FACILITY FORM 602

N68-24772	
(ACCESSION NUMBER)	(THRU)
79	1
(PAGES)	(CODE)
CR-94759	04
(NASA CR OR TMX OR AD NUMBER)	(CATEGORY)

JET PROPULSION LABORATORY

CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA, CALIFORNIA

JUN 1968

RECEIVED

NASA STI FACILITY

INPUT BRANCH

Progress Report
Microorganism Study
JPL Contract No. 950783
Systematic Description and Key to
Streptomyces Isolants from Chile-Atacama
Desert, Hawaii, and Oregon Soils

Professor W. B. Bollen, Microbiologist and,
Sumie Nishikawa, Assistant in Microbiology
Oregon State University, Corvallis, Oregon
April 25, 1968

This work was performed for the Jet Propulsion Laboratory, California Institute of Technology, sponsored by the National Aeronautics and Space Administration under Contract NAS7-100.

Index

	Page No.
Materials and methods	1
Characteristics used in identification	2
Isolants identified	4
Key to identification of isolants	5
Descriptive charts (in order of laboratory culture numbers, 1 to 17, excluding isolants that failed to grow on subsequent transfer)	7

Materials and Methods

The species designations of the cultures included in this report have been determined according to Hutter, Ralf, "Systematik der Streptomyceten", S. Karger, Basel and New York, 1967. 382 p.

The methods used for characterization of the streptomycetes were those recommended by Shirling, E. B and D. Gottlieb in International Journal of Systematic Bacteriology 16:313-340. 1966. The culture media used for the characterization and identification of the species are as follows:

Code	Medium
Medium 1	Tryptone-yeast extract broth
Medium 2	Yeast extract-malt extract agar
Medium 3	Oatmeal agar
Medium 4	Inorganic salts-starch agar
Medium 5	Glycerol-asparagine agar
Medium 6	Peptone-yeast extract agar
Medium 7	Tyrosine agar
Medium 8	Carbon utilization medium

The descriptions of the various media are included in the reference above.

Morphology of the spore surface was determined by electron microscopy. The micrographs were taken with a Phillips EM 200 electron microscope by R. B. Addison and K. M. Hughes, Forestry Sciences Laboratory, USDA, Corvallis, Oregon.

Color of the aerial mycelium was compared with standard color tabs in the Color Harmony Manual (Container Corporation of America, Chicago, Illinois, 4th edition, 1958).

Morphology of aerial mycelia was observed from cover glass impressions under the oil immersion objective at 1000X.

Ability to produce melanin was determined on media recommended by Shirling and Gottlieb (Internat. J. Syst. Bact. 16:313-340. 1966).

Characteristics used to Differentiate Streptomyces
(According to Hutter)

1. Morphology of the spore surface

   a. Spores smooth or warty, or both.

   b. Spores with spiny outgrowth.

   c. Spores with hairy outgrowth.

2. Color of matured aerial mycelia

   1. Niveus: Aerial mycelium also in matured state without distinct color, snow white or chalk white ("White series" according to Tresner & Backus, 1963)*

   2. Griseus: Aerial mycelium - yellow-green, goldish-greenish-gray, sandy-olive color ("Yellow series")

   3. Azureus - glaucus: Aerial mycelium color sky blue or blue-gray to blue green (Blue series)

   4. Cinnamoneus: Color of aerial mycelium pale-carmine to cinnamon brown or gray-brown (Red Series and violet series)

   5. Cinereus: Color of aerial mycelium ash-gray to brown gray - rarely greenish-gray (Gray series)

   6. Prasinus: Color of aerial mycelium light green to grayish-green (Green series)

3. Morphology of the aerial mycelia

   1. Rectus - Flexibilis: spore chain straight or wavy

   2. Retinaculum - Apertum: spore chain with hooks, open twists or short irregular screws of 1 to 3 turns

   3. Spira - spore chains with screws

      a. Spira, Type a: Screws tight, intensive, compact

      b. Spira, Type b: Screws long, loose, drawn out

   4. Verticillus - Rectus - Flexibilis: spore chain arise in verticils

*Tresner, H. D. and Backus, E. J.: System of color wheels for Streptomycete taxonomy. Applied Microbiology 11:335-338 (1963).

5. Verticillus - Spira: spore chain in verticils, branched umbel-like

4. Ability to produce melanin

   a. Capacity to produce melanin present

   b. Capacity to produce melanin absent

Streptomyces Isolants Identified

Culture No.	JPL No.	Species	Source	Invoice No.
1	29 Bc	Streptomyces collinus	Hawaii	C-89146
2	29 Bd	S. venezuelae	Hawaii	C-89146
3	30 Ab	S. olivaceus	Hawaii	C-89146
4	34 d	failed to grow	Hawaii	C-89146
5	151 Ad	failed to grow	Oregon	C-90054
6	156 Ab	S. viridochromogenes	Oregon	C-89146
7	260 Af	S. caelestis	Chile-Atacama Desert	D-17577 On TSA
8	260 Ae	S. caelestis	Chile-Atacama Desert	D-17577 on TSA
9	275 Aa	S. albus	Chile-Atacama Desert	D-17577 on TSA
10	277 Bb	S. parvulus	Chile-Atacama Desert	D-17577 on TSA
11	278 Bc	S. longisporuber	Chile-Atacama Desert	D-17577 on TSA
12	292 Ac	Nocardia	Chile-Atacama Desert	D-00318
13	292 Ae	S. olivaceus	Chile-Atacama Desert	D-00318
15	292 Bd	S. olivaceus	Chile-Atacama Desert	D-00318
16	292 Be	S. olivaceus	Chile-Atacama Desert	D-00318
17	292 Bf	S. olivaceus	Chile-Atacama Desert	D-00318
18	292 Bk	failed to grow	Chile-Atacama Desert	D-00318
19	310 Ab	no spores produced	Wyoming	C-90054
20	313-1Ab	no spores produced	Wyoming	C-90054

Key to the Identification of *Streptomyces*
Isolants 1 to 17

I. True mycelia produced, spores formed but not in sporangia. Substrate mycelium non septate, not fragmenting into bacillary or coccoid components — *Streptomycetaceae*

II. Aerial mycelia produced
Spores formed in chains — *Streptomyces*

A. Ability to produce melanin pigment positive

1. Morphology of aerial mycelium, rectus - flexibilis

a. Spore surface smooth

b. Color of aerial mycelium, grayish-pink (cinnamomeus) — *S. venezuelae* (29 Bd)

2. Morphology of aerial mycelium, retinaculum - apertum

a. Some spores smooth, some spores warty

b. Color of aerial mycelium, white — *S. longisporuber* (278 Bc)

3. Morphology of aerial mycelium, spira

a. Spore surface, spiny

b. Color of aerial mycelium white, in matured state becoming aqua-blue — *S. viridochromogenis* (156 Ab)

aa. Spore surface, smooth or warty

b. Spores smooth, color of aerial mycelium white to ash-gray — *S. collinus* (29 Bc)

bb. Spores warty, white, in mature state become bluish gray — *S. caelestis* (260 Af) (260 Ae)

B. Ability to produce melanin pigment negative.

1. Morphology of aerial mycelium, rectus - flexibilis

a. Spore surface smooth

b. Color of aerial mycelium, white, later becoming grayish-white.

		Carbohydrate utilization			
		rham-nose	man-nose	inos-itol	raff-inose
# 3	S. olivaceus (30 Ab)	-	-	-	-
#15	S. olivaceus (292 Bd)	++	-	++	-
#13	S. olivaceus (292 Ae)	-	++	++	±
#16*	S. olivaceus (292 Be)	-	++	++	±
#17	S. olivaceus (292 Bf)	-	++	++	-

* aerial mycelium production extremely sparse in comparison to 292 Ae.

2. Morphology of aerial mycelium, spira

a. Spore surface warty

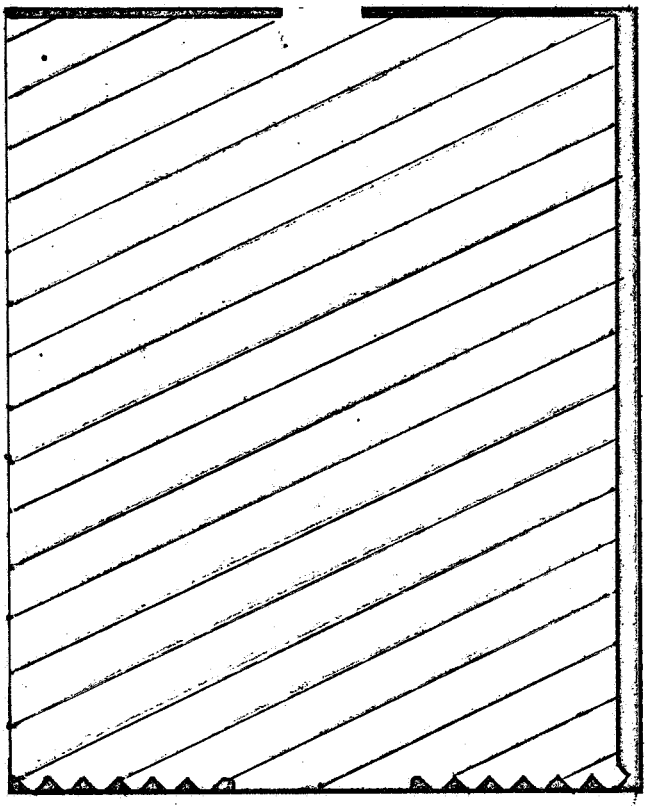
b. Color of aerial mycelium, white — S. albus (275 Aa)

bb. Color of aerial mycelium, ash-gray — S. parvulus (277 Bb)

#1000 carbon replica grating

28,800 lines/inch

Magnification = 6,990X



Culture No. 1

JPL No. 29 Bc

Source Hawaii

Invoice # C-89146

Studied by S. Nishikawa

Species Streptomyces collinus

1. Cultural properties: Temp. 26°C

	Da.	CHM* number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
aerial mycelium	7	a → b white → oyster white	5 fe=ashes (abundant)	a → d white to gray	none
	14	13 de → 13 fe Pearl gray → dusk pewter smoke	10 fe=dusk	c → e light gray → gray	none
	21	c=light gray	7 fe=ashes		none
substrate mycelium	7	7 po	24½ lg=light olive green	2 ne=mustard gold old gold	3 ba=pearl shell tint
	14	7 po	4 ig=fawn	3 ni → 3 ng chestnut brown → lt. brown saddle tan maple spice brown	3 ng=lt. brown saddle tan maple
	21	7 po	4 ge=lt. fawn rose beige	3 pl=dk. spice brown deep brown	3 ng=lt. brown saddle tan maple
soluble pigment	7	7 po	none	none	none
	14	4 pl=dk. spice brown deep brown	none	none	3 pg=dark luggage tan
	21	4 pi=oak brown russet brown	3 ie=camel maple sugar tan	3 lg=lt. spice brown sandal wood toast tan	3 ne=luggage tan

*Color Harmony Manual, Container Corporation of America, Chicago, Illinois, 4th edition, 1958.

Culture No. 1 Page 9

JPL No. 29 Bc

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	simple, spiral abundant	simple, spiral	--	--
	14	simple, spiral	simple, spiral	simple, spiral	none
	21	simple, spiral	simple, spiral	simple, spiral	none
Spore Number	7	> 10	> 10	--	--
	14	> 10	> 10	> 10	--
	21	> 10	> 10	> 10	--
Verticils	7	none	none	--	--
	14	none	none	none	--
	21	none	none	none	--

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 1

JPL No. 29 Bc

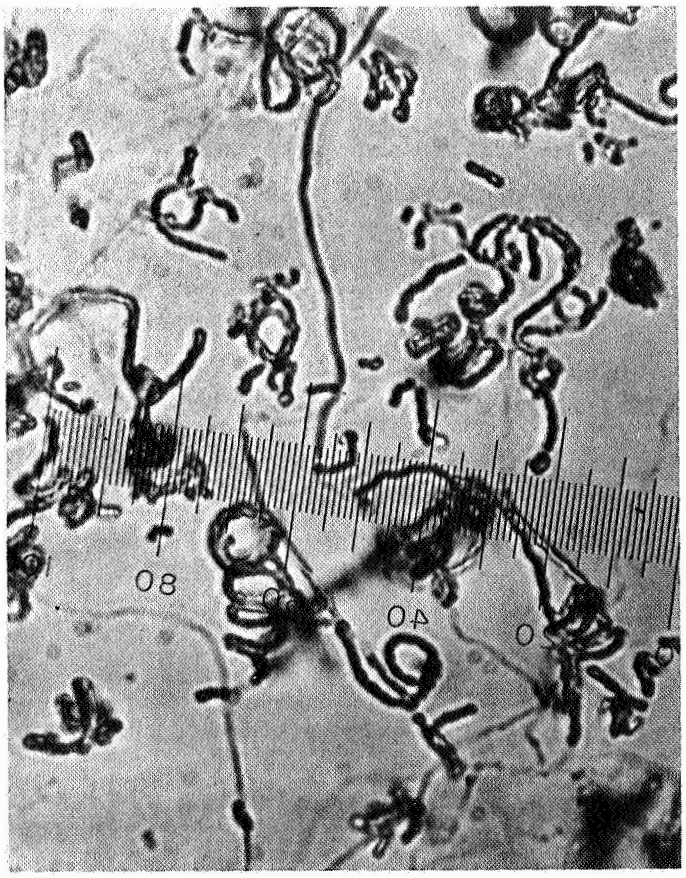
Species S. collinus

Photographs:

Medium #3 (oatmeal agar)

Age of culture 21 days

Magnification 1600X



Culture No. 1

JPL NO. 29 Bc

Species S. collinus

III. Spore morphology and surface: Smooth, warty, spiny, hairy

Dimensions 0.6 - 0.7 x 0.9 - 1.8 μ

Medium #2 malt-extract agar

Age of culture 14 days

Magnification = 6990x

Culture No. 1

JPL No. 29 Bc

Species S. collinus

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	++	++
L-arabinose	++	++
Sucrose	++	++
D-mannitol	++	++
I-inositol	++	++
D-fructose	++	++
Rhamnose	++	++
Raffinose	++	++
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 -

Medium 6 - positive after 7 days

Medium 7 - positive after 7 days

C. Starch hydrolysis +

Culture No. 2

JPL No. 29 Bd

Source Hawaii

Page 13

Invoice # C-89146

Studied by S. Nishikawa

Species Streptomyces venezuelae

1. Cultural properties: Temp. 26°C

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
aerial mycelium	7	12 ec=dusty periwinkle blue abundant	12½ ec → 9 ig dusty periwinkle blue → orchid gray	12½ gc=twilight blue	none
	14	7 fe=ashes	3 cb=sand	5 dc=pussywillow gray	none
	21	7 fe=ashes	3 cb → 7 fe sand → ashes	10 fe=dusk	7 cb=cloud pink (sparse)
substrate mycelium	7	2 le=mustard old gold	2 ge=convert gray griege	2 fb=bamboo buff straw wheat	2 fb=bamboo buff straw wheat
	14	2 le=mustard old gold	2 ba=pearl shell tint	2 ic=honey gold lt. gold	2 db=ivory
	21	2 le=mustard old gold	2 ba=pearl shell tint	2 ic=honey gold lt. gold	2 gc=bamboo chamois
soluble pigment	7	2 pe=mustard gold	none	none	none
	14	2 pe=mustard gold	none	none	none
	21	2 pe=mustard gold	none	none	none

Culture No. 2

JPL No. 29 Bd

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	simple, rectus	simple, rectus	simple, rectus	none
	14	simple, rectus	simple, rectus	simple, rectus	none
	21	simple, rectus	simple, rectus	simple, rectus	simple, rectus
Spore Number	7	> 10	> 10	> 10	--
	14	> 10	> 10	> 10	--
	21	> 10	> 10	> 10	> 10
Verticils	7	none	none	none	--
	14	none	none	none	--
	21	none	none	none	none

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 2

JPL No. 29 Bd

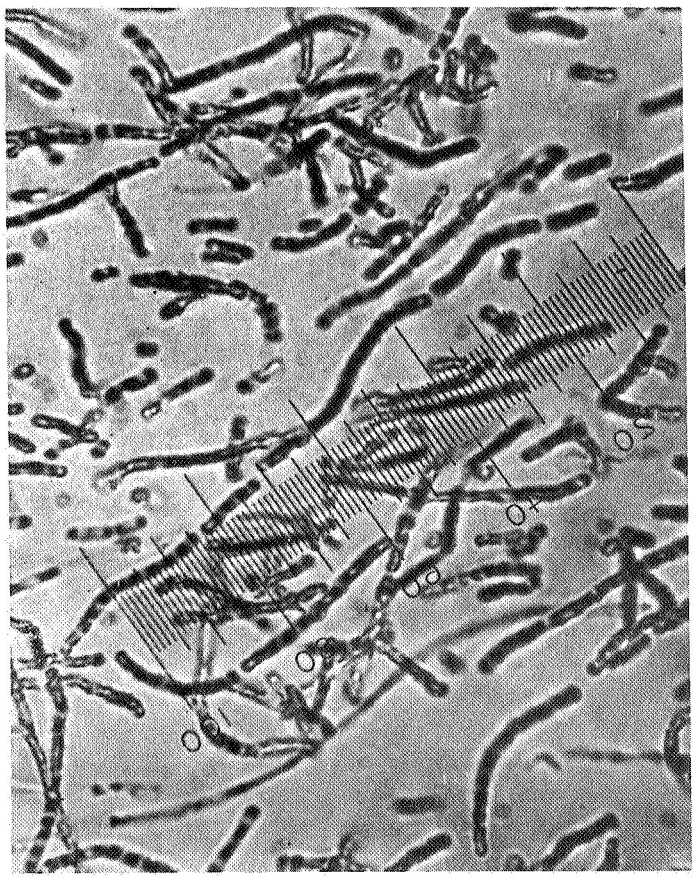
Species S. venezuelae

Photographs:

Medium #3 (oatmeal agar)

Age of culture 21 days

Magnification 1600X



Culture No. 2

JPL NO. 29 Bd

Species S. venezuelae

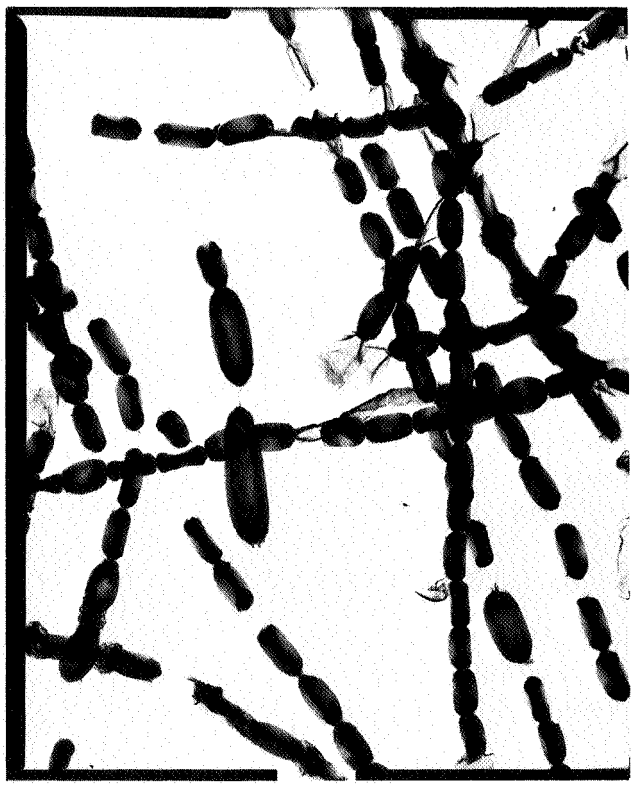
III. Spore morphology and surface: Smooth, warty, spiny, hairy

Dimensions 0.4 - 0.8 x 1.0 - 2.6 μ

Medium #3 starch agar

Age of culture 14 days

Magnification = 6,990X



Culture No. 2

JPL No. 29 Bd

Species S. venezuelae

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	±	+
L-arabinose	±	±
Sucrose	+	+
D-mannitol	-	-
I-inositol	-	-
D-fructose	++	++
Rhamnose	-	-
Raffinose	-	-
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - **positive after 2 days**

Medium 6 - **7 days - positive**

Medium 7 - **7 days - negative**

C. Starch hydrolysis +

Culture No. 3

JPL No. 30 Ab

Source Hawaii

Invoice # C-89146

Studied by S. Nishikawa

Species Streptomyces olivaceus

1. Cultural properties: Temp. 26°C

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
aerial mycelium	7	3cb=sand	7fe=ashes	2ba → 7dc	3ba=pearl shell tint
	14	7fe=ashes peripheral area 7fe=ashes	7fe=ashes	pearl shell → dawn pink tint 7fe=ashes	a → 7dc white → dawn pink
	21	7fe=ashes	5fe=ashes	5fe=ashes	7dc=dawn pink
substrate mycelium	7	3ne=topaz butterscotch	2ba=pearl shell tint	2ba=pearl shell tint	2ea=light wheat light maize
	14	2ne=mustard gold old gold	2ca=light ivory eggshell	2ca=light ivory eggshell	2ca=light ivory eggshell
	21	2ic=honey gold light gold	2ca=light ivory eggshell	2ca=light ivory eggshell	2ca=light ivory eggshell
soluble pigment	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

Culture No. 3

JPL No. 30 Ab

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	Rectus-Flexibilis	Rectus-Flexibilis	Rectus-Flexibilis	none
	14	Rectus-Flexibilis	Rectus-Flexibilis	Rectus-Flexibilis	Rectus-Flexibilis
	21	Rectus-Flexibilis	Rectus-Flexibilis	Rectus-Flexibilis	Rectus-Flexibilis
Spore Number	7	> 10	> 10	> 10	--
	14	> 10	> 10	> 10	> 10
	21	> 10	> 10	> 10	> 10
Verticils	7	none	none	none	--
	14	none	none	none	none
	21	none	none	none	none

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 3

JPL No. 30 Ab

Species S. olivaceus

Photographs:

Medium 5-Glycerol-asparagine agar

Age of culture 14 days

Magnification 1600X

Culture No. 3

JPL No. 30 Ab

Species S. olivaceus

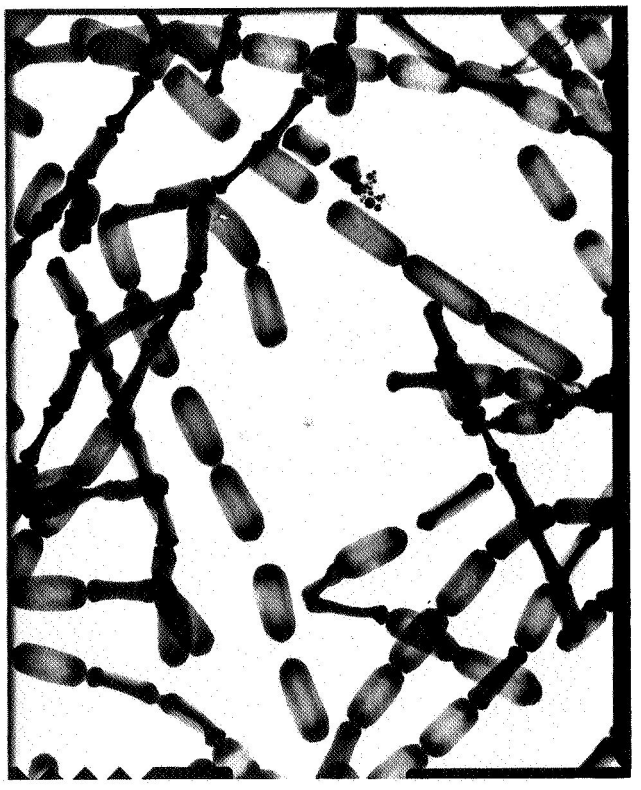
III. Spore morphology and surface: Smooth, warty, spiny, hairy

Dimensions 0.5 - 0.7 x 0.9 - 2.1 μ

Medium 3-oatmeal agar

Age of culture 14 days

Magnification = 6990x



Culture No. 3

JPL No. 30 Ab

Species S. olivaceus

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	±	±
L-arabinose	+	+
Sucrose	±	±
D-mannitol	-	-
I-inositol	-	-
D-fructose	+	++
Rhamnose	-	-
Raffinose	-	-
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - **light brown, positive after 2 days**

Medium 6 - **7 days - positive**

Medium 7 - **7 days - negative**

C. Starch hydrolysis +

Culture No. 6

JPL No. 156 Ab

Source Oregon

Page 23

Invoice # C-89146

Studied by S. Nishikawa

Species Streptomyces viridochromogenes

1. Cultural properties: Temp. 26°C

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
aerial mycelium	7	a → 4 ge → 3pn white → lt. fawn → chocolate brown	a → c white → light gray	a → c → 3 ec white → lt. gray → lt. beige	b=oyster white
	14	14 gc=pastel blue wedgewood blue	a → d → 17 ec white → gray → lt. aqua blue	14 ec=powder blue wedgewood blue	
	21	15 dc=dawn blue	a → 17 ec white → lt. aqua blue	a → 14 ec white → powder bl. wedgewood bl.	
substrate mycelium	7	10 po=black plum	4 lg=lt. spice brown sandal wood toast tan	3 pl=deep brown	1½ ca → 5 pe → 5 pl cream → terra cotta → deep bn.
	14	10 po=black plum	4 ng=lt. brown sandle tan maple	3 pl=clove brown deep brown	
	21	10 po=black plum	3 le=cinnamon yellow maple	4 ni=chestnut brown spice brown	
soluble pigment	7	brown	light brown	light brown	light brown
	14	5 pg=lt. copper bn. russet rust brown	3 ec=bisque lt. beige	3 gc=light tan	4 pg=dk. luggage tan
	21	4 pg=dk. luggage tan	3 gc=light tan	3 ec=bisque lt. beige	4 pg=dk. luggage tan

Culture No. 6 Page 24

JPL No. 156 Ab

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	spirals	spirals	spirals	none
	14	spirals	spirals	spirals	spirals
	21	spirals some, reticulum-apertum	spirals some, reticulum-apertum	spirals	spirals
Spore Number	7	> 10	> 10	> 10	--
	14	> 10	> 10	> 10	> 10
	21	> 10	> 10	> 10	> 10
Verticils	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 6

JPL No. 156 Ab

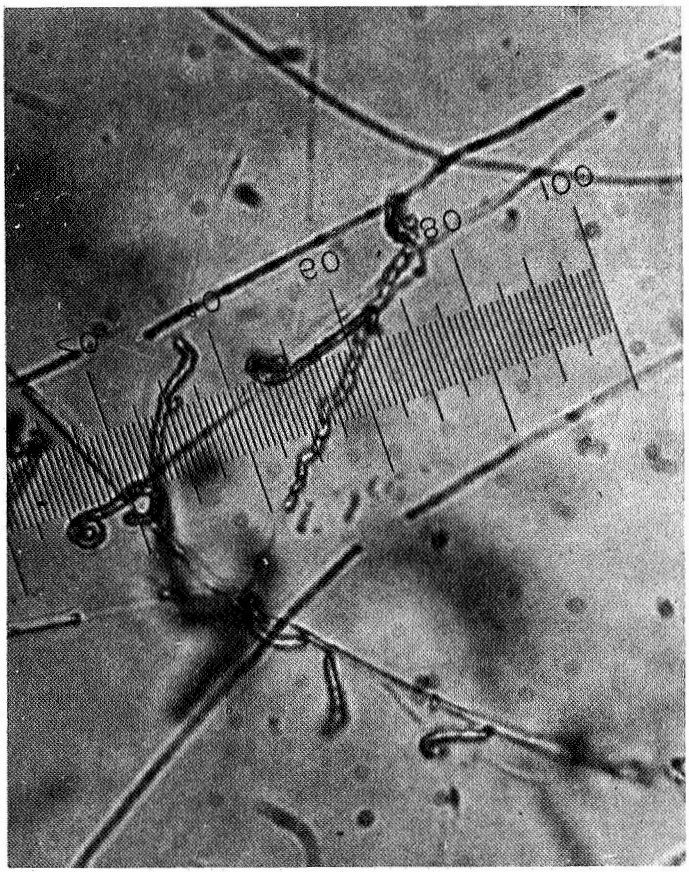
Species S. viridochromogenes

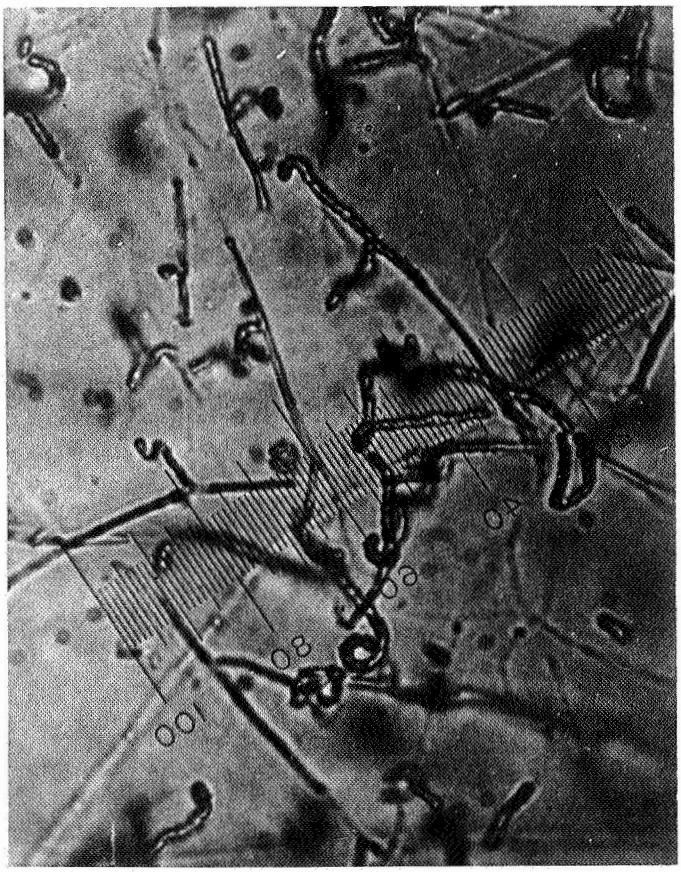
Photographs:

Medium 3-oatmeal agar

Age of culture 21 days

Magnification 1600X





Culture No. 6

JPL No. 156 Ab

Species S. viridochromogenes

III. Spore morphology & surface: Smooth, warty, spiny, hairy

Dimensions 0.5 - 0.8 x 0.9 - 1.4 μ

Medium 2-malt-extract agar

Age of culture 14 days

Magnification = 6990x

Culture No. 6

JPL No. 156 Ab

Species S. viridochromogenes

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	++	++
L-arabinose	++	++
Sucrose	++	++
D-mannitol	++	++
I-inositol	++	++
D-fructose	++	++
Rhamnose	++	++
Raffinose	++	++
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - 2 days - positive

Medium 6 - 7 days - positive

Medium 7 - 7 days - positive

C. Starch hydrolysis +

Culture No. 7

JPL No. 260 Af

Source Chile Atacama Desert

T.S.A. Invoice # D-17577

Studied by S. Nishikawa

Species Streptomyces caelestis

1. Cultural properties: Temp. 26°C

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
aerial mycelium	7	white	white	white	white
	14	a → 17 ge white → dusty aqua blue	white	white → 17 ig	white
	21	a → 17 ge white → dusty aqua blue	a → 17 ec white → lt. aqua blue	17 ig	white
substrate mycelium	7	3 le=cinnamon yellow maple	2 ic=gold	2 cb=ivory tint	3 le=cinnamon yellow maple
	14	3 le=cinnamon yellow maple	2 ic=gold	2 cb=ivory tint	3 le=cinnamon yellow maple
	21	3 le → 17 nl cinnamon yellow maple →	2 ic=gold	2 cb=ivory tint	3 le=cinnamon yellow maple
soluble pigment	7	3 le=cinnamon yellow maple	none	none	none
	14	3 le=cinnamon yellow maple	none	none	none
	21	3 le=cinnamon yellow maple	3 ie=camel maple sugar tan	none	3 ic=light amber

Culture No. 7

JPL No. 260 Af

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	none	none	none	none
	14	spiral	none	spores in spirals only where aerial myc. was aqua in color. White areas devoid of spores	none
	21	spiral	spiral	spiral	none
Spore Number	7	--	--	--	--
	14	> 10	--	> 10	--
	21	> 10	> 10	> 10	--
Verticils	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 7

JPL No. 260 Af

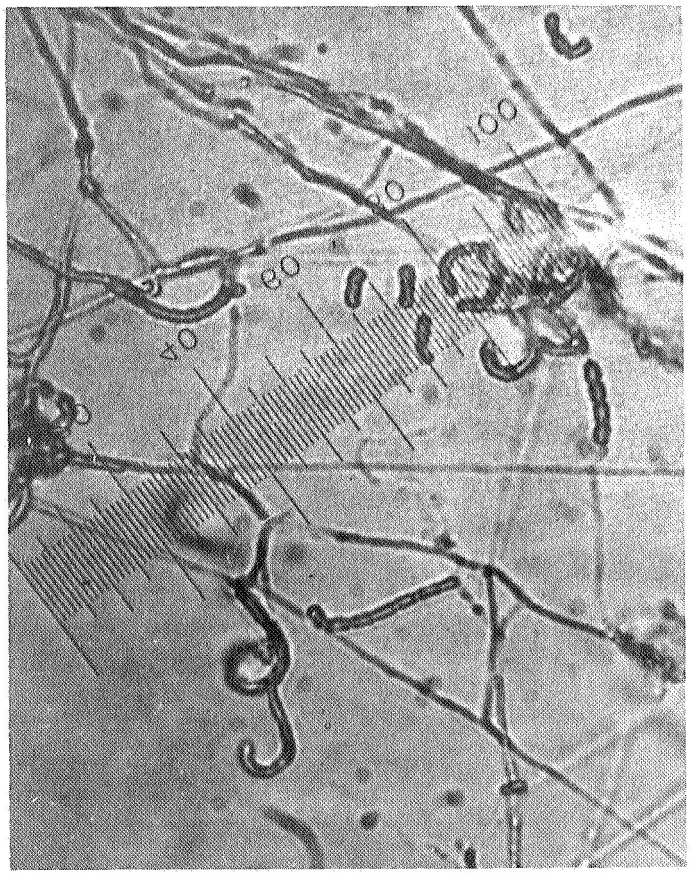
Species S. caelestis

Photographs:

Medium 3-oatmeal agar

Age of culture 21 days

Magnification 1600X



Culture No. 7

JPL No. 260 Af

Species S. caelestis

III. Spore morphology & surface: Smooth, warty, spiny, hairy

Dimensions 0.6 - 0.7 x 1.0 - 1.6 μ

Medium 2-malt-extract agar

Age of culture 14 days

Magnification = 6990x

Culture No. 7

JPL No. 260 Af

Species S. caelestis

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	++	++
L-arabinose	++	++
Sucrose	++	++
D-mannitol	++	++
I-inositol	++	++
D-fructose	++	++
Rhamnose	++	++
Raffinose	++	++
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - negative

Medium 6 - 2 days - negative
4 days - negative

Medium 7 - 2 days - negative
4 days - positive

C. Starch hydrolysis +

Culture No. 8 Source Chile Atacama Desert

JPL No. 260 Ae T.S.A. Invoice # D-17577

Studied by S. Nishikawa

Species Streptomyces caelestis

1. Cultural properties: Temp. 26°C

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
aerial mycelium	7	a → 5fe → 15ge white → ashes → dusty blue lt. gray blue	b=oyster white	a → 15ec (specks) white → powder blue	b → 3dc oyster white → natural
	14	a → d → 18ic white → gray → aqua turquoise (few parts)	b → 18ic oyster white → aqua turquoise (few parts)	a → 18gc white → aqua turquoise	white → 2fe → 18ge → covert gray → dusty aqua
	21	a → d → 18ic white → gray → aqua turquoise	b → 18ic oyster white → aqua turquoise	a → 18gc white → aqua turquoise	a → 2fe → 18ge white → covert gray → dusty aqua
substrate mycelium	7	3pg=golden brown	2ic=lt. antique gold	a → 2ea white → lt. wheat lt. maize	2ne=mustard gold old gold
	14	3pg=golden brown	2ca=lt. ivory eggshell	2ea=lt. wheat lt. maize	3ie=camel maple sugar tan
	21	3pg=golden brown	21e=mustard old gold	3ic → 2ea lt. amber → lt. wheat lt. maize	3ie=camel maple sugar tan
soluble pigment	7	4ng=lt. brown saddle tan maple	none	none	4ng=lt. brown saddle tan maple
	14	4pi=oak brown russel brown	4ec=bisque lt. rose beige	none	4pi=oak brown russel brown
	21	4pi=oak brown russel brown	3ec=bisque lt. beige	none	4pi=oak brown russet brown

Culture No. 8

JPL No. 260 Ae

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	none	none	none	none
	14	none	spirals	spirals and reticulum-apertum	none
	21	spirals-present where mycelia turquoise in color	--	spirals	spirals
Spore Number	7	--	--	--	--
	14	--	> 10	> 10	--
	21	> 10	--	> 10	> 10
Verticils	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 8

JPL No. 260 Ae

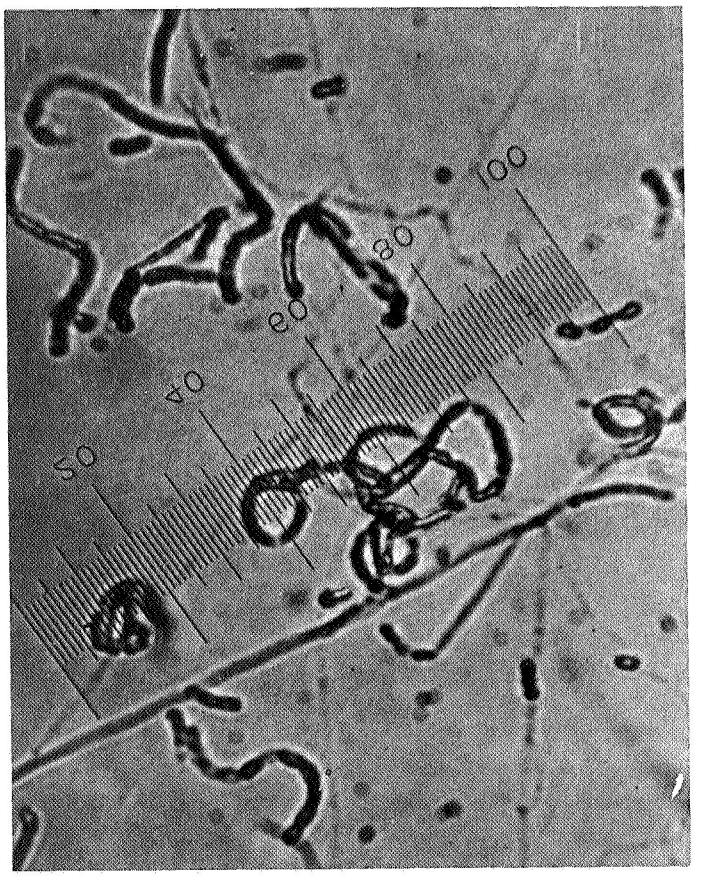
Species S. caelestis

Photographs:

Medium 4-starch agar

Age of culture 21 days

Magnification 1600X



Culture No. 8

JPL No. 260 Ae

Species S. caelestis

III. Spore morphology and surface: Smooth, warty, spiny, hairy

Dimensions 0.5 - 0.8 x 1.3 - 2.6 μ

Medium 2-malt extract agar

Age of culture 14 days

Magnification = 6990 x

Culture No. 8

JPL No. 260 Ae

Species S. caelestis

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	++	++
L-arabinose	++	++
Sucrose	++	++
D-mannitol	++	++
I-inositol	++	++
D-fructose	++	++
Rhamnose	++	++
Raffinose	++	++
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - negative

Medium 6 - 2 days - negative
4 days - negative

Medium 7 - 2 days - negative
4 days - positive

C. Starch hydrolysis +

Culture No. 9

JPL No. 275 Aa

Source Chile Atacama Desert

T.S.A. Invoice # D-17577

Studied by S. Nishikawa

Species ~~Streptomyces albus~~

1. Cultural properties: Temp. 26°C

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
aerial mycelium	7	white	white	none	white
	14	white	white	none	white
	21	a → d white → gray	white	a → b white → oyster white	white
substrate mycelium	7	1½ ca=cream	1½ ca=cream	1½ ca=cream	2 ba=pearl
	14	21c =gold	2 ba=pearl shell tint	2 ca=lt. ivory eggshell	1 ba=pearl shell tint
	21	2 nc=bright gold nugget gold	2 ba=pearl shell tint	2 ic=honey gold lt. gold	1 ba=pearl shell tint
soluble pigment	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

Culture No. 9

JPL No. 275 Aa

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	none	none	none	none
	14	Retinaculum-Apertum and spirals	none	none	none
	21	spirals	none	spirals	none
Spore Number	7	--	--	--	--
	14	> 10	--	--	--
	21	> 10	--	> 10	--
Verticils	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 9

JPL No. 275 Aa

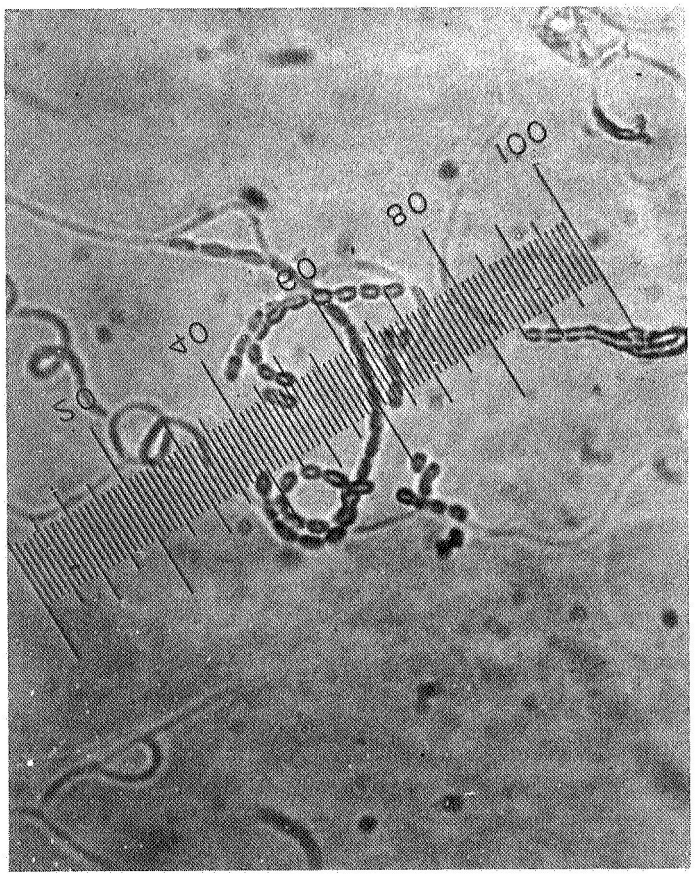
Species S. albus

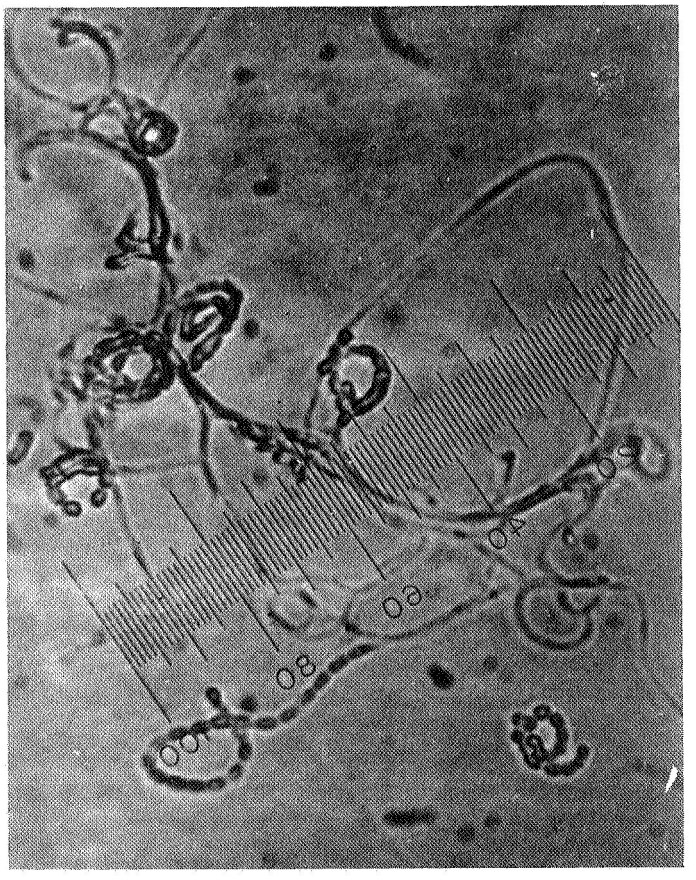
Photographs:

Medium 4-starch agar

Age of culture 21 days

Magnification 1600X





Culture No. 9

JPL No. 275 Aa

Species S. albus

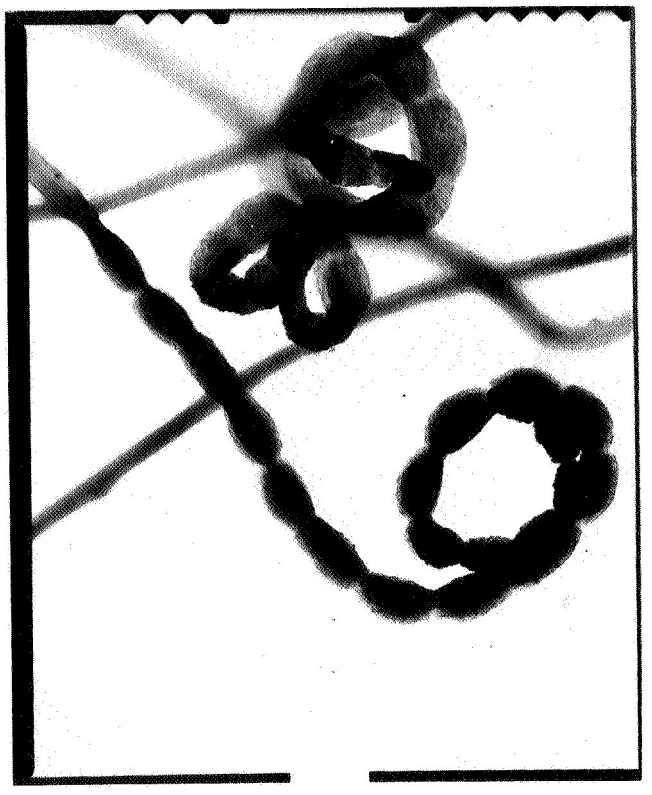
III. Spore morphology & surface: Smooth, warty, spiny, hairy

Dimensions 0.6 - 0.9 x 1.0 - 1.6 μ

Medium 4-starch agar

Age of culture 14 days

Magnification = 6990 x



Culture No. 9

JPL No. 275 Aa

Species S. albus

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	±
D-glucose	++	++
D-xylose	++	++
L-arabinose	++	++
Sucrose	+	+
D-mannitol	++	++
I-inositol	±	±
D-fructose	++	++
Rhamnose	++	++
Raffinose	±	±
Cellulose	±	±

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - negative

Medium 6 - 2 days - negative
4 days - negative

Medium 7 - 2 days - negative
4 days - negative

C. Starch hydrolysis +

Culture No. 10

JPL No. 277 Bb

Source Chile Atacama Desert

T.S.A. Invoice # D-17577

Studied by S. Nishikawa

Species Streptomyces parvulus

1. Cultural properties: Temp. 26°C

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
aerial mycelium	7	white	white	white	a → d white → gray
	14	white	white → 5 fe (few sections) → ashes	white few specks of 5 fe=ashes	a → 5 fe white → ashes
	21	white	white → 5 fe → ashes	c → 5 fe lt. gray → ashes	5 fe → ashes
substrate mycelium	7	2 ea=lt. wheat lt. maize	3 ba=pearl shell tint	2 ba=pearl shell tint	3 ba=pearl shell tint
	14	2 ga=colonial yellow maize	3 ba=pearl shell tint	2 ea=lt. wheat lt. maize	2 ea=lt. wheat lt. maize
	21	2 lc=gold	3 ba=pearl shell tint	2 ga=bamboo chamois	2 ec=biscuit ecru oatmeal sand
soluble pigment	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

Culture No. 10 · Page 44

JPL No. 277 Bb

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	none	none	none	spira
	14	none	spira	spira	spira
	21	none	spira	spira	spira-short & compact, some long
Spore Number	7	--	--	none	> 10
	14	--	> 10	>10	> 10
	21	--	> 10	> 10	> 10
Verticils	7	none	none	--	none
	14	none	none	none	none
	21	none	none	none	none

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 10

JPL No. 277 Bb

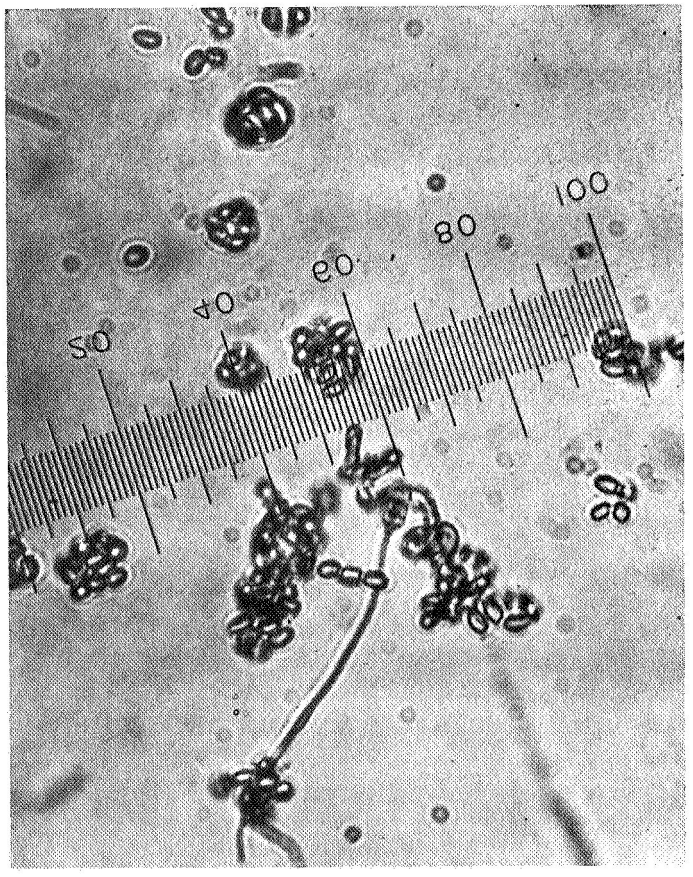
Species S. parvulus

Photographs:

Medium 5-glycerol-asparagine agar

Age of culture 21 days

Magnification 1600X



Culture No. 10

JPL No. 277 Bb

Species S. parvulus

III. Spore morphology & surface: Smooth, warty, spiny, hairy

Dimensions 0.8 - 1.0 x 1.3 - 1.5 μ

Medium 5-glycerol-asparagine agar

Age of culture 14 days

Magnification = 6990 x

Culture No. 10

JPL No. 277 Bb

Species S. parvulus

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	++	++
L-arabinose	++	++
Sucrose	±	±
D-mannitol	-	±
I-inositol	-	±
D-fructose	±	±
Rhamnose	++	++
Raffinose	-	-
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - 2 days - negative
4 days - negative

Medium 6 - 2 days - negative
4 days - negative

Medium 7 - 2 days - negative
4 days - negative

C. Starch hydrolysis +

Culture No. 11

JPL No. 278 Bc

Source Chile Atacama Desert

T.S.A. Invoice # D-;7577

Studied by S.Nishikawa

Species Streptomyces longisporuber

1. Cultural properties: Temp. 26°C

	Da.	Medium 2	CHM number and color Medium 3	Medium 4	Medium 5
aerial mycelium	7	none	white	white	white
	14	none	white	white	white
	21	white	white	a → c white → lt. gray	white
substrate mycelium	7	colorless	2 ca=lt. ivory eggshell	2 lc=gold	2 ne=mustard gold old gold
	14	colorless	2 ca=lt. ivory eggshell	2 lc=gold	2 ne=mustard gold old gold
	21	colorless	2 ca=lt. ivory eggshell	2 lc=gold	2 ne=mustard gold old gold
soluble pigment	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

Culture No. 11

JPL No. 278 Bc

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	--	rectus-flexibilis	rectus-flexibilis	rectus-flexibilis
	14	--	rectus-flexibilis	rectus-flexibilis	rectus-flexibilis
	21	rectus-flexibilis	rectus-flexibilis	rectus-flexibilis	rectus-flexibilis
Spore Number	7	--	> 10	> 10	> 10
	14	--	> 10	> 10	> 10
	21	> 10	> 10	> 10	> 10
Verticils	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 11

JPL No. 278 Bc

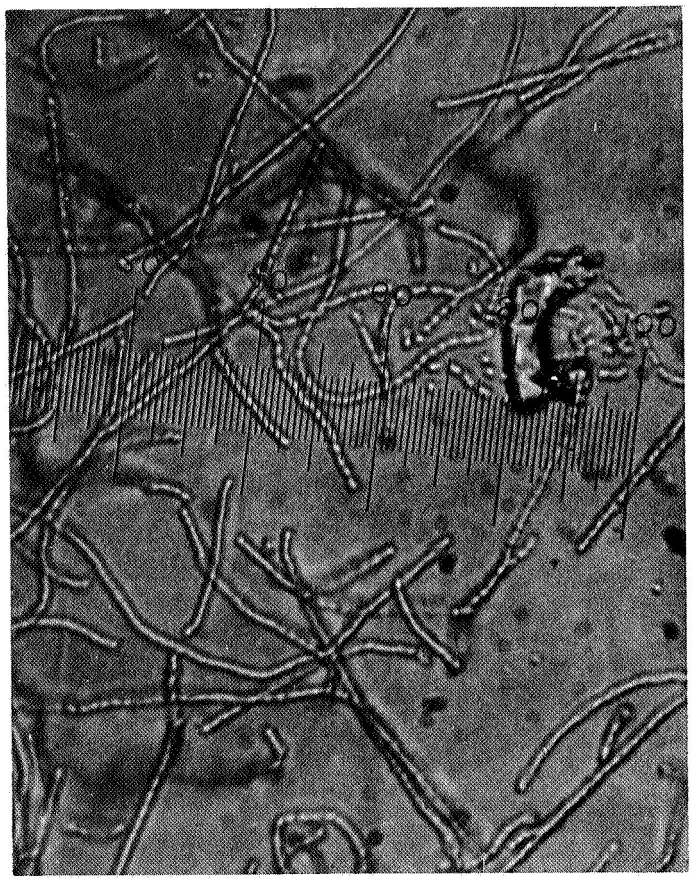
Species S. longisporuber

Photographs:

Medium 4-starch agar

Age of culture 14 days

Magnification 1600X



Culture No. 11

JPL No. 278 Bc

Species S. longisporuber

III. Spore morphology & surface: Smooth, warty, spiny, hairy

Dimensions 0.3 - 0.9 x 0.8 - 1.8 μ

Medium 4-starch agar

Age of culture 14 days

Magnification = 6990 x

Culture No. 11

JPL No. 278 Bc

Species S. longisporuber

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	++	++
L-arabinose	++	++
Sucrose	+	+
D-mannitol	+	+
I-inositol	++	++
D-fructose	++	++
Rhamnose	-	-
Raffinose	-	+
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - 2 days - positive
4 days - positive

Medium 6 - 2 days - positive
4 days - positive

Medium 7 - 2 days - negative
4 days - negative

C. Starch hydrolysis negative

Culture No. 13

JPL No. 292 Ae

Source Chile Atacama Desert

Invoice # D-00318

Studied by S. Nishikawa

Species Streptomyces olivaceus

1. Cultural properties: Temp. 26°C

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
aerial mycelium	7	none	a → b white → oyster white	white	none
	14	white (scant)	a=white	white	white (sparse)
	21	white	white	white	white
substrate mycelium	7	2 ea=lt. wheat lt. maize	2 ba=pearl shell tint	2 ba=pearl shell tint	2 ba=pearl shell tint
	14	2 ic=honey gold lt. gold	2 ca=lt, ivory eggshell	2 ea=lt. maize lt. wheat	2 ca=lt, ivory eggshell
	21	2 ea=lt. wheat lt. maize	2 ca=lt. ivory eggshell	2 ca=lt, ivory eggshell	2 ca=lt, ivory eggshell
soluble pigment	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

Culture No. 13

JPL No. 292 Ae

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	--	--	--	--
	14	--	--	--	--
	21	--	--	--	--
	45	--	rectus-flexibilis	rectus-flexibilis	rectus-flexibilis
Spore Number	7	--	--	--	--
	14	--	--	--	--
	21	--	--	--	--
	45	--	> 10	> 10	> 10
Verticilis	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

10 da culture on oatmeal agar.

Culture No. 13

JPL No. 292 Ae

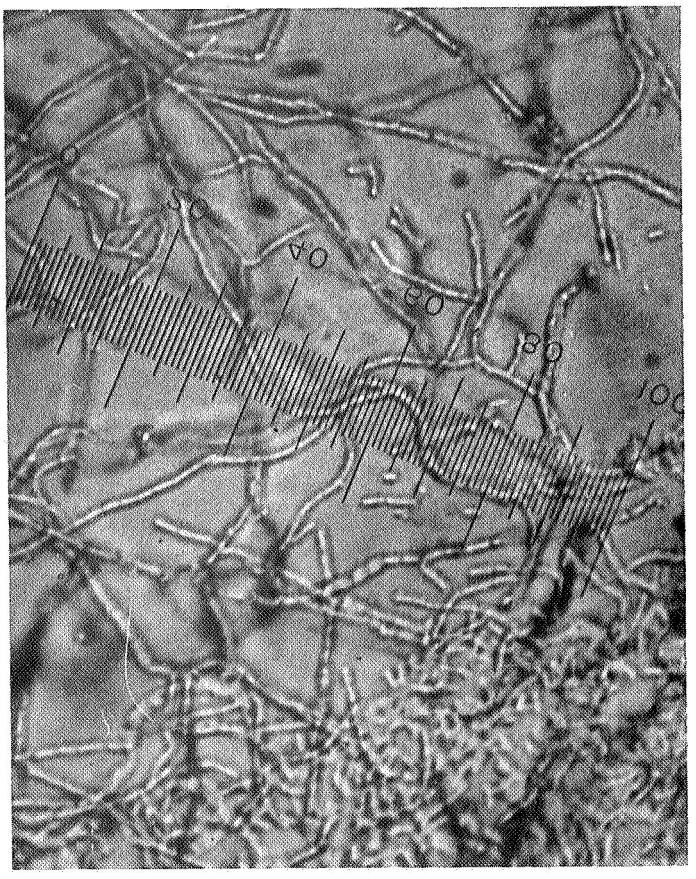
Species S. olivaceus

Photographs:

Medium 4-starch agar

Age of culture 45 days

Magnification 1600X



Culture No. 13

JPL No. 292 Ae

Species S. olivaceus

III. Spore morphology & surface: Smooth, warty, spiny, hairy

Dimensions 0.5 - 1.1 - 2.4 μ

Medium 4-starch agar

Age of culture 45 days

Magnification = 6990×

Culture No. 13

JPL No. 292 Ae

Species S. olivaceus

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	++	++
L-arabinose	++	++
Sucrose	++	++
D-mannitol	++	++
I-inositol	±	++
D-fructose	++	++
Rhamnose	-	-
Raffinose	-	±
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - 2 days - negative
4 days - negative

Medium 6 - 2 days - negative
4 days - negative

Medium 7 - 2 days - negative
4 days - negative

C. Starch hydrolysis +

Culture No. 15

JPL No. 292 Bd

Source Chile Atacama Desert

Invoice # D-00318

Studied by S. Nishikawa

Species Streptomyces olivaceus

1. Cultural properties: Temp. 26°C

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
aerial mycelium	7	white	white	white	white
	14	white	white	white	white
	21	white	white	b=oyster white	white
substrate mycelium	7	2ga=colonial yellow maize	2ba=pearl shell tint	2ca=lt. ivory eggshell	2ea=lt. wheat lt. maize
	14	2ga=colonial yellow maize	2ba=pearl shell tint	2ga=colonial yellow maize	2ga=colonial yellow maize
	21	2ga=colonial yellow maize	2ba=pearl shell tint	2ga=colonial yellow maize	2ga=colonial yellow maize
soluble pigment	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

Culture No. 15

JPL No. 292 Bd

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	rectus-flexibilis	rectus-flexibilis	rectus-flexibilis	--
	14	rectus-flexibilis	rectus-flexibilis	rectus-flexibilis	rectus-flexibilis
	21	rectus-flexibilis	rectus-flexibilis	rectus-flexibilis	rectus-flexibilis
Spore Number	7	> 10	> 10	> 10	--
	14	> 10	> 10	> 10	≤ 10
	21	> 10	> 10	> 10	> 10
Verticils	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 15

JPL No. 292 Bd

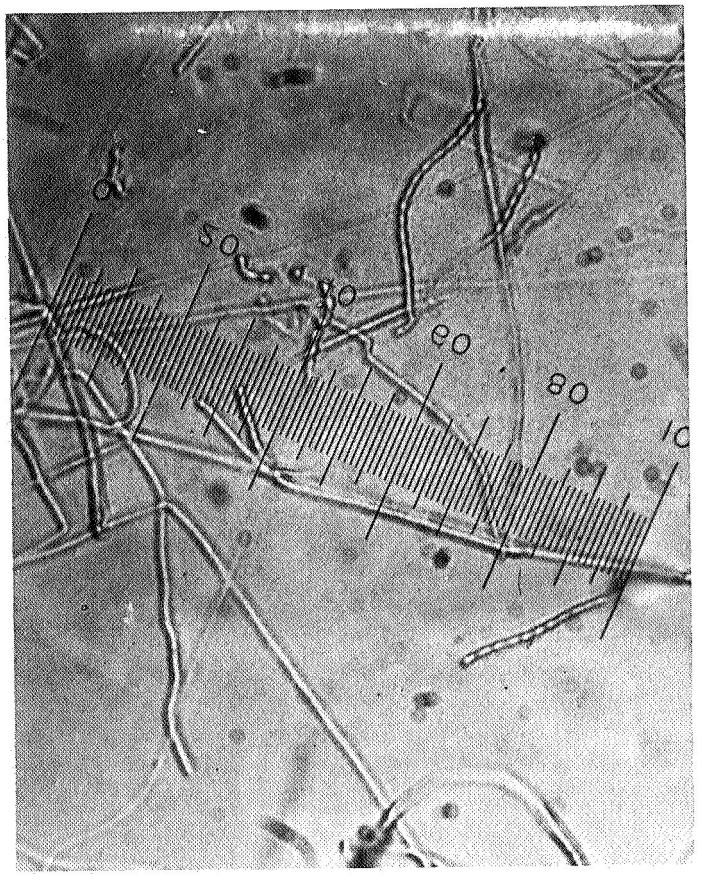
Species S. olivaceus

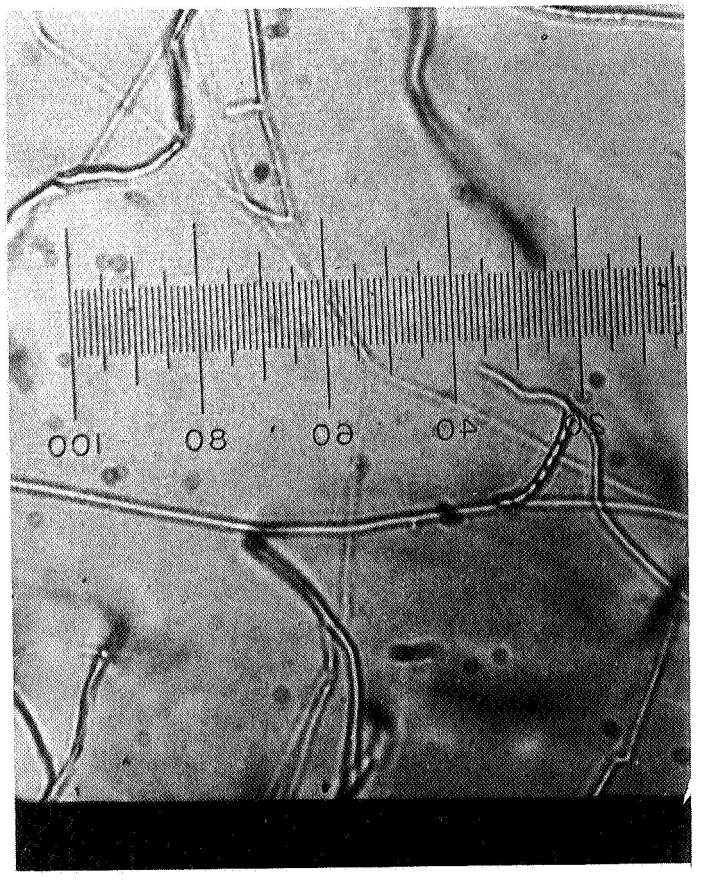
Photographs:

Medium 3-oatmeal agar

Age of culture 14 days

Magnification 1600X





Culture No. 15

JPL No. 292 Bd

Species S. olivaceus

III. Spore morphology & surface: Smooth, warty, spiny, hairy

Dimensions 0.4 - 0.6 x 1.3 - 1.7 μ

Medium 3-oatmeal agar

Age of culture 14 days

Magnification = 6990 x

Culture No. 15 Page 62

JPL No. 292 Bd

Species S. olivaceus

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	+	++
L-arabinose	++	++
Sucrose	-	-
D-mannitol	-	-
I-inositol	+	++
D-fructose	++	++
Rhamnose	+	++
Raffinose	-	-
Cellulose	±	±

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - 2 days - negative
4 days - negative

Medium 6 - 2 days - negative
4 days - negative

Medium 7 - 2 days - negative
4 days - negative

C. Starch hydrolysis +

Culture No. 16

JPL No. 292 Be

Source Chile Atacama Desert

Invoice # D-00318

Studied by S. Nishikawa

Species Streptomyces olivaceus

1. Cultural properties: Temp. 26°C

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
aerial mycelium	7	none	none	none	none
	14	white (sparse)	white (sparse)	white (sparse)	white (sparse)
	21	white (sparse)	white (sparse)	white (sparse)	white (sparse)
substrate mycelium	7	2ea=lt. wheat lt. maize	2ba=pearl shell tint	2ba=pearl shell tint	2ba=pearl shell tint
	14	2ea=lt. wheat lt. maize	2ba=pearl shell tint	2ba=pearl shell tint	2ba=pearl shell tint
	21	2ea=lt. wheat lt. maize	2ba=pearl shell tint	2ba=pearl shell tint	2ba=pearl shell tint
soluble pigment	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

Culture No. 16 Page 64

JPL No. 292 Be

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	--	--	--	--
	14	rectus-flexibilis	rectus	rectus-flexibilis	rectus
	21	rectus-flexibilis	rectus-flexibilis	rectus-flexibilis	rectus-flexibilis
Spore Number	7	--	--	--	--
	14	> 10	3-10 > 10	> 10	< 10
	21	> 10	> 10	> 10	> 10
Verticils	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

14 da oatmeal, starch, and glycerol-asparagine agar plates.

Culture No. 16

JPL No. 292 Be

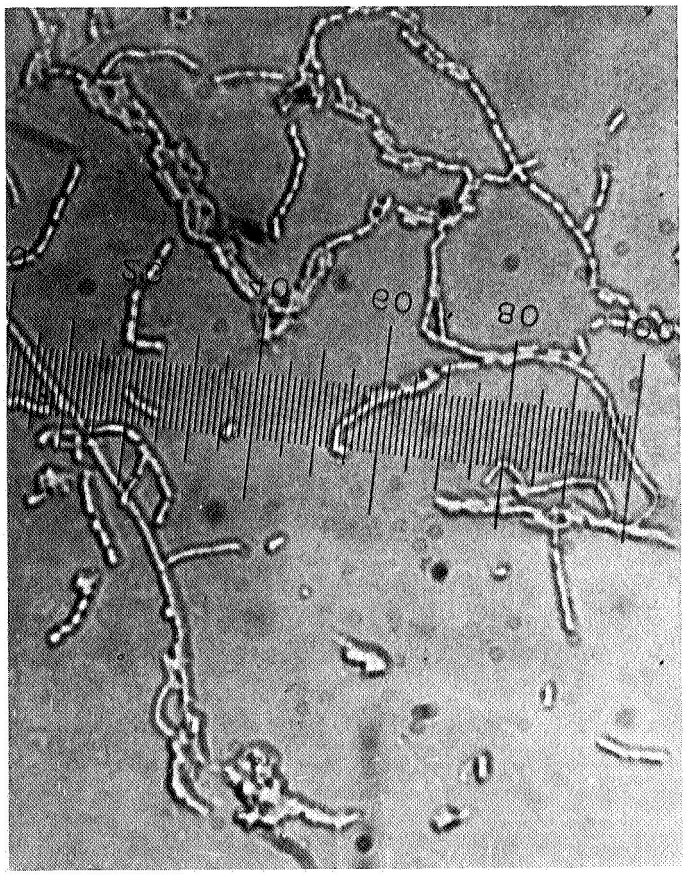
Species S. olivaceus

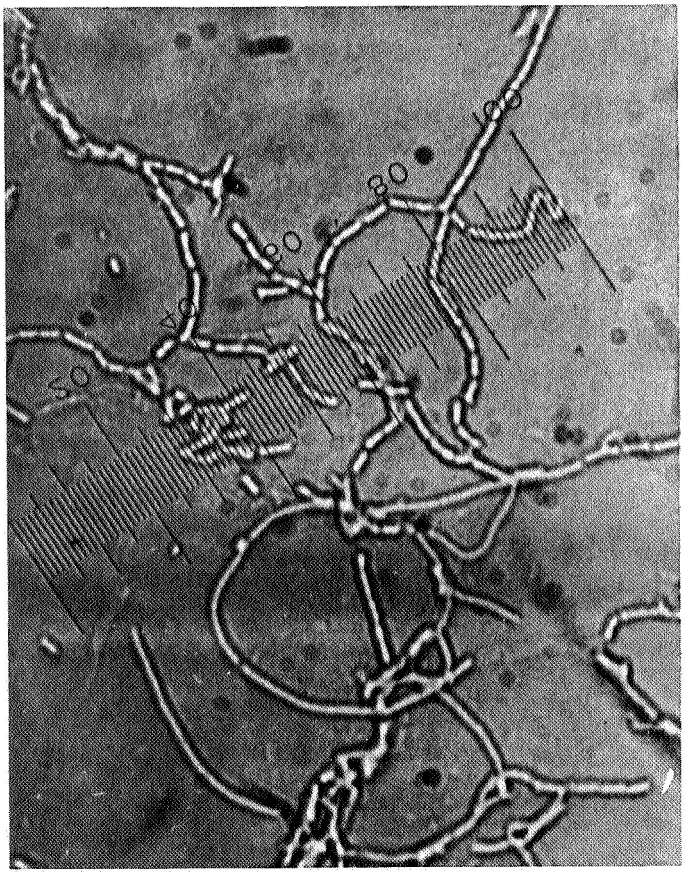
Photographs:

Medium 4-starch agar

Age of culture 14 days

Magnification 1600X





Culture No. 16 Page 66

JPL No. 292 Be

Species S. olivaceus

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	++	++
L-arabinose	++	++
Sucrose	++	++
D-mannitol	++	++
I-inositol	++	++
D-fructose	++	++
Rhamnose	-	-
Raffinose	-	±
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 – 2 days - negative
4 days - negative

Medium 6 – 2 days - negative
4 days - negative

Medium 7 – 2 days - negative
4 days - negative

C. Starch hydrolysis +

Culture No. 17

JPL No. 292 Bf

Source Chile Atacama Desert

Invoice # D-00318

Studied by S. Nishikawa

Species Streptomyces olivaceus

1. Cultural properties: Temp. 26°C

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
aerial mycelium	7	none	white (scant)	white	white (scant)
	14	white	white (scant)	white	white
	21	white	white	white	white
substrate mycelium	7	2ea=lt. wheat lt. maize	2ea=lt. ivory eggshell	2ba=pearl shell tint	2ba=pearl shell tint
	14	2ea=lt. wheat lt. maize	2ca=lt. ivory eggshell	2ba=pearl shell tint	2ca=lt. ivory eggshell
	21	2ea=lt. wheat lt. maize	2ca=lt. ivory eggshell	2ba=pearl shell tint	2ca=lt. ivory eggshell
soluble pigment	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

Culture No. 17 Page 68

JPL No. 292 Bf

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	--	--	--	--
	14	--	--	--	rectus-flexibilis (fragmented mycelia)
	21	--	--	rectus-(like thin rods in chains)	rectus
Spore Number	7	--	--	--	--
	14	--	--	--	> 10
	21	--	--	> 10	> 10
Verticils	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none

special observations: e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 17

JPL No. 292 Bf

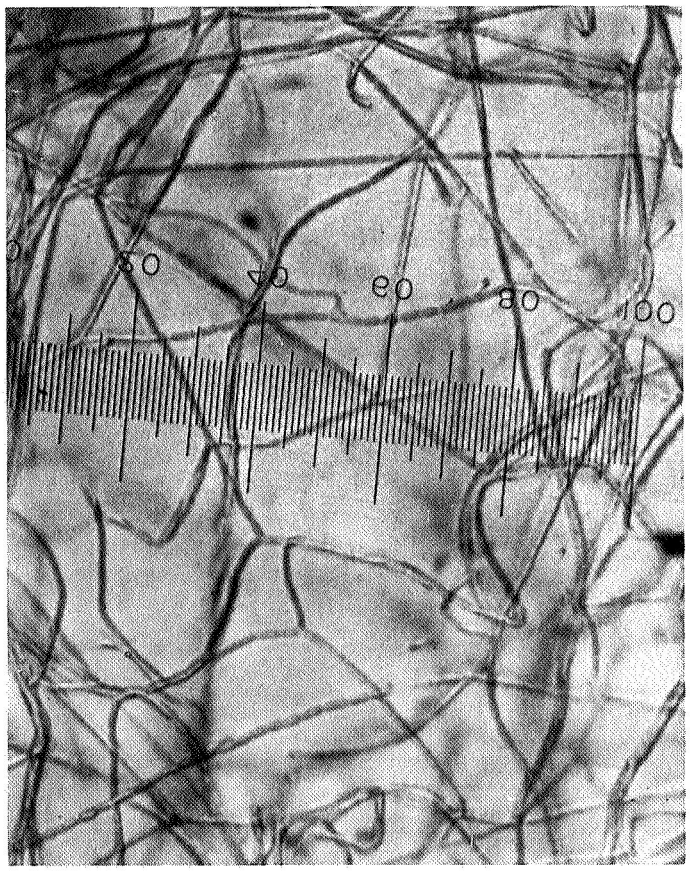
Species S. olivaceus

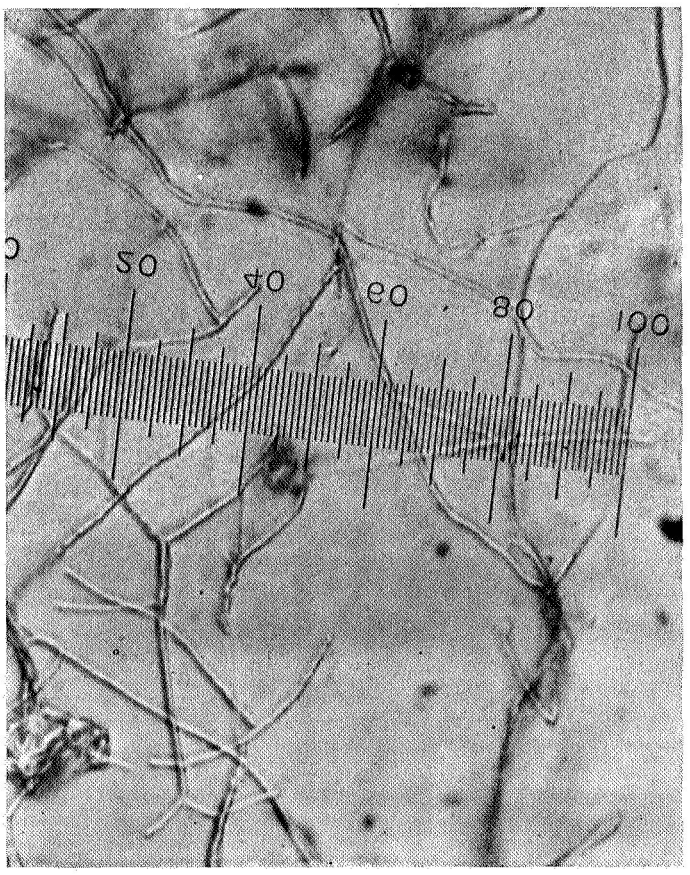
Photographs:

Medium 5-glycerol-asparagine agar

Age of culture 21 days

Magnification 1600X





Culture NO. 17

JPL No. 292 Bf

Species S. olivaceus

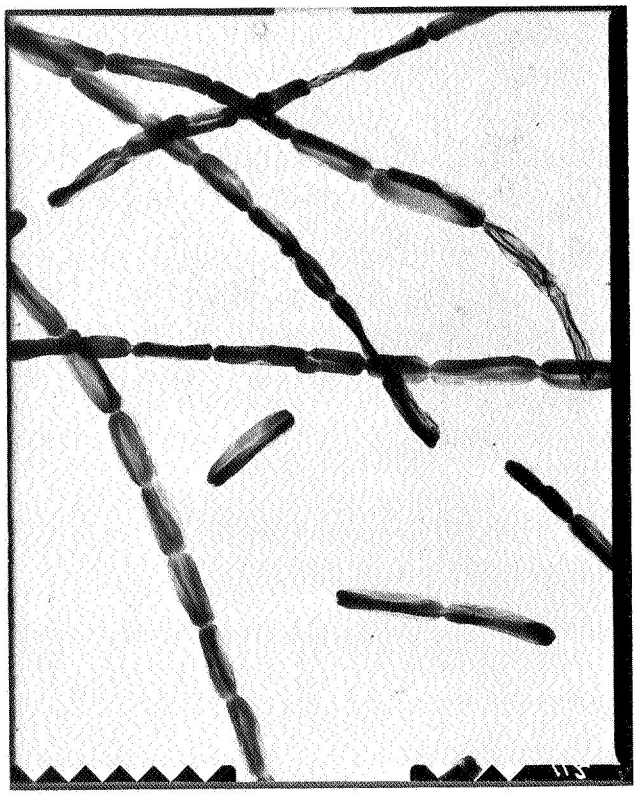
III. Spore morphology & surface: Smooth, warty, spiny, hairy

Dimensions 0.2 - 0.5 x 1.2 - 2.6 μ

Medium 5-glycerol-asparagine agar

Age of culture 21 days

Magnification = 6990x



Culture No. 17

JPL No. 292 Bf

Species S. olivaceus

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	++	++
L-arabinose	++	++
Sucrose	+	++
D-mannitol	++	++
I-inositol	++	++
D-fructose	++	++
Rhamnose	-	-
Raffinose	-	-
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - **negative**

Medium 6 - **negative**

Medium 7 - **negative**

C. Starch hydrolysis +

Culture No. 19 Source Wyoming

JPL No. 310 Ab T.S.A. Invoice # C-90054

Studied by S. Nishikawa

Species not determinable (no spores produced)

1. Cultural properties: Temp. 26

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
Aerial mycelium	7	3ec = Bisque Lt. beige (sparse)	a = white (sparse)	a = white	none
	14	3dc = Natural (sparse)	a = white (sparse)	3ba = Pearl Shell tint	none
	21	3cb = Sand (sparse)	a = white (sparse)	a = white ↓ b = oyster white	a = white (sparse)
Substrate mycelium	7	4ng = Lt. brown Saddle tan Maple	2ea = Lt. wheat Lt. maize	2ga = Colonial yellow Maize	2ea = Lt. wheat Lt. maize
	14	4ng = Lt. brown Saddle tan Maple	2ic = Honey gold Lt. gold	3gc = Lt. tan	2ic = Honey gold Lt. gold
	21	4ng = Lt. brown Saddle tan Maple	2ne = Mustard gold Old gold	3ne = Topaz Butter-scotch	3ne = Topaz Butter-scotch
Soluble pigment	7	none	none	none	none
	14	4ne = Luggage tan	none	none	none
	21	4ne = Luggage tan	none	none	none

Culture No. 19 Page 73

JPL No. 310 Ab

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	7	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none
Spore No.	7	--	--	--	--
	14	--	--	--	--
	21	--	--	--	--
Verticil	7	--	--	--	--
	14	--	--	--	--
	21	--	--	--	--

special observations: None observed.
e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 19

JPL No. 310 Ab

Species not determinable

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	+	+
L-arabinose	-	-
Sucrose	-	-
D-mannitol	++	++
I-inositol	++	++
D-fructose	++	++
Rhamnose	-	-
Raffinose	++	++
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - 2 da - positive
4 da - positive

Medium 6 - 2 da - no growth
4 da - no growth

Medium 7 - 2 da - positive
4 da - positive

C. Starch hydrolysis

positive

Culture No. 20 Source Wyoming

JPL No. 313 - 1 Ab T.S.A. Invoice # C-90054

Studied by S. Nishikawa

Species not determinable (no spores produced)

1. Cultural properties: Temp. 26

	Da.	CHM number and color			
		Medium 2	Medium 3	Medium 4	Medium 5
Aerial mycelium	10	none	none	none	c = light gray
	14	b = oyster white ↓ g = gray	b = oyster white (sparse)	c = light gray (sparse)	b = oyster white ↓ c = gray
	21	c = gray (sparse)	c = gray (sparse)	c = light gray (sparse)	c = gray
Substrate mycelium	10	2ne = mustard gold Old gold ↓ 2pg = mustard gold	2gc = Bamboo chamois ↓ 2ie = Lt. mustard tan	2ge = covert tan Griege ↓ 2pi = mustard brown	7 po
	14	2ng = dull gold	2le = mustard old gold	2pl = mustard brown	7 po
	21	3pg = golden brown ↓ 3pl = clove brown deep brown	2le = mustard old gold	2pg = mustard gold ↓ 2pl = mustard brown	7 po
Soluble pigment	10	none	none	none	none
	14	none	none	none	3le = cinnamon yellow maple
	21	4gc = Nude tan Rose beige	none	3gc = Lt. tan	3lc = Amber Butter-scotch

Culture No. 20 Page 75

JPL No. 313 - 1 Ab

II. Morphological observations

	Da.	Medium 2	Medium 3	Medium 4	Medium 5
Sporophore	10	none	none	none	none
	14	none	none	none	none
	21	none	none	none	none
	35	none	none	none	none
Spore No.	10	--	--	--	--
	14	--	--	--	--
	21	--	--	--	--
	35	--	--	--	--
Verticils	10	--	--	--	--
	14	--	--	--	--
	21	--	--	--	--

special observations: None observed.
e.g. globular sporangia; flagellated spores; spores on substrate hyphae; mycelia fragmentation; schlerotia.

Culture No. 20 Page 79

JPL No. 313 - 1 Ab

Species not determinable

IV. Physiological characteristics

A. Carbohydrate utilization

Carbohydrate	Growth After 10 days	Growth After 16 days
Negative control	-	-
D-glucose	++	++
D-xylose	±	±
L-arabinose	++	++
Sucrose	++	++
D-mannitol	±	±
I-inositol	+	+
D-fructose	+	+
Rhamnose	±	±
Raffinose	-	-
Cellulose	-	-

(++) = Strongly positive utilization. Growth equal to or greater than glucose growth.

(+) = Positive utilization. Growth is significantly better than on basal medium without carbon but less than on glucose.

(±) = Utilization doubtful. Growth slightly better than on basal medium without carbon but significantly less than with glucose.

(-) = Growth similar to or less than growth on basal medium without carbon.

B. Melanin production

Medium 1 - 2 da - negative
4 da - negative

Medium 6 - 2 da - negative
4 da - negative

Medium 7 - 2 da - negative
4 da - negative

C. Starch hydrolysis

positive