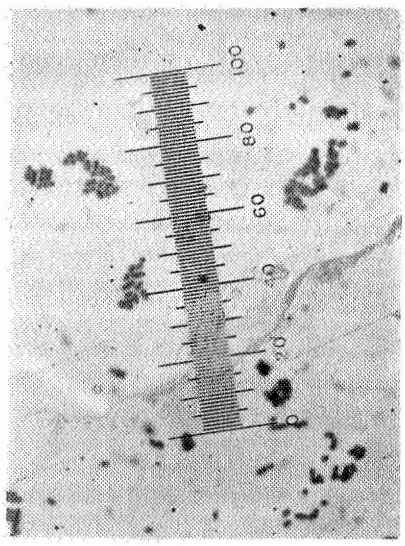
MOTILITY: age 2 DA. NEGATIVE.
Flagella:

OTHER STAINS:
~~Acid fast.~~

18, 24, & 48 hr. GRAM:







II. *CULTURAL CHARACTERISTICS*

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 3 DA.

Macroscopic

Size: 1 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	LT IVORY	2 CA
Potato slant	NO GROWTH - TO SCANT	
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling MOLD.

GELATIN STAB: age _____.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: NO GROWTH.

Fat agar:

Glucose-nitrate agar: SCANT.

GLUCOSE-NUTRIENT AGAR: SCANT.

NUTRIENT AGAR: GOOD GROWTH.

ANAEROBIC NITRATE BROTH: NO GAS.

ANAEROBIC GLUCOSE BROTH: SL. GROWTH. pH 7.2.

DNA

G:C _____

G+C _____ moles %

III. *PHYSIOLOGICAL CHARACTERISTICS* 268Bb

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.* (WEAK)

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 5°C. +, 20°C. +, 28°C. +, 37° +, 45°C. ±, 55°C. ±.

SOLE CARBON SOURCE: age _____.

Glucose: *positive, negative.*	7 DA.
Sucrose: *positive, negative.*	7 DA.
Xylose: *positive, negative.*	7 DA.
Citrate: *positive, negative.*	7 DA.
NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.*	7 DA.
LACTOSE: POSITIVE.	4 DA.
MANNITOL: POSITIVE.	7 DA.

REDUCTIONS:

Nitrate: NO_2^- +, NH_4^+ ____, *gas* ____, *negative.*	1 DA.
Methylene blue: *positive, negative.*	3 DA.
Selenite: *positive, negative.*	____
Tellurite: *positive, negative.*	____
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline* ____, *neutral, gas.*	30 DA.
Sucrose: *acid* +, *alkaline* ____, *neutral, gas.*	30 DA.
Lactose: *acid* +, *alkaline* ____, *neutral, gas.*	30 DA.
Xylose: *acid* +, *alkaline* ____, *neutral, gas.*	30 DA.
Mannitol: *acid* +, *alkaline, neutral, gas.*	30 DA.
–	

HYDROLYSIS:

Gelatin: *positive, negative.*	____
Casein: *positive, negative.*	12 DA.
Fat: *positive, negative.*	7 DA.
Starch: *positive, negative.*	17 DA.
Cellulose: *positive, negative.*	____
Urea: *positive, negative.*	____

TOLERANCES:

Salt: 2%—*positive, negative.*	7 DA.
7%—*positive, negative.*	
10%—*positive, negative.*	
pH: *acid* ____, *alkaline* ____.	____

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.*	20 DA.
Curd: *acid, alkaline, absent, gas.*	20 DA.
Peptionization: *positive, negative.*	20 DA.
Reduction: *positive, negative.*	20 DA.

OTHER REACTIONS:

H_2S from ____: *positive, negative.*	____
NH_4^+ from peptone: *positive, negative.*	7 DA.
Acetylmethylcarbinol: *positive, negative.*	15 DA.
Indol: *positive, negative.*	23 DA.
Methyl red: *positive, negative.*	15 DA.

OREGON STATE UNIVERSITY
DEPARTMENT OF MICROBIOLOGY
(JPL–NASA)

Descriptive Chart

268Ac	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)

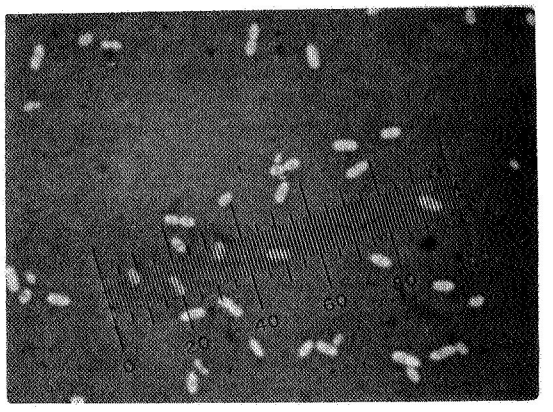
Mycococcus albus subsp. albidus	28°C.	W. B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*

MORPHOLOGY:
Form: *rods, ends* ROUND,
filaments, cocci, spirals,
branching _____.
Size: *average* – 1.18 x 2.38μ.
range – 1.11 - 1.31 x 2.11 - 2.97μ.
Irregular forms COCCOID, ELLIPSOIDAL. PLEOMORPHIC RODS. "INVOLUTION FORMS"

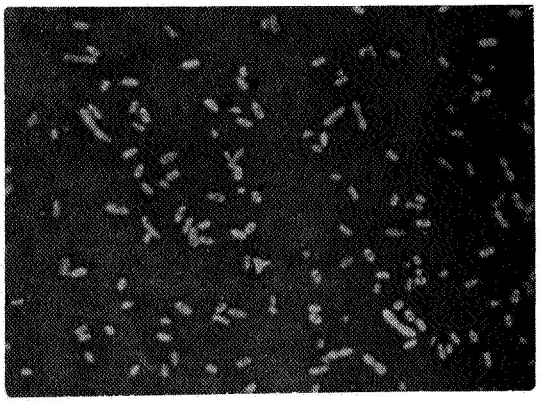
GRAM REACTION:
18 hrs: 100 % POSITIVE.
24 hrs: 100 % NEGATIVE.
48 hrs: 100 % NEGATIVE.

NIGROSIN: 24 hr.



PASTEURIZATION SURVIVAL (85°C, 10 minutes): NEGATIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen,.*
Position: *central to excentric, terminal, subterminal.*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average –
range –

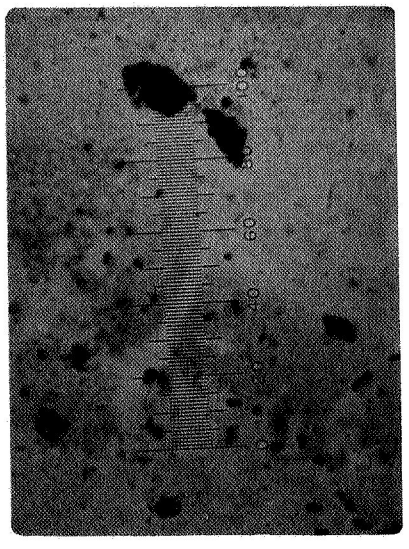
NIGROSIN: 3 da.

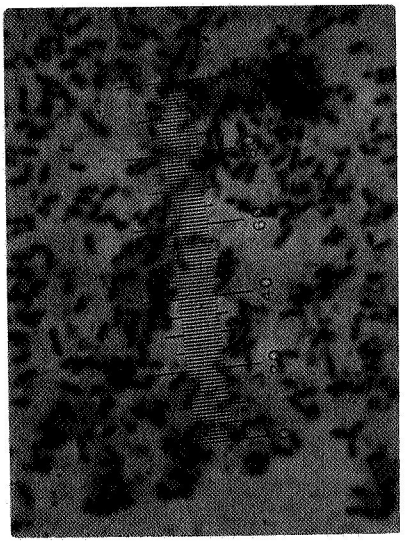


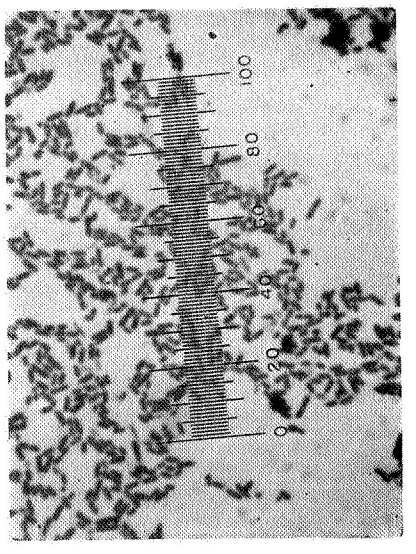
MOTILITY: age 2 DAYS. NEGATIVE.
Flagella:

OTHER STAINS:
~~Acid fast.~~

18, 24, 48 hr. GRAM:







II. *CULTURAL CHARACTERISTICS*

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 2 DA.

Macroscopic

Size: 2 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, umbonate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	color)	(CHM No.)
Trypticase soy agar	LT TAN	3GC
Potato slant	NO GROWTH - TO SCANT	
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling MOLD.

GELATIN STAB: age 18 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: NO GROWTH.

Fat agar:

Glucose-nitrate agar: NONE TO SCANT.

GLUCOSE-NUTRIENT AGAR: FAIR.

NUTRIENT AGAR: MODERATE.

ANAEROBIC NITRATE BROTH: NO GAS.

ANAEROBIC GLUCOSE BROTH: SL. GROWTH. pH 7.2.

DNA

G:C _____

G+C _____ moles %

III. *PHYSIOLOGICAL CHARACTERISTICS* 268 Ac

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 5°C. +, 20°C. +, 28°C. +, 37° +, 45°C. ±, 55°C. ±.

SOLE CARBON SOURCE: age _____.

Glucose: *positive, negative.*	25 DA.
Sucrose: *positive, negative.*	25 DA.
Xylose: *positive, negative.*	25 DA.
Citrate: *positive, negative.*	7 DA.
NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.*	25 DA.
LACTOSE: POSITIVE.	25 DA.
MANNITOL: POSITIVE.	25 DA.

REDUCTIONS:

Nitrate: NO_2^- +, NH_4^+ ___, *gas* ___, *negative.*	1 DA.
Methylene blue: *positive, negative.*	16 DA.
Selenite: *positive, negative.*	___
Tellurite: *positive, negative.*	___
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Sucrose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Lactose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Xylose: *acid* +, *alkaline* ___, *neutral, gas.*	20 DA.
Mannitol: *acid* +, *alkaline, neutral, gas.*	7 DA.
–	

HYDROLYSIS:

Gelatin: *positive, negative.*	20 DA.
Casein: *positive, negative.*	12 DA.
Fat: *positive, negative.*	7 DA.
Starch: *positive, negative.*	17 DA
Cellulose: *positive, negative.*	___
Urea: *positive, negative.*	___

TOLERANCES:

Salt: 2%—*positive, negative.*	7 DA.
7%—*positive, negative.*	
10%—*positive, negative.*	
pH: *acid* ___, *alkaline* ___.	___

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.*	20 DA
Curd: *acid, alkaline, absent, gas.*	20 DA
Peptionization: *positive, negative.*	20 DA
Reduction: *positive, negative.*	20 DA

OTHER REACTIONS:

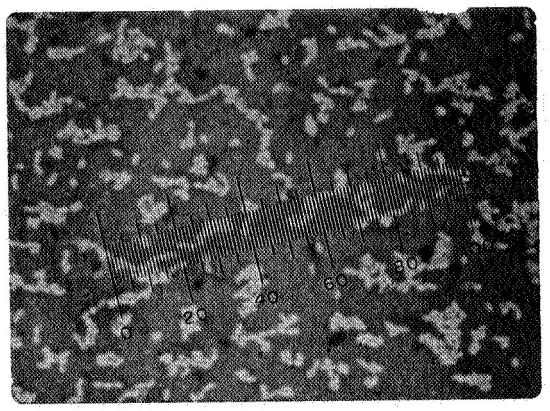
H_2S from ___: *positive, negative.*	___
NH_4^+ from peptone: *positive, negative.*	7 DA
Acetylmethylcarbinol: *positive, negative.*	15 DA
Indol: *positive, negative.*	23 DA.
Methyl red: *positive, negative.*	15 DA.

OREGON STATE UNIVERSITY
DEPARTMENT OF MICROBIOLOGY
(JPL–NASA)

Descriptive Chart

277Ac	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
"soil diphtheroid"	28°C.	W. B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*



MORPHOLOGY:
Form: *rods, ends* _____,
filaments, cocci, spirals,
branching _____.
Size: *average* – 0.64 x 1.38μ.
range – 0.56 – 0.71 x 1.12 – 1.76μ.
Irregular forms:

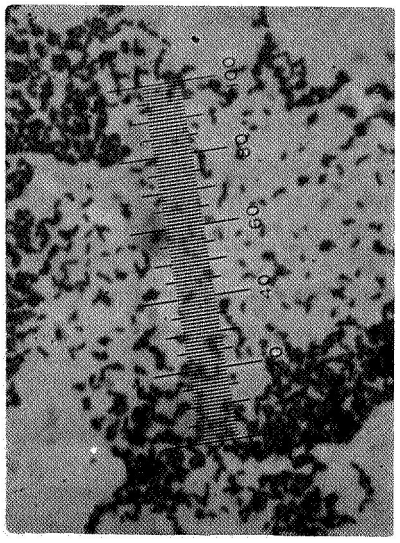
GRAM REACTION:
18 hrs: 100 % POSITIVE.
24 hrs: 100 % POSITIVE.
48 hrs: 100 % POSITIVE.

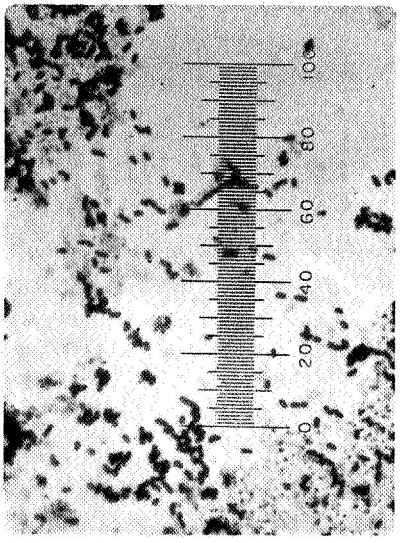
NIGROSIN:

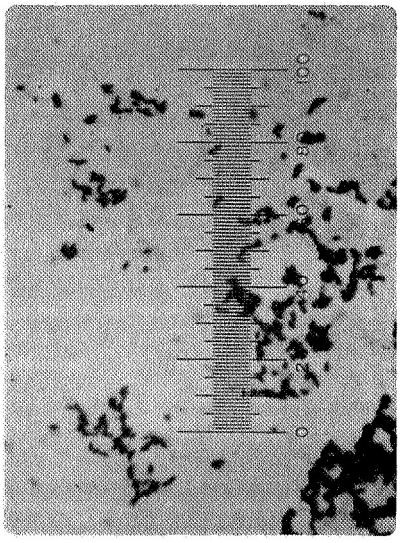
PASTEURIZATION SURVIVAL (85°C, 10 minutes): NEGATIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen,.*
Position: *central to excentric, terminal, subterminal.*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average –
range –

MOTILITY: age 2 DAY. NEGATIVES.
Flagella:

OTHER STAINS: 18, 24, 48 GRAM:
~~Acid fast.~~







II. *CULTURAL CHARACTERISTICS*

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age _____.

Macroscopic

Size: _____ mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium) (color) (CHM No.)

Trypticase soy agar

Potato slant NO GROWTH - TO SCANT CREAM 1½CA

—

—

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling NONE.

GELATIN STAB: age 12 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: MODERATE GROWTH.

Fat agar:

Glucose-nitrate agar: FAINT GROWTH.

GLUCOSE · NUTRIENT AGAR: GROWTH BETTER THAN NUTRIENT AGAR.

ANAEROBIC NITRATE BROTH: NEGATIVE.

ANAEROBIC GLUCOSE BROTH: POSITIVE GROWTH. pH 7.2.

DNA

G:C _____

G+C _____ moles %

III. *PHYSIOLOGICAL CHARACTERISTICS*

277Ac

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 55°C. +, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. ±.

SOLE CARBON SOURCE: age _____.

Glucose: *positive, negative.* _____

Sucrose: *positive, negative.* _____

Xylose: *positive, negative.* _____

Citrate: *positive, negative.* 7 DA

NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.* 7 DA

—

REDUCTIONS:

Nitrate: NO_2^-____, NH_4^+____, *gas*____, *negative.* 17 DA.

Methylene blue: *positive, negative.* _____

Selenite: *positive, negative.* _____

Tellurite: *positive, negative.* _____

—

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline*____, *neutral, gas.* 30 DA

Sucrose: *acid* +, *alkaline*____, *neutral, gas.* 7 DA

Lactose: *acid* +, *alkaline*____, *neutral, gas.* 7 DA

Xylose: *acid* +, *alkaline*____, *neutral, gas.* 7 DA

Mannitol: *acid* +, *alkaline, neutral, gas.* 7 DA

—

HYDROLYSIS:

Gelatin: *positive, negative.* _____

Casein: *positive, negative.* 7 DA

Fat: *positive, negative.* 7 DA

Starch: *positive, negative.* WIDE 17 DA

Cellulose: *positive, negative.* _____

Urea: *positive, negative.* _____

TOLERANCES:

Salt: 2%—*positive, negative.* 5 DA.

7%—*positive, negative.*

10%—*positive, negative.*

pH: *acid*_____, *alkaline*_____. _____

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.* 20 DA.

Curd: *acid, alkaline, absent, gas.* 20 DA.

Peptionization: *positive, negative.* 20 DA.

Reduction: *positive, negative.* 20 DA.

OTHER REACTIONS:

H_2S from _____: *positive, negative.* _____

NH_4^+ from peptone: *positive, negative.* _____

Acetylmethylcarbinol: *positive, negative.* 17 DA.

Indol: *positive, negative.* 23 DA.

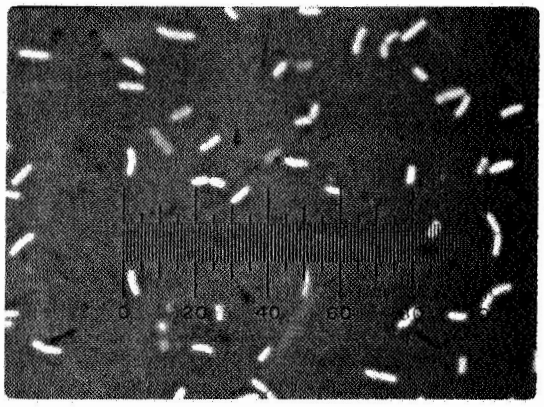
Methyl red: *positive, negative.* 17 DA.

OREGON STATE UNIVERSITY
DEPARTMENT OF MICROBIOLOGY
(JPL–NASA)

Descriptive Chart

259Ab	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Bacillus megaterium.	28°C.	W. B. Bollen
(name of organism)	(temperature)	(studied by)

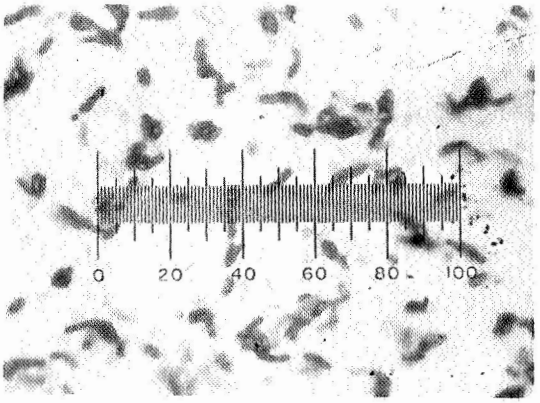
I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*



NIGROSIN:

MORPHOLOGY:
Form: *rods, ends* ROUND,
filaments, cocci, spirals,
branching _____.
Size: *average* – 1.06 x 3.05μ.
range – 0.96 - 1.20 x 2.30 - 3.80μ.
Irregular forms:

GRAM REACTION:
18 hrs: 100% POSITIVE.
24 hrs: 100 % POSITIVE.
48 hrs: 100 % POSITIVE.



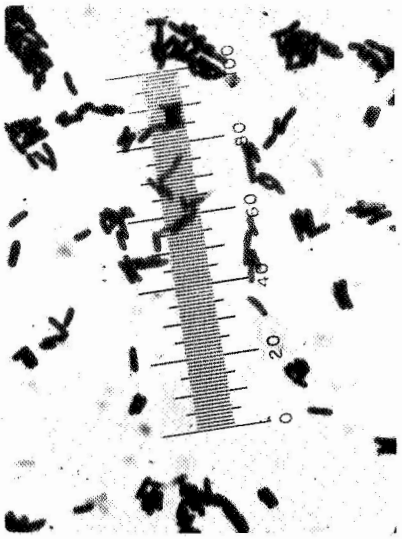
SPORE:

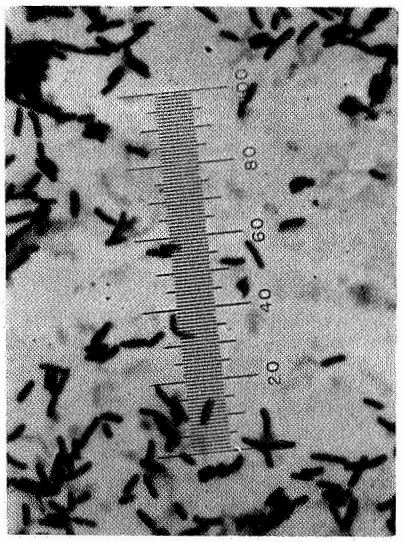
PASTEURIZATION SURVIVAL (85°C, 10 minutes): POSITIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen,.*
Position: *central to excentric, terminal, subterminal,*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average – 1.10 x 1.94μ.
range – 0.97 - 1.43 x 1.37 - 2.18μ.

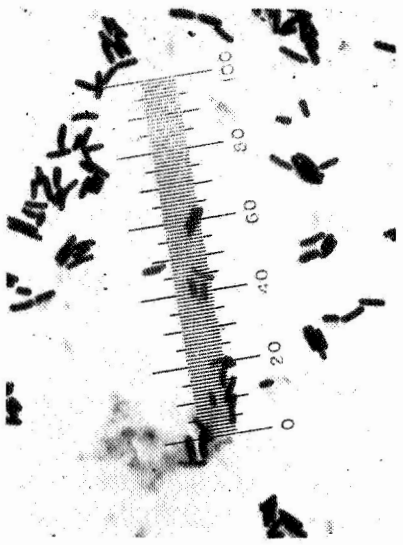
MOTILITY: age 1 DA. POSITIVE.
Flagella:

OTHER STAINS:
Acid fast:

18; 24; 48 hr. GRAM:







259AA

II. *CULTURAL CHARACTERISTICS*

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 2 DA.

Macroscopic

Size: 4 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	CREAM	1½ CQ
Potato slant	NONE	
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling NONE.

GELATIN STAB: age 12 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: NO GROWTH.

Fat agar:

Glucose-nitrate agar: NO GROWTH.

GLUCOSE-NUTRIENT AGAR: SCANT.

NUTRIENT AGAR: MODERATE.

ANAEROBIC NITRATE BROTH: NO GAS.

ANAEROBIC GLUCOSE BROTH: SLIGHT POSITIVE. pH 6.8.

DNA

G:C _____

G+C _____ moles %

III. *PHYSIOLOGICAL CHARACTERISTICS*

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 5°C. +, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. ±.

SOLE CARBON SOURCE: age 7 DA.

Glucose: *positive, negative.*	7 DA.
Sucrose: *positive, negative.*	7 DA.
Xylose: *positive, negative.*	7 DA.
Citrate: *positive, negative.*	7 DA.
NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.*	7 DA.
LACTOSE: POSITIVE.	7 DA.
MANNITOL: POSITIVE.	7 DA.

REDUCTIONS:

Nitrate: NO_2^- +, NH_4^+ ____, *gas* ____, *negative.*	1 DA.
Methylene blue: *positive, negative.*	20 DA.
Selenite: *positive, negative.*	____
Tellurite: *positive, negative.*	____
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline* ____, *neutral, gas.*	7 DA.
Sucrose: *acid* +, *alkaline* ____, *neutral, gas.*	7 DA.
Lactose: *acid* +, *alkaline* ____, *neutral, gas.*	7 DA.
Xylose: *acid* +, *alkaline* ____, *neutral, gas.*	7 DA.
Mannitol: *acid* +, *alkaline, neutral, gas.*	7 DA.
–	

HYDROLYSIS:

Gelatin: *positive, negative.*	20 DA.
Casein: *positive, negative.*	12 DA.
Fat: *positive, negative.*	7 DA.
Starch: *positive, negative.*	7 DA.
Cellulose: *positive, negative.*	____
Urea: *positive, negative.*	____

TOLERANCES:

Salt: 2%—*positive, negative.*	7 DA.
7%—*positive, negative.*	
10%—*positive, negative.*	
pH: *acid* ____, *alkaline* ____.	____

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.*	30 DA.
Curd: *acid, alkaline, absent, gas.*	30 DA.
Peptionization: *positive, negative.*	30 DA.
Reduction: *positive, negative.*	30 DA.

OTHER REACTIONS:

H_2S from ____: *positive, negative.*	____
NH_4^+ from peptone: *positive, negative.*	15 DA.
Acetylmethylcarbinol: *positive, negative.*	15 DA.
Indol: *positive, negative.*	23 DA.
Methyl red: *positive, negative.*	15 DA.

OREGON STATE UNIVERSITY
DEPARTMENT OF MICROBIOLOGY
(JPL–NASA)

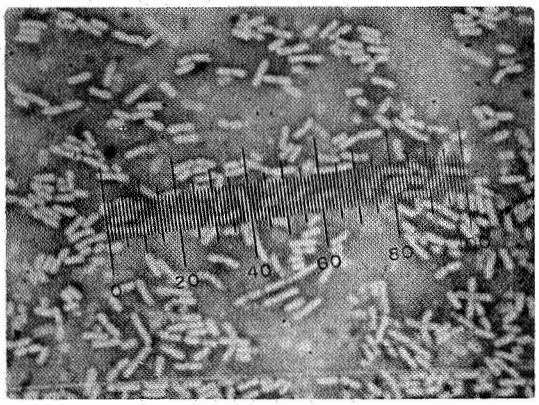
Descriptive Chart

260Ab	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Bacillus megaterium.	28°C.	W. B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*

MORPHOLOGY:
Form: *rods, ends* ROUND,
filaments, cocci, spirals,
branching _____.
Size: *average* – 0.98 x 2.50 μ.
range – 0.93 – 1.07 x 1.93 – 3.88 μ.
Irregular forms:

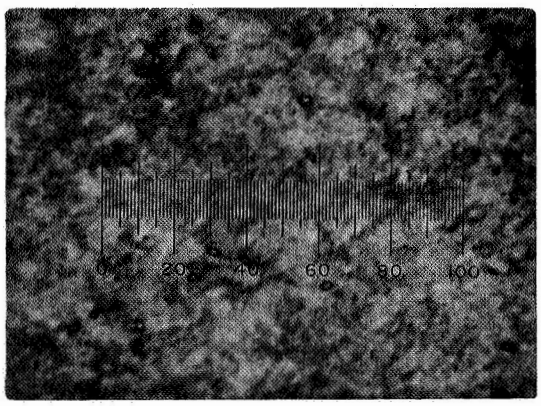
NIGROSIN:



GRAM REACTION:
18 hrs: 100% POSITIVE.
24 hrs: 100% POSITIVE.
48 hrs: 100% POSITIVE.

PASTEURIZATION SURVIVAL (85°C, 10 minutes): POSITIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen,.*
Position: *central to excentric, terminal, subterminal.*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average – 0.90 x 1.49 μ.
range – 0.81 – 0.99 x 1.42 – 1.76 μ.

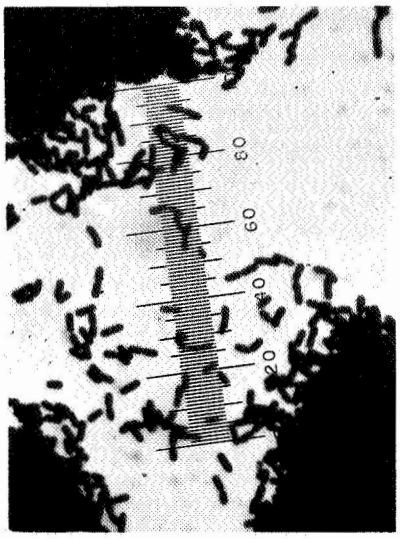
SPORE:

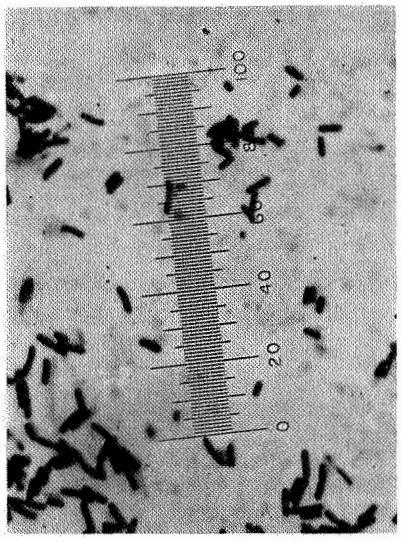


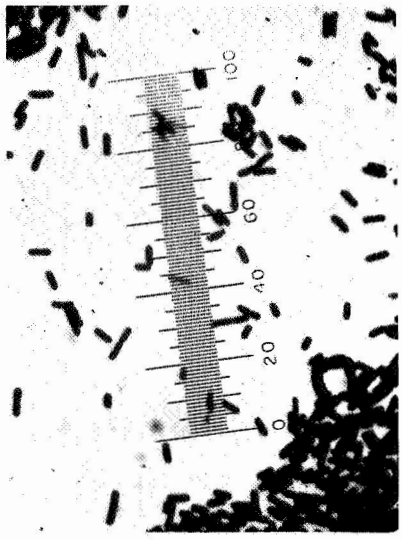
MOTILITY: age 2 DA. NEGATIVE.
Flagella:

OTHER STAINS:
Acid fast:

18; 24; 48 hr. GRAM:







II. CULTURAL CHARACTERISTICS

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *arborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 2 DA.

Macroscopic

Size: 2 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	LT. WHEAT	2ea
Potato slant	ROSE BEIGE	4gc
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling NONE.

GELATIN STAB: age 8 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: EXCELLENT.

Fat agar:

Glucose-nitrate agar: SCANT.

GLUCOSE·NUTRIENT AGAR: GOOD.
NUTRIENT AGAR: FAIR.
ANAEROBIC NITRATE BROTH: NO GAS.
ANAEROBIC GLUCOSE BROTH: GROWTH. pH 7.2.

DNA

G:C _____

G+C _____ moles %

III. PHYSIOLOGICAL CHARACTERISTICS

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 15°C. +, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. –.

SOLE CARBON SOURCE: age 7 DA.

Glucose: *positive, negative.*	7 DA.
Sucrose: *positive, negative.*	7 DA.
Xylose: *positive, negative.*	7 DA.
Citrate: *positive, negative.*	7 DA.
NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.*	7 DA.
LACTOSE: POSITIVE.	7 DA.
MANNITOL: POSITIVE.	7 DA.

REDUCTIONS:

Nitrate: NO_2^- ____, NH_4^+ ____, *gas* ____, *negative.*	11 DA.
Methylene blue: *positive, negative.*	2 DA.
Selenite: *positive, negative.*	
Tellurite: *positive, negative.*	
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Sucrose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Lactose: *acid* ___, *alkaline* ___, *neutral, gas.*	42 DA.
Xylose: *acid* +, *alkaline* ___, *neutral, gas.*	20 DA.
Mannitol: *acid* +, *alkaline, neutral, gas.*	7 DA.
–	

HYDROLYSIS:

Gelatin: *positive, negative.*	20 DA.
Casein: *positive, negative.*	7 DA.
Fat: *positive, negative.*	7 DA.
Starch: *positive, negative.*	7 DA.
Cellulose: *positive, negative.*	
Urea: *positive, negative.*	

TOLERANCES:

Salt: 2%—*positive, negative.*	7 DA.
7%—*positive, negative.*	
10%—*positive, negative.*	
pH: *acid* ____, *alkaline* ____.	

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.*	10 DA.
Curd: *acid, alkaline, absent, gas.*	18 DA.
Peptionization: *positive, negative.*	18 DA.
Reduction: *positive, negative.*	7 DA.

OTHER REACTIONS:

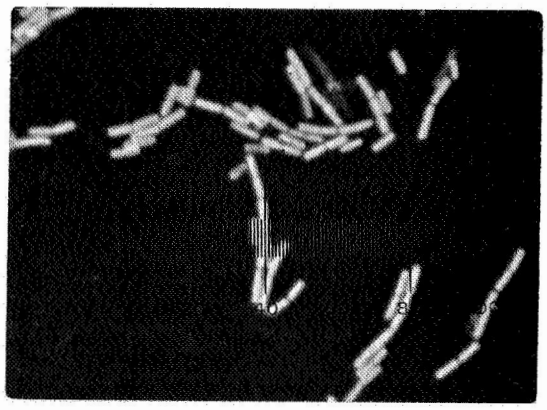
H_2S from ____: *positive, negative.*	
NH_4^+ from peptone: *positive, negative.*	7 DA.
Acetylmethylcarbinol: *positive, negative.*	15 DA.
Indol: *positive, negative.*	23 DA.
Methyl red: *positive, negative.*	15 DA.

OREGON STATE UNIVERSITY
DEPARTMENT OF MICROBIOLOGY
(JPL–NASA)

Descriptive Chart

260Bd	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Bacillus megaterium.	28°C.	W.B. Bollen
(name of organism)	(temperature)	(studied by)

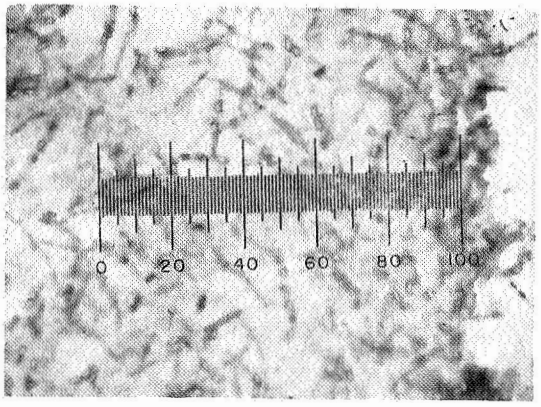
I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*



NIGROSIN:

MORPHOLOGY:
Form: *rods, ends* ROUND,
filaments, cocci, spirals,
branching _____.
Size: *average* – 1.09 x 3.58μ.
range – 1.02-1.15 x 2.38-4.84μ.
Irregular forms:

GRAM REACTION:
18 hrs: 100% POSITIVE.
24 hrs: 100% POSITIVE.
48 hrs: 100% POSITIVE.



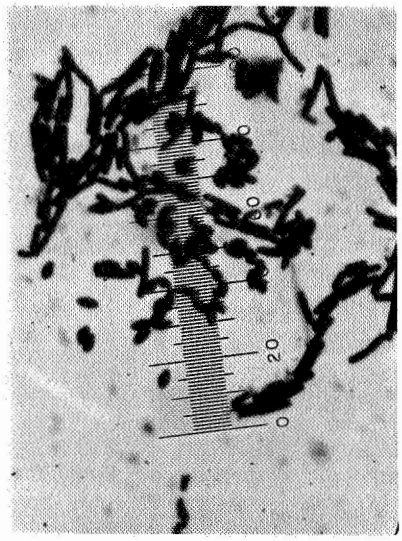
SPORE:

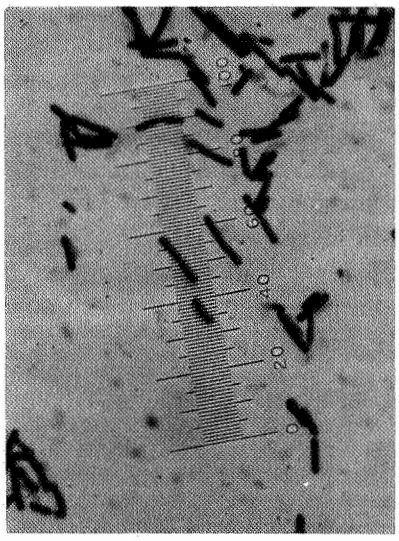
PASTEURIZATION SURVIVAL (85°C, 10 minutes): POSITIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen,.*
Position: *central to excentric, terminal, subterminal.*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average – 0.84 x 1.57μ.
range – 0.70-0.90 x 1.23-1.85μ.

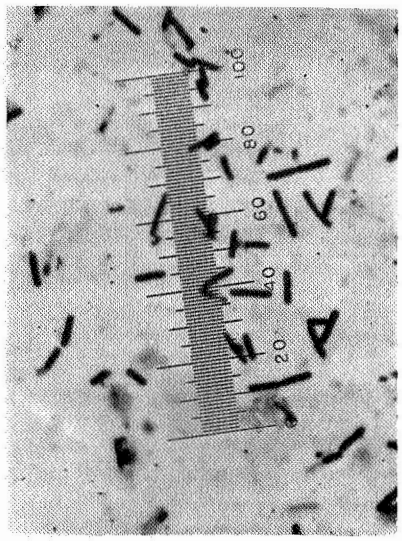
MOTILITY: age 2 DAY. NEGATIVE
Flagella:

OTHER STAINS:
Acid fast:

18; 24; 48hr. GRAM:







260 B D.

II. CULTURAL CHARACTERISTICS

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 1 DA.

Macroscopic

Size: 2 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	LT. IVORY	2 CA
Potato slant	PEARL PINK	3 CA
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.* SLIGHT

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling NONE.

GELATIN STAB: age 3 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: EXCELLENT.

Fat agar:

Glucose-nitrate agar: POOR.

GLUCOSE-NUTRIENT AGAR: EXCELLENT.

NUTRIENT AGAR: MODERATE.

ANAEROBIC NITRATE BROTH: NO GAS.

ANAEROBIC GLUCOSE BROTH: GROWTH. pH 7.2.

DNA

G:C _____

G+C _____ moles %

III. PHYSIOLOGICAL CHARACTERISTICS

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 5°C. +, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. ±.

SOLE CARBON SOURCE: age 7 DA.

Glucose: *positive, negative.* 7 DA.

Sucrose: *positive, negative.* 7 DA.

Xylose: *positive, negative.* 7 DA.

Citrate: *positive, negative.* 7 DA.

NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.* 7 DA.

LACTOSE: POSITIVE. 7 DA.

MANNITOL: POSITIVE. 7 DA.

REDUCTIONS:

Nitrate: NO_2^- ____, NH_4^+ ____, *gas* ____, *negative.* 11 DA.

Methylene blue: *positive, negative.* 3 DA.

Selenite: *positive, negative.* ____

Tellurite: *positive, negative.* ____

–

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline* ____, *neutral, gas.* 7 DA.

Sucrose: *acid* +, *alkaline* ____, *neutral, gas.* 7 DA.

Lactose: *acid* ____, *alkaline* ____, *neutral, gas.* 42 DA.

Xylose: *acid* ____, *alkaline* ____, *neutral, gas.* 42 DA.

Mannitol: *acid* +, *alkaline, neutral, gas.* 7 DA.

–

HYDROLYSIS:

Gelatin: *positive, negative.* 7 DA.

Casein: *positive, negative.* 7 DA.

Fat: *positive, negative.* 7 DA.

Starch: *positive, negative.* 7 DA.

Cellulose: *positive, negative.* ____

Urea: *positive, negative.* ____

TOLERANCES:

Salt: 2%—*positive, negative.* 7 DA.

7%—*positive, negative.*

10%—*positive, negative.*

pH: *acid* ____, *alkaline* ____. ____

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.* 7 DA.

Curd: *acid, alkaline, absent, gas.* 30 DA.

Peptionization: *positive, negative.* 10 DA.

Reduction: *positive, negative.* 10 DA.

OTHER REACTIONS:

H_2S from ____: *positive, negative.* ____

NH_4^+ from peptone: *positive, negative.* 7 DA.

Acetylmethylcarbinol: *positive, negative.* 15 DA.

Indol: *positive, negative.* 23 DA.

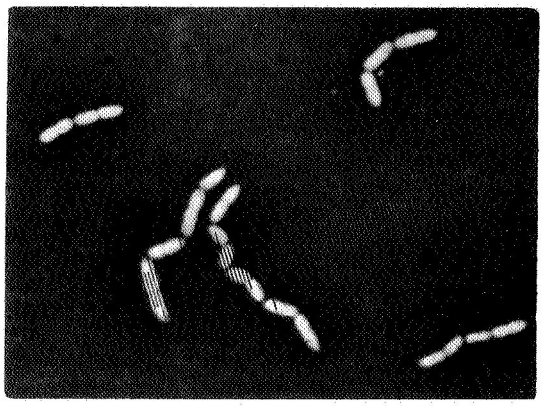
Methyl red: *positive, negative.* 15 DA.

OREGON STATE UNIVERSITY
DEPARTMENT OF MICROBIOLOGY
(JPL–NASA)

Descriptive Chart

266Ab	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Bacillus megaterium.	28°C.	W.B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*



NIGROSIN:

MORPHOLOGY:

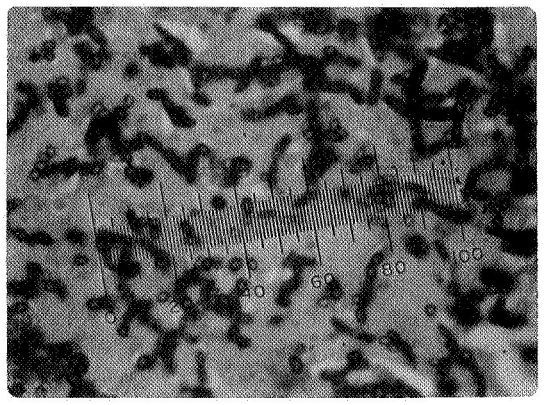
Form: *rods, ends* ROUND,
filaments, cocci, spirals,
branching _____.

Size: *average* – 1.73 x 4.37 μ.
range – 1.48 - 1.98 x 3.80 - 5.39 μ.

Irregular forms:

GRAM REACTION:

18 hrs: 100 % POSITIVE.
24 hrs: 100 % POSITIVE.
48 hrs: 100 % POSITIVE.



SPORE:

PASTEURIZATION SURVIVAL (85°C, 10 minutes): POSITIVE.

Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*

Endospores: ~~swollen~~ *not swollen,*.

Position: *central to excentric, terminal, subterminal.*

Shape: *spherical, ellipsoidal, cylindrical, oval.*

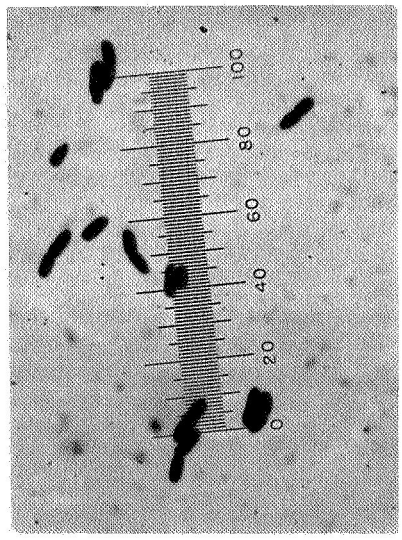
size: average – 1.27 x 1.95 μ.
range – 1.14 - 1.32 x 1.76 - 2.17 μ.

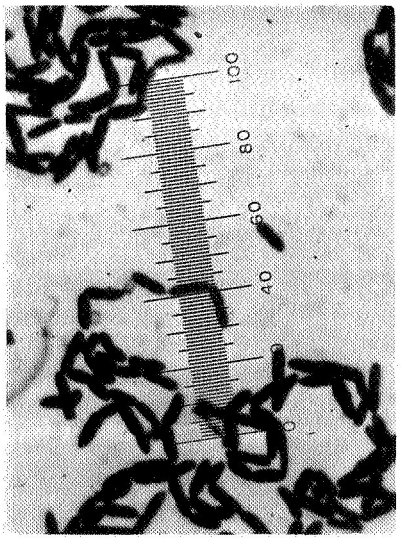
MOTILITY: age 2 DA. NEGATIVE.

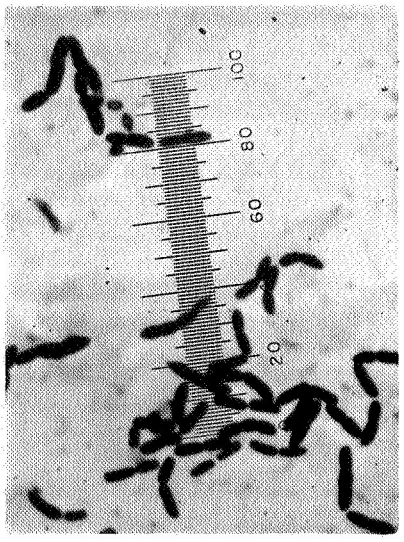
Flagella:

OTHER STAINS:

18; 24; 48 hr. GRAM:







266Ab

II. *CULTURAL CHARACTERISTICS*

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 1 DA.

Macroscopic

Size: 4 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	PEARL	3ba
Potato slant	IVORY	2db
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling NONE.

GELATIN STAB: age 3 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: EXCELLENT

Fat agar:

Glucose-nitrate agar: MODERATE

GLUCOSE·NUTRIENT AGAR: EXCELLENT.

NUTRIENT AGAR: GOOD.

ANAEROBIC GAS FROM NITRATE BROTH: NEGATIVE.

ANAEROBIC GROWTH FROM GLUCOSE BROTH: POSITIVE. pH 7.0.

DNA

G:C

G+C moles %

III. *PHYSIOLOGICAL CHARACTERISTICS*

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 5°C. +, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. +. 65°C. +.

SOLE CARBON SOURCE: age 7 DA.

Glucose: *positive, negative.*	7DA.
Sucrose: *positive, negative.*	7 DA.
Xylose: *positive, negative.*	7 DA.
Citrate: *positive, negative.*	7 DA.
NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.*	7 DA.
LACTOSE: POSITIVE.	7 DA.
MANNITOL: POSITIVE.	7 DA.

REDUCTIONS:

Nitrate: NO_2^-____, NH_4^+____, *gas*____, *negative.*	11 DA.
Methylene blue: *positive, negative.*	3 DA.
Selenite: *positive, negative.*	
Tellurite: *positive, negative.*	
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline*____, *neutral, gas.*	7 DA.
Sucrose: *acid* +, *alkaline*____, *neutral, gas.*	7 DA.
Lactose: *acid* +, *alkaline*____, *neutral, gas.*	20 DA.
Xylose: *acid* +, *alkaline*____, *neutral, gas.*	7 DA.
Mannitol: *acid* +, *alkaline, neutral, gas.*	7 DA.
–	

HYDROLYSIS:

Gelatin: *positive, negative.*	7 DA.
Casein: *positive, negative.*	7 DA.
Fat: *positive, negative.*	7 DA.
Starch: *positive, negative.*	7 DA.
Cellulose: *positive, negative.*	
Urea: *positive, negative.*	

TOLERANCES:

Salt: 2%—*positive, negative.*	7 DA.
7%—*positive, negative.*	
10%—*positive, negative.*	
pH: *acid*____, *alkaline*____.	

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.*	2 DA.
Curd: *acid, alkaline, absent, gas.*	30 DA.
Peptionization: *positive, negative.*	2 DA.
Reduction: *positive, negative.*	7 DA.

OTHER REACTIONS:

H_2S from ____: *positive, negative.*	
NH_4^+ from peptone: *positive, negative.*	7 DA
Acetylmethylcarbinol: *positive, negative.*	15 DA.
Indol: *positive, negative.*	23 DA.
Methyl red: *positive, negative.*	15 DA.

OREGON STATE UNIVERSITY
DEPARTMENT OF MICROBIOLOGY
(JPL—NASA)

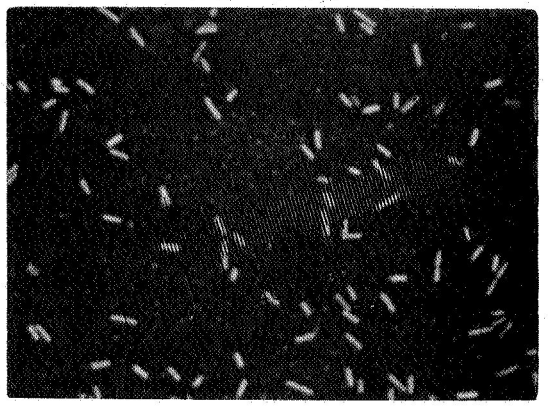
Descriptive Chart

279Aa	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Bacillus licheniformis	28°C.	W.B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*

MORPHOLOGY:
Form: *rods, ends* ROUND,
filaments, cocci, spirals,
branching _____.
Size: *average* – 0.64 x 2.32μ.
range –0.54 - 0.78 x 1.98 -2.85μ.
Irregular forms:

NIGROSIN:

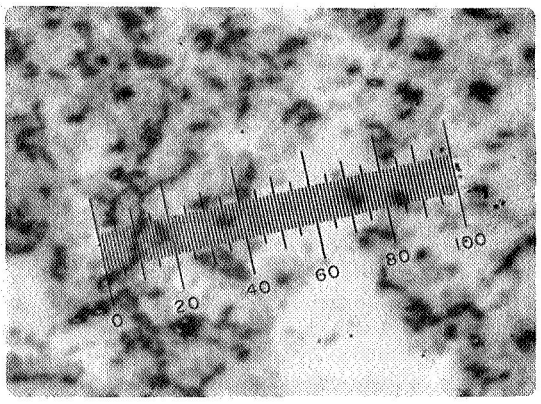


GRAM REACTION:
18 hrs: 100 % POSITIVE.
24 hrs: 100 % POSITIVE.
48 hrs: 100 % POSITIVE.

PASTEURIZATION SURVIVAL (85°C, 10 minutes): POSITIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen,.*
Position: *central to excentric, terminal, subterminal.*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average – 1.09 x 2.20μ.
range –0.81 - 1.33 x 1.67 -2.72μ.

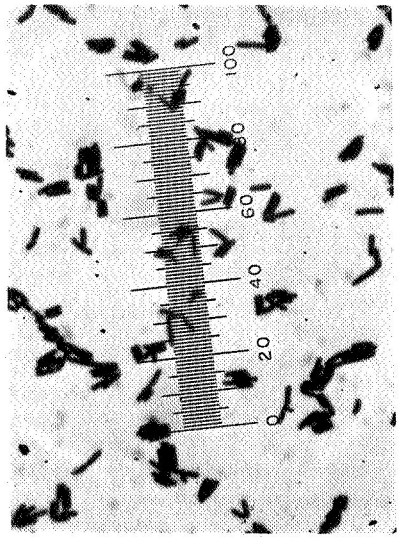
MOTILITY: age 1 DA. POSITIVE.
Flagella:

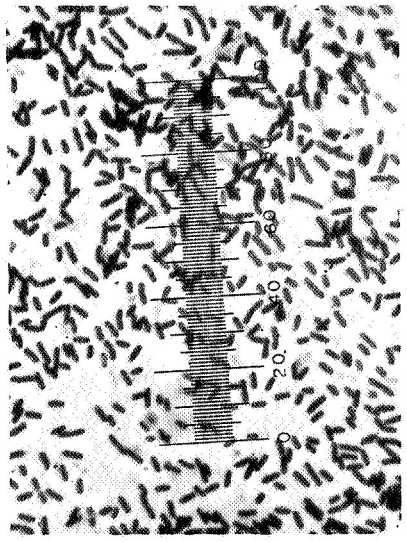
SPORE:

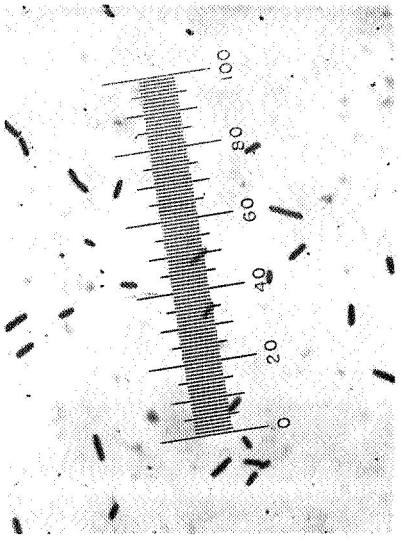


OTHER STAINS:

18; 24; 48 hr. GRAM:







279Aa

II. CULTURAL CHARACTERISTICS

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 1 DA.

Macroscopic

Size: 2 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	CREAM	1½ca
Potato slant	LT TAN	3gc
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling NONE.

GELATIN STAB: age 3 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: GOOD.

Fat agar:

Glucose-nitrate agar: MODERATE.

GLUCOSE-NUTRIENT AGAR: EXCELLENT.

NUTRIENT AGAR: GOOD.

ANAEROBIC NITRATE BROTH: GAS.

ANAEROBIC GLUCOSE BROTH: GROWTH. pH 5.0.

DNA

G:C _____

G+C _____ moles %

III. PHYSIOLOGICAL CHARACTERISTICS

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 5°C. –, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. +.

SOLE CARBON SOURCE: age _____.

Glucose: *positive, negative.*	7 DA
Sucrose: *positive, negative.*	7 DA.
Xylose: *positive, negative.*	7 DA.
Citrate: *positive, negative.*	7 DA
NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.*	7 DA.
LACTOSE: POSITIVE.	
MANNITOL: POSITIVE.	7 DA.

REDUCTIONS:

Nitrate: NO_2^- +, NH_4^+ ___, gas +, *negative.*	1 DA.
Methylene blue: *positive, negative.*	1 DA.
Selenite: *positive, negative.*	_____
Tellurite: *positive, negative.*	_____
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Sucrose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Lactose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Xylose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Mannitol: *acid* +, *alkaline, neutral, gas.*	7 DA.
–	

HYDROLYSIS:

Gelatin: *positive, negative.*	7 DA.
Casein: *positive, negative.*	7 DA.
Fat: *positive, negative.*	7 DA.
Starch: *positive, negative.*	7 DA.
Cellulose: *positive, negative.*	_____
Urea: *positive, negative.*	_____

TOLERANCES:

Salt: 2%—*positive, negative.*	7 DA.
7%—*positive, negative.*	
10%—*positive, negative.*	
pH: *acid* _____, *alkaline* _____.	_____

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.*	30 DA.
Curd: *acid, alkaline, absent, gas.*	30 DA.
Peptionization: *positive, negative.*	3 DA.
Reduction: *positive, negative.*	3 DA.

OTHER REACTIONS:

H_2S from _____: *positive, negative.*	_____
NH_4^+ from peptone: *positive, negative.*	7 DA.
Acetylmethylcarbinol: *positive, negative.*	15 DA.
Indol: *positive, negative.*	23 DA.
Methyl red: *positive, negative.*	15 DA.

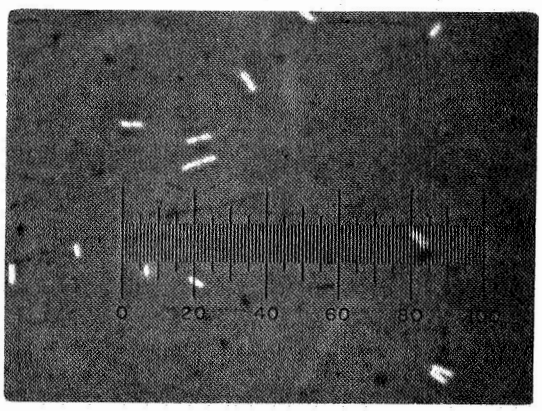
OREGON STATE UNIVERSITY
DEPARTMENT OF MICROBIOLOGY
(JPL–NASA)

Descriptive Chart

256Ba	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Bacillus subtilis	28°C.	W. B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*

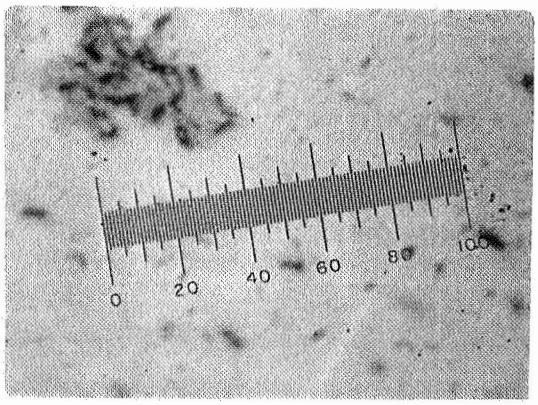
MORPHOLOGY:
Form: *rods, ends* ROUND,
filaments, cocci, spirals,
branching _____.
Size: *average* – 0.84μ x 2.57μ.
range – 0.73 - 0.94μ x 1.82 - 3.21μ.
Irregular forms:



NIGROSIN:

GRAM REACTION:
18 hrs: 100% POSITIVE.
24 hrs: 100% POSITIVE.
48 hrs: 100% POSITIVE.

PASTEURIZATION SURVIVAL (85°C, 10 minutes): POSITIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen.*
Position: *central to excentric, terminal, subterminal.*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average – 1.26 - 2.25μ.
range – 0.92 - 1.35 x 1.57 - 2.84μ.

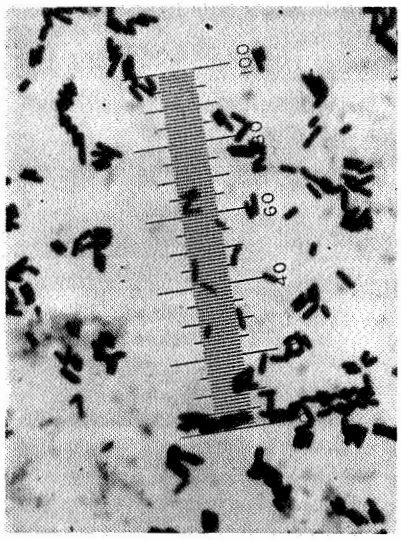


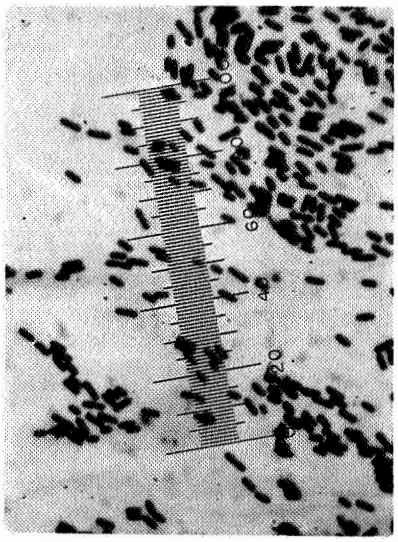
SPORE:

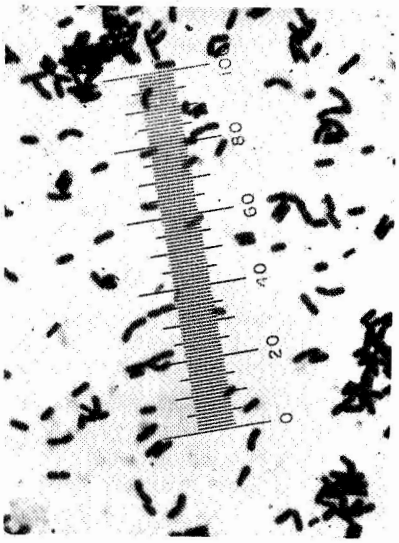
MOTILITY: age 1 DA. POSITIVE.
Flagella:

OTHER STAINS:
Acid fast:

18; 24; 48 hr. GRAM:







256 BA

II. *CULTURAL CHARACTERISTICS*

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 2 DA.

Macroscopic

Size: 3 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	YELLOW TINT	1 ba
Potato slant	OATMEAL	2 ec
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling _____.

GELATIN STAB: age 3 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: EXCELLENT.

Fat agar:

Glucose-nitrate agar: MODERATE.

GLUCOSE-NUTRIENT AGAR: EXCELLENT.

NUTRIENT AGAR: EXCELLENT.

ANAEROBIC NITRATE BROTH: NO GAS.

ANAEROBIC GLUCOSE BROTH: NO GROWTH.

DNA

G:C _____

G+C _____ moles %

III. *PHYSIOLOGICAL CHARACTERISTICS*

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 5°C. –, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. –.

SOLE CARBON SOURCE: age 7 DA.

Glucose: *positive, negative.*	7 DA.
Sucrose: *positive, negative.*	7 DA.
Xylose: *positive, negative.*	7 DA.
Citrate: *positive, negative.*	7 DA.
NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.*	7 DA.
–	

REDUCTIONS:

Nitrate: NO_2^- +, NH_4^+ ___, *gas* ___, *negative.*	1 DA.
Methylene blue: *positive, negative.*	1 DA.
Selenite: *positive, negative.*	___
Tellurite: *positive, negative.*	___
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Sucrose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Lactose: *acid* +, *alkaline* ___, *neutral, gas.*	42 DA.
Xylose: *acid* +, *alkaline* ___, *neutral, gas.*	42 DA.
Mannitol: *acid* +, *alkaline, neutral, gas.*	7 DA.
–	

HYDROLYSIS:

Gelatin: *positive, negative.*	7 DA.
Casein: *positive, negative.*	7 DA.
Fat: *positive, negative.*	7 DA.
Starch: *positive, negative.*	7 DA.
Cellulose: *positive, negative.*	___
Urea: *positive, negative.*	___

TOLERANCES:

Salt: 2%—*positive, negative.*	7 DA.
7%—*positive, negative.*	
10%—*positive, negative.*	
pH: *acid* ___, *alkaline* ___.	___

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.*	3 DA.
Curd: *acid, alkaline, absent, gas.*	3 DA.
Peptionization: *positive, negative.*	3 DA.
Reduction: *positive, negative.*	10 DA.

OTHER REACTIONS:

H_2S from ___: *positive, negative.*	___
NH_4^+ from peptone: *positive, negative.*	7 DA.
Acetylmethylcarbinol: *positive, negative.*	3 DA.
Indol: *positive, negative.*	23 DA.
Methyl red: *positive, negative.*	15 DA.

OREGON STATE UNIVERSITY
DEPARTMENT OF MICROBIOLOGY
(JPL–NASA)

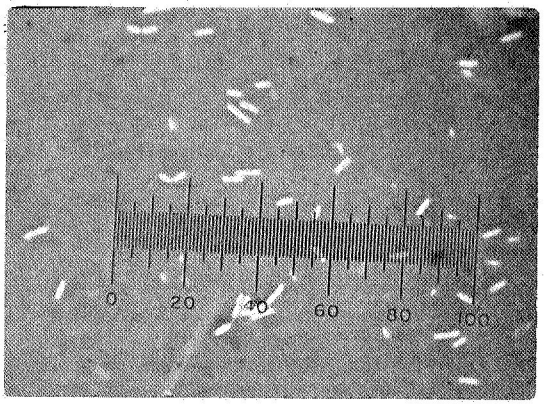
Descriptive Chart

260Aa	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Bacillus subtilis var. niger.	28°C.	W. B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*

MORPHOLOGY:
Form: *rods, ends* ROUND,
filaments, cocci, spirals,
branching _____.
Size: *average* – 0.79 x 2.42μ.
range – 0.66 - 0.82 x 2.10 - 2.75μ.
Irregular forms:

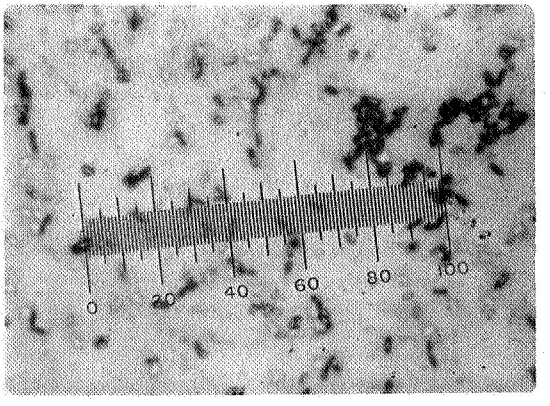
NIGROSIN:



GRAM REACTION:
18 hrs: 100% POSITIVE.
24 hrs: 100% POSITIVE.
48 hrs: 100% POSITIVE.

PASTEURIZATION SURVIVAL (85°C, 10 minutes): POSITIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen,.*
Position: *central to excentric, terminal, subterminal.*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average – 0.95 x 2.5 μ.
range – 0.84 - 1.07 x 1.46 - 2.67μ.

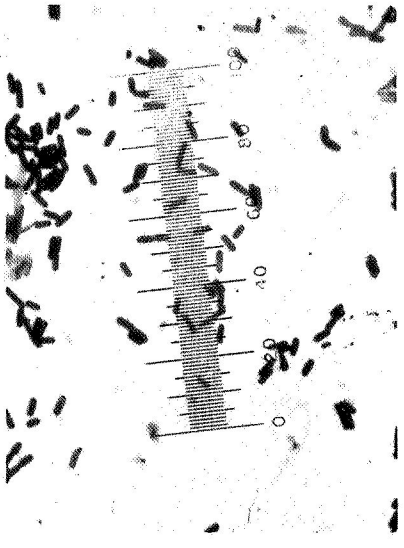
SPORE:



MOTILITY: age 2 DA. NEGATIVE.
Flagella:

OTHER STAINS:
Acid fast:

18; 24; 48 hr. GRAM:



260 AA

II. *CULTURAL CHARACTERISTICS*

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 2 DA.

Macroscopic

Size: 4 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	CREAM	1½ ca
Potato slant	BLACK PLUM	10 po
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling NONE.

GELATIN STAB: age 1 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: EXCELLENT.

Fat agar:

Glucose-nitrate agar: FAIR.

GLUCOSE-NUTRIENT AGAR: EXCELLENT.

NUTRIENT AGAR: GOOD.

TYROSINE-NUTRIENT AGAR: BLACK.

ANAEROBIC NITRATE BROTH: NO GAS.

ANAEROBIC GLUCOSE BROTH: GROWTH. pH 6.8.

DNA

G:C _____

G+C _____ moles %

III. *PHYSIOLOGICAL CHARACTERISTICS*

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 55°C. +, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. +.

SOLE CARBON SOURCE: age 7 DA.

Glucose: *positive, negative.*	7 DA.
Sucrose: *positive, negative.*	7 DA.
Xylose: *positive, negative.*	7 DA.
Citrate: *positive, negative.*	7 DA.
NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.*	7 DA.
LACTOSE: POSITIVE.	7 DA.
MANNITOL: POSITIVE.	7 DA.

REDUCTIONS:

Nitrate: NO_2^- +, NH_4^+ ____, *gas* ____, *negative.*	1 DA.
Methylene blue: *positive, negative.*	1 DA.
Selenite: *positive, negative.*	____
Tellurite: *positive, negative.*	____
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline* ____, *neutral, gas.*	7 DA.
Sucrose: *acid* +, *alkaline* ____, *neutral, gas.*	7 DA.
Lactose: *acid* +, *alkaline* ____, *neutral, gas.*	42 DA.
Xylose: *acid* +, *alkaline* ____, *neutral, gas.*	7 DA.
Mannitol: *acid* +, *alkaline, neutral, gas.*	7 DA.
–	

HYDROLYSIS:

Gelatin: *positive, negative.*	7 DA.
Casein: *positive, negative.*	7 DA.
Fat: *positive, negative.*	7 DA.
Starch: *positive, negative.*	7 DA.
Cellulose: *positive, negative.*	____
Urea: *positive, negative.*	____

TOLERANCES:

Salt: 2%—*positive, negative.*	7 DA.
7%—*positive, negative.*	
10%—*positive, negative.*	
pH: *acid* ____, *alkaline* ____.	____

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.*	7 DA.
Curd: *acid, alkaline, absent, gas.*	18 DA.
Peptionization: *positive, negative.*	2 DA.
Reduction: *positive, negative.*	18 DA.

OTHER REACTIONS:

H_2S from ____: *positive, negative.*	____
NH_4^+ from peptone: *positive, negative.*	7 DA.
Acetylmethylcarbinol: *positive, negative.*	15 DA.
Indol: *positive, negative.*	23 DA.
Methyl red: *positive, negative.*	15 DA.

OREGON STATE UNIVERSITY
DEPARTMENT OF MICROBIOLOGY
(JPL–NASA)

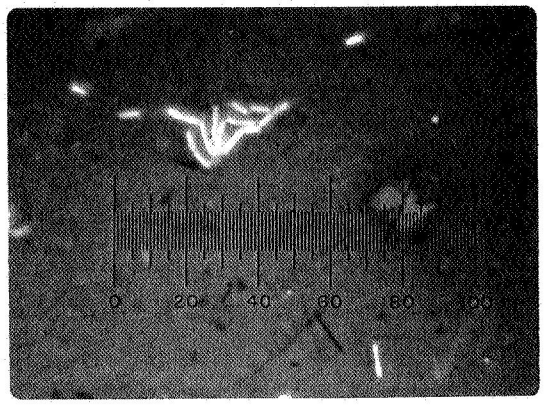
Descriptive Chart

260Bc	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Bacillus subtilis var. niger.	28°C.	W. B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*

MORPHOLOGY:
Form: *rods, ends* ROUND,
filaments, cocci, spirals,
branching _____.
Size: *average* – 0.90 x 2.88 μ.
range – 0.80 - 1.04 x 2.12 - 3.61μ.
Irregular forms:

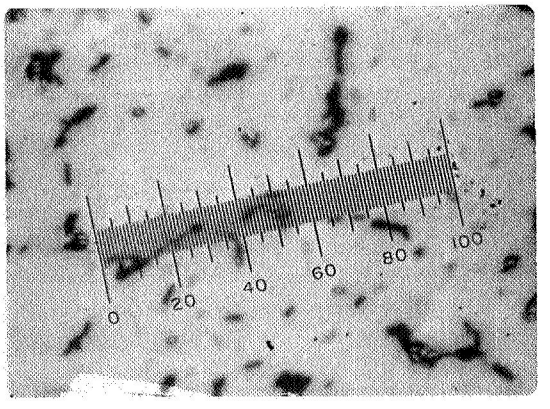
NIGROSIN:



GRAM REACTION:
18 hrs: 100% POSITIVE.
24 hrs: 100% POSITIVE.
48 hrs: 100% POSITIVE.

PASTEURIZATION SURVIVAL (85°C, 10 minutes): POSITIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen,.*
Position: *central to excentric, terminal, subterminal.*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average – 0.87 x 1.49μ.
range – 0.70 - 1.06 x 1.34 - 1.58μ.

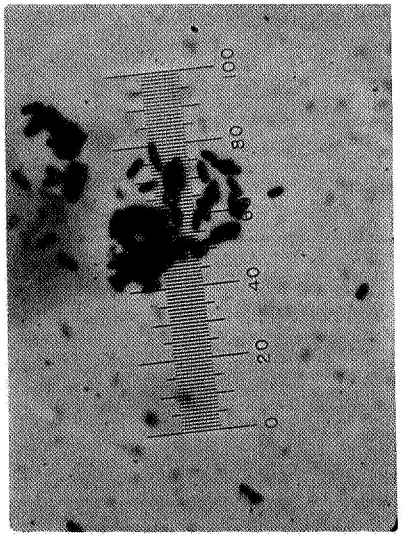
SPORE:

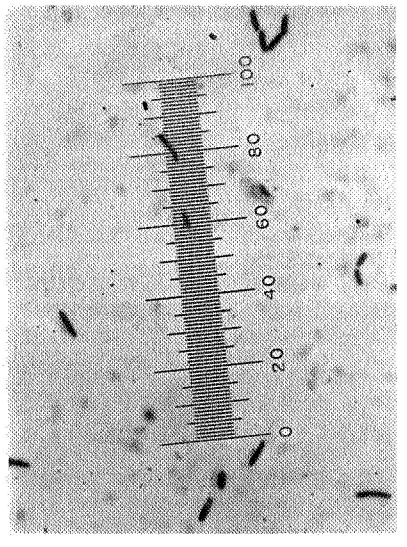


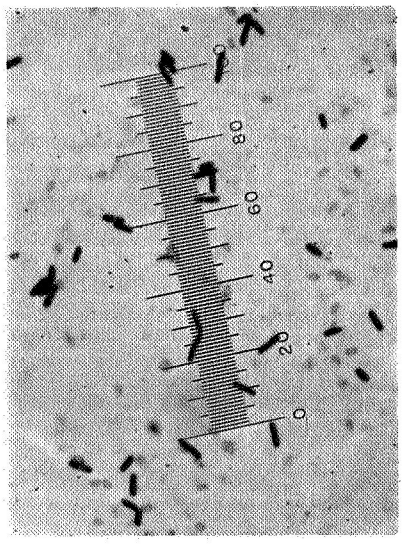
MOTILITY: age 1 DAY. POSITIVE.
Flagella:

OTHER STAINS:
Acid fast:

18; 24; 48 hour GRAM:







260 Bc

II. *CULTURAL CHARACTERISTICS*

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 2 DA.

Macroscopic

Size: 3 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	PEARL	3 ba
Potato slant	BLACK PLUM	10 po
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling NONE.

GELATIN STAB: age 6 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: EXCELLENT.

Fat agar:

Glucose-nitrate agar: FAIR.

GLUCOSE-NUTRIENT-AGAR: EXCELLENT.

NUTRIENT AGAR: GOOD

TYROSINE - NUTRIENT AGAR: BLACK.

ANAEROBIC NITRATE BROTH: NO GAS

ANAEROBIC GLUCOSE BROTH: GROWTH. pH 6.8.

DNA

G:C _____

G+C _____ moles %

III. *PHYSIOLOGICAL CHARACTERISTICS*

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 5°C. +, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. ±.

SOLE CARBON SOURCE: age 7 DA.

Glucose: *positive, negative.*	7 DA.
Sucrose: *positive, negative.*	7 DA.
Xylose: *positive, negative.*	7 DA.
Citrate: *positive, negative.*	7 DA.
NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.*	7 DA.
LACTOSE: POSITIVE.	7 DA.
MANNITOL: POSITIVE.	7 DA.

REDUCTIONS:

Nitrate: NO_2^- +, NH_4^+ ___, *gas* ___, *negative.*	1 DA.
Methylene blue: *positive, negative.*	1 DA.
Selenite: *positive, negative.*	___
Tellurite: *positive, negative.*	___
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Sucrose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Lactose: *acid* ___, *alkaline* ___, *neutral, gas.*	42 DA.
Xylose: *acid* +, *alkaline* ___, *neutral, gas.*	20 DA.
Mannitol: *acid* +, *alkaline, neutral, gas.*	7 DA.
–	

HYDROLYSIS:

Gelatin: *positive, negative.*	7 DA.
Casein: *positive, negative.*	7 DA.
Fat: *positive, negative.*	7 DA.
Starch: *positive, negative.*	7 DA.
Cellulose: *positive, negative.*	___
Urea: *positive, negative.*	___

TOLERANCES:

Salt: 2%—*positive, negative.*	7 DA.
7%—*positive, negative.*	
10%—*positive, negative.*	
pH: *acid* ___, *alkaline* ___.	___

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.*	10 DA.
Curd: *acid, alkaline, absent, gas.*	10 DA.
Peptionization: *positive, negative.*	3 DA.
Reduction: *positive, negative.*	10 DA.

OTHER REACTIONS:

H_2S from ___: *positive, negative.*	___
NH_4^+ from peptone: *positive, negative.*	6 DA.
Acetylmethylcarbinol: *positive, negative.*	15 DA.
Indol: *positive, negative.*	23 DA.
Methyl red: *positive, negative.*	15 DA.

OREGON STATE UNIVERSITY
DEPARTMENT OF MICROBIOLOGY
(JPL–NASA)

Descriptive Chart

266Aa	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Bacillus laterosporus*	28°C.	W.B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*

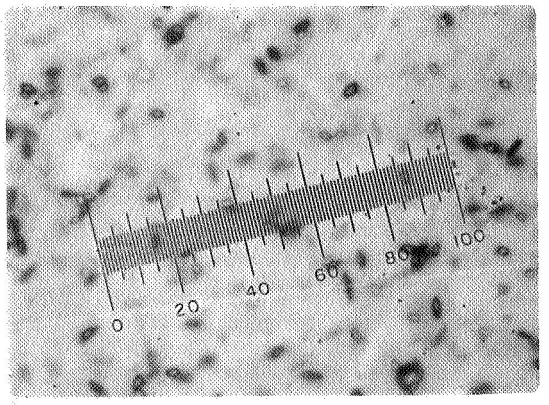
MORPHOLOGY:
Form: *rods, ends* ROUND,
filaments, cocci, spirals,
branching _____.
Size: *average* – 1.35 x 3.07μ.
range – 1.22 - 1.46 x 2.24 - 4.04 μ.
Irregular forms:

NIGROSIN:

GRAM REACTION:
18 hrs: 100% POSITIVE.
24 hrs: 100% POSITIVE.
48 hrs: 100% POSITIVE.

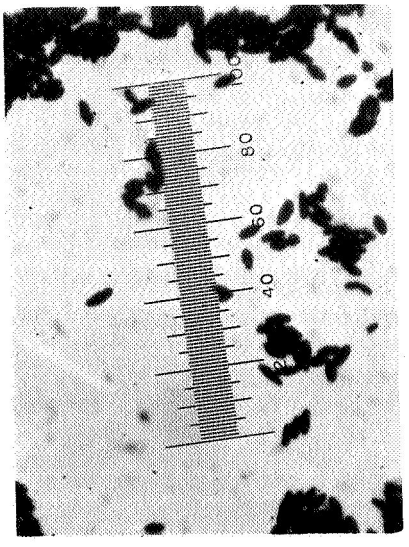
PASTEURIZATION SURVIVAL (85°C, 10 minutes): POSITIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen,.*
Position: *central to excentric, terminal, subterminal.*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average – 1.21 x 1.78μ.
range – 1.06 - 1.34 x 1.42 - 2.26μ.

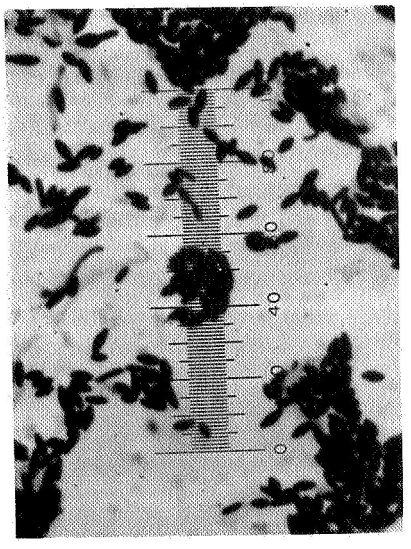
SPORE:

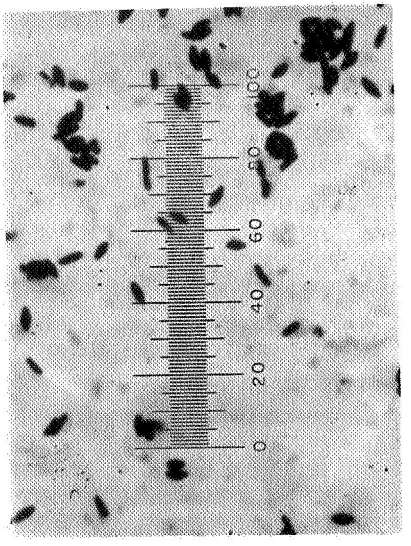


MOTILITY: age 2 DA. NEGATIVE.
Flagella:

OTHER STAINS:
~~Acid fast:~~ 18, 24, 48 hr. GRAM:







* Physiologically resembles this species, although isolant is indol neg.

266Aa

II. CULTURAL CHARACTERISTICS

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *aborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 3 DA.

Macroscopic

Size: 3 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	CREAM	1½ ca
Potato slant	GOLDEN BROWN	3 pg
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling NONE.

GELATIN STAB: age 12 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: FAIR GROWTH.

Fat agar:

Glucose-nitrate agar: FAINT GROWTH.

GLUCOSE-NUTRIENT AGAR: FAINT GROWTH.

NUTRIENT AGAR: FAIR GROWTH.

ANAEROBIC NITRATE BROTH: GROWTH & GAS.

ANAEROBIC GLUCOSE BROTH: POSITIVE GROWTH.

pH 7.0.

DNA

G:C _____

G+C _____ moles %

III. PHYSIOLOGICAL CHARACTERISTICS

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 5.5°C. +, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. +.

SOLE CARBON SOURCE: age _____.

Glucose: *positive, negative.*	7 DA.
Sucrose: *positive, negative.*	7 DA.
Xylose: *positive, negative.*	7 DA.
Citrate: *positive, negative.*	7 DA.
NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.*	7 DA.
LACTOSE: POSITIVE.	4 DA.
MANNITOL: POSITIVE.	7 DA.

REDUCTIONS:

Nitrate: NO_2^- +, NH_4^+ ___, *gas* ___, *negative.*	1 DA.
Methylene blue: *positive, negative.*	20 DA.
Selenite: *positive, negative.*	___
Tellurite: *positive, negative.*	___
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Sucrose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Lactose: *acid* ___, *alkaline* ___, *neutral, gas.*	42 DA.
Xylose: *acid* +, *alkaline* ___, *neutral, gas.*	7 DA.
Mannitol: *acid* +, *alkaline, neutral, gas.*	7 DA.
–	

HYDROLYSIS:

Gelatin: *positive, negative.*	20 DA.
Casein: *positive, negative.*	12 DA.
Fat: *positive, negative.*	7 DA.
Starch: *positive, negative.*	17 DA.
Cellulose: *positive, negative.*	___
Urea: *positive, negative.*	___

TOLERANCES:

Salt: 2%—*positive, negative.*	7 DA
7%—*positive, negative.*	
10%—*positive, negative.*	
pH: *acid* ___, *alkaline* ___.	___

LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.*	30 DA.
Curd: *acid, alkaline, absent, gas.*	30 DA.
Peptionization: *positive, negative.*	30 DA.
Reduction: *positive, negative.*	30 DA.

OTHER REACTIONS:

H_2S from ___: *positive, negative.*	___
NH_4^+ from peptone: *positive, negative.*	15 DA.
Acetylmethylcarbinol: *positive, negative.*	15 DA.
Indol: *positive, negative.*	23 DA.
Methyl red: *positive, negative.*	15 DA.

OREGON STATE UNIVERSITY
DEPARTMENT OF MICROBIOLOGY
(JPL–NASA)

Descriptive Chart

266Ac	Trypticase Soy Agar	Chile Atacama Desert
(code number)	(medium)	(source)
Bacillus laterosporus*	28°C.	W.B. Bollen
(name of organism)	(temperature)	(studied by)

I. *STAINING & MORPHOLOGICAL CHARACTERISTICS*

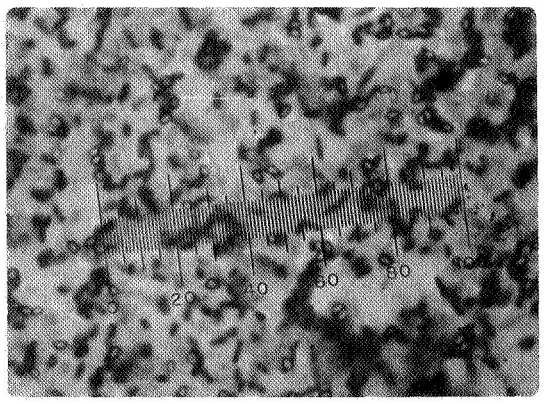
MORPHOLOGY:
Form: *rods*, *ends* ROUND,
filaments, cocci, spirals,
branching _____.
Size: *average* – 1.07 x 3.03μ.
range – 0.93 - 1.28 x 2.13 - 4.67 μ.
Irregular forms:

NIGROSIN:

GRAM REACTION:
18 hrs: 100% POSITIVE.
24 hrs: 100% POSITIVE.
48 hrs: 100% POSITIVE.

PASTEURIZATION SURVIVAL (85°C, 10 minutes): POSITIVE.
Sporangia: *none, rods, spindles, elliptical, clavate, drumstick.*
Endospores: *swollen, not swollen,.*
Position: *central to excentric, terminal, subterminal.*
Shape: *spherical, ellipsoidal, cylindrical, oval.*
size: average – 1.19 x 1.79μ.
range – 1.02 - 1.30 x 1.68 - 1.88μ.

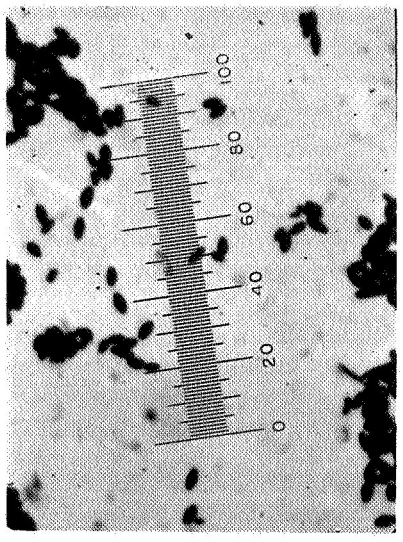
SPORE:

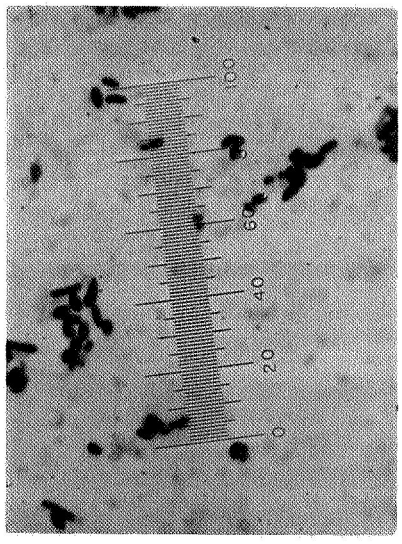


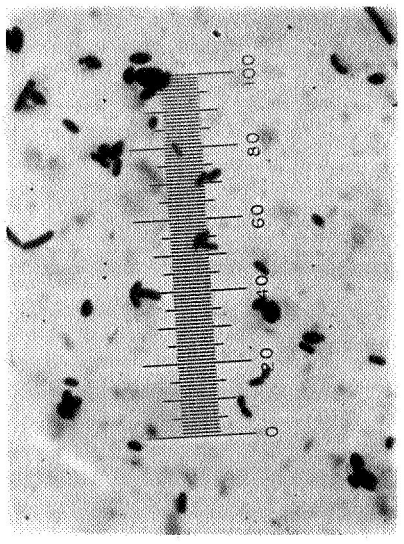
MOTILITY: age 1 DAY. NEGATIVE.
Flagella:

OTHER STAINS:
~~Acid-fast~~:

18, 24, 48 hr. GRAM:







* Physiologically resembles this sp., although this isolant is indol neg

266 Oc

II. *CULTURAL CHARACTERISTICS*

AGAR STROKE: age 3 DA.

Amount of growth: *abundant, moderate, scant.*

Form: *arborescent, beaded, echinulate, effuse, filiform, rhizoid, spreading.*

Consistency: *adherent, brittle, butyrous, membranous, moist, slimy, soft, tough, viscid, waxy.*

AGAR COLONIES: age 2 DA.

Macroscopic

Size: 2 mm.

Shape: *filamentous, irregular, oval, puntiform, round.*

Elevation: *beveled, convex, effuse, flat, papillate, pulvinate, raised, rugose, umbonate.*

Topography: *contoured, rough, smooth, striated, wrinkled.*

Habit: *compact, spreading.*

Microscopic (100x)

Margin: *Ciliate, cleft, crenate, entire, erose, granular, lobed, rhizoid, undulate.*

Internal structure: *amorphous, dense, filamentous, granular (fine, coarse), interlaced, striated.*

Optical properties

Appearance by reflected light: *dull, fluorescent, glistening, iridescent, opalescent.*

Appearance by transmitted light: *opaque, translucent, transparent.*

Medium: *blackened, blued, browned, grayed, greened, yellowed, unchanged.*

Chromogenesis:

(medium)	(color)	(CHM No.)
Trypticase soy agar	Bamboo	2Fb
Potato slant	NONE	
–		
–		

NUTRIENT BROTH: age 4 DA.

Amount of growth: *abundant, moderate, scant.*

Surface growth: *none, flocculent, membranous, pellicle, ring.*

Subsurface growth: *none, granular, turbid.*

Sediment: *none, compact, flaky, flocculent, granular, viscid.*

Odor: resembling NONE.

GELATIN STAB: age 18 DA.

Liquefaction: *none, crateriform, infundibuliform, napiform, saccate, stratiform.*

Rate: *fast, moderate, slow.*

OTHER GROWTH CHARACTERISTICS:

Soybean infusion agar: NO GROWTH.

Fat agar:

Glucose-nitrate agar: FAINT.

GLUCOSE-NUTRIENT AGAR: FAIR

NUTRIENT AGAR: GOOD.

ANAEROBIC NITRATE BROTH: GAS.

ANAEROBIC GLUCOSE BROTH: SL. GROWTH. pH 7.2.

DNA

G:C _____

G+C _____ moles %

III. *PHYSIOLOGICAL CHARACTERISTICS*

RELATIONSHIP TO O_2: *aerobic, anaerobic, facultative, microaerophilic.*

CATALASE: *positive, negative.*

TEMPERATURE RELATIONSHIPS: age 3 DA.

Growth at 5°C. +, 20°C. +, 28°C. +, 37° +, 45°C. +, 55°C. +.

SOLE CARBON SOURCE: age _____.

Glucose: *positive, negative.*	25 DA.
Sucrose: *positive, negative.*	25 DA.
Xylose: *positive, negative.*	25 DA.
Citrate: *positive, negative.*	7 DA.
NH_4^+ AS SOLE NITROGEN SOURCE: *positive, negative.*	25 DA.
LACTOSE: POSITIVE.	25 DA.
MANNITOL: POSITIVE.	25 DA.

REDUCTIONS:

Nitrate: NO_2^- +, NH_4^+ ____, *gas* ____, *negative.*	3 DA.
Methylene blue: *positive, negative.*	20 DA.
Selenite: *positive, negative.*	____
Tellurite: *positive, negative.*	____
–	

OXIDATIVE-FERMENTATIVE REACTIONS

Glucose: *acid* +, *alkaline* ____, *neutral, gas.*	20 DA.
Sucrose: *acid* +, *alkaline* ____, *neutral, gas.*	7 DA.
Lactose: *acid* ____, *alkaline* ____, *neutral, gas.*	7 DA.
Xylose: *acid* +, *alkaline* ____, *neutral, gas.*	7 DA.
Mannitol: *acid* +, *alkaline, neutral, gas.*	20 DA.
–	

HYDROLYSIS:

Gelatin: *positive, negative.*	____
Casein: *positive, negative.*	12 DA.
Fat: *positive, negative.*	7 DA.
Starch: *positive, negative.*	17 DA.
Cellulose: *positive, negative.*	____
Urea: *positive, negative.*	____

TOLERANCES:

Salt: 2%—*positive, negative.*	7 DA.
7%—*positive, negative.*	
10%—*positive, negative.*	
pH: *acid* ____, *alkaline* ____	____

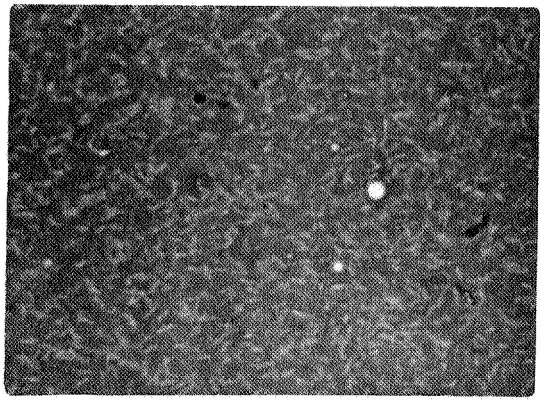
LITMUS MILK REACTIONS:

Reaction: *acid, alkaline, neutral.*	30 DA.
Curd: *acid, alkaline, absent, gas.*	30 DA.
Peptionization: *positive, negative.*	30 DA.
Reduction: *positive, negative.*	30 DA.

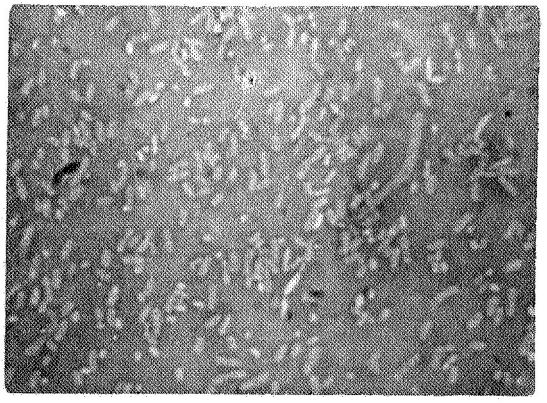
OTHER REACTIONS:

H_2S from ____: *positive, negative.*	____
NH_4^+ from peptone: *positive, negative.*	15 DA.
Acetylmethylcarbinol: *positive, negative.*	15 DA.
Indol: *positive, negative.*	23 DA.
Methyl red: *positive, negative.*	15 DA.

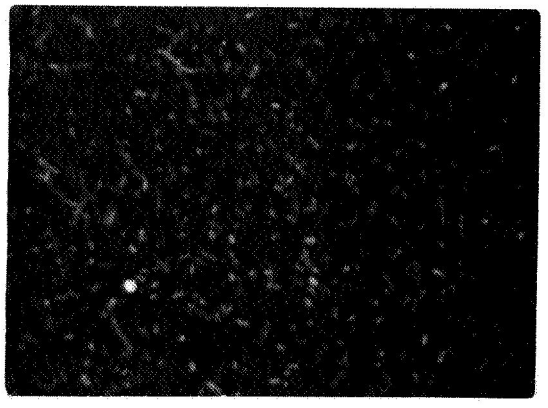
PHOTOMICROGRAPHS OF NON-VIABLE ORIGINAL CULTURES



257Ab



268Aa



268Bd

NIGROSIN STAIN 1000X