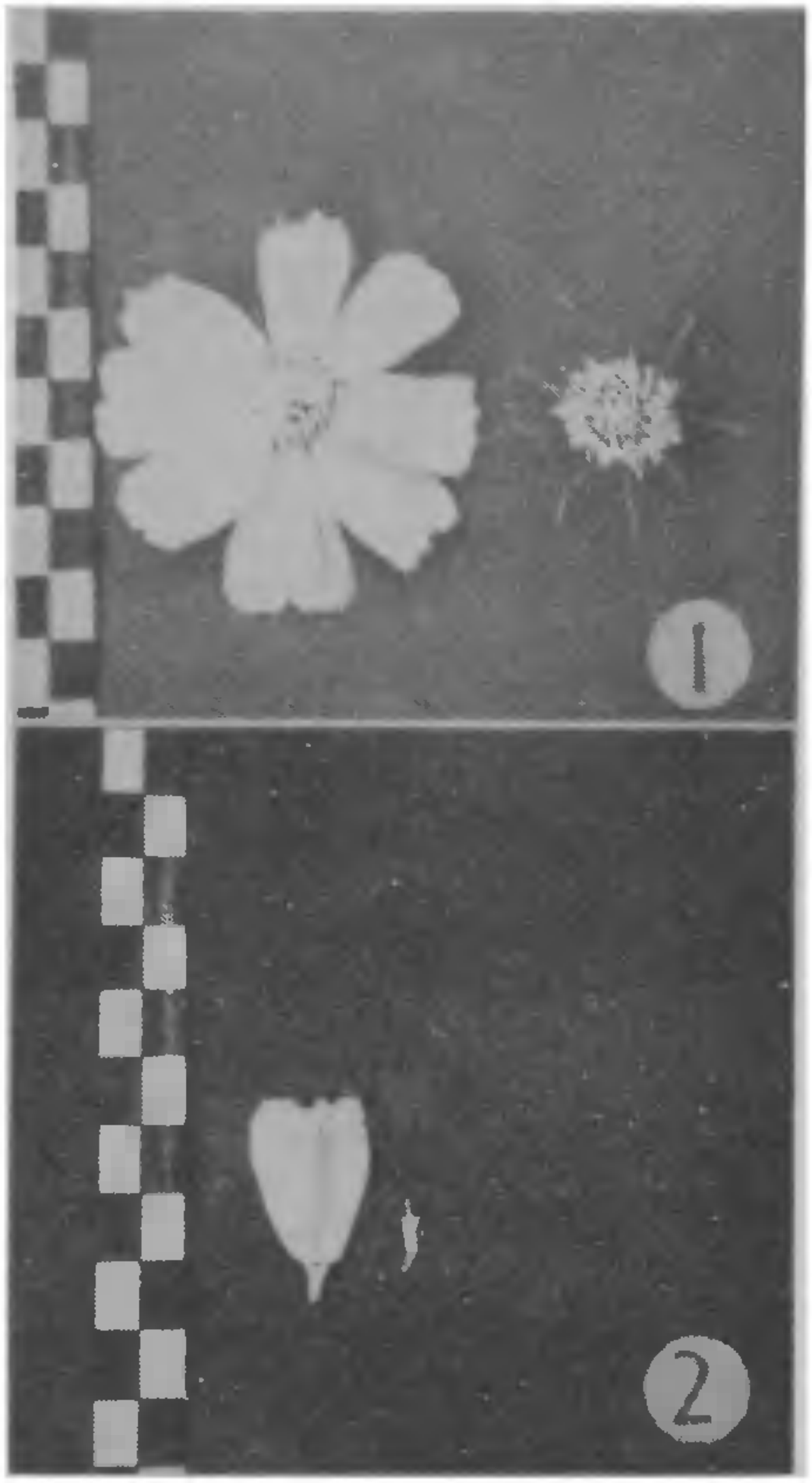
In a population of 100 plants grown at the Nagarjuna University, Botanic garden, two abnormal plants showing the absence of ray florets in all the inflorescences could be located (figure 1). These are similar to their sibs in leaf characters but differ in other parameters (table 1). The capitulum diameter, size of the floret of the outermost whorl and percent seed set are drastically reduced (figure 2, table 1). The disc florets of the mutant are similar in all respects to the normal ones. However, when carefully examined the outer florets of the mutant exhibits a slight tinge of purple and a slight increase in size thereby indicating that the ray florets during ontogeny converted themselves into discs.

TABLE 1

Morphometrics of the control and mutant plants of Cosmos bipinnatus Cav.

Character	Control	Mutant
Height (cm)	180	185
Pedicel length (cm)	11.3	15
Capitulum diameter (cm)	4.28	1.6
Floret size in the outer most whorl (cm)	2.6 × 1.2	1 × 0.4
Disc floret size (cm)	1.2 × 0.1	1.28 × 0.15
% Seed set	8.4	2.63

All measurements are the averages of ten except the height of the mutant plant which is an average of two plants.



Figures 1&2. **1.** Inflorescences of the normal and mutant *Cosmos*. **2.** Florets of the outermost whorl of normal and mutant heads.

Cytological studies of the normal and mutant plants revealed normal meiosis with regular formation of 12 bivalents as recorded by earlier workers[1,2] and 100% pollen fertility. Because of the absence of detectable chromosomal abnormalities and heritability of the character, the abnormality can be ascribed to gene mutation/mutations, which are helpful in bringing out the diversification of the species. The observations further indicate that there is a reversal from derived unisexual condition to bisexual state making the head homogamous. Hence, the present teratological condition in all probability represents an atavistic tendency.

The authors are grateful to Prof. A. S. Rao, Head of the Department of Botany for facilities. One of us (ZV) is thankful to the UGC for a fellowship.

21 June 1982

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HYDROCARBON UTILIZATION BY *AEROMONAS, ARTHROBACTER, BREVIBACTERIUM, CORYNEBACTERIUM, MICROCOCCUS, MYCOBACTERIUM, NOCARDIA* AND *SERRATIA* SPP.

BIDYA B. GHOSH* AND A. K. BANERJEE
Department of Botany, Burdwan University, Burdwan 713 104, India.
*Present address: Lecturer, Kalimpong College, Kalimpong, Darjeeling 734 301.

MORPHOLOGICAL, cultural and biochemical characteristics of 10 bacterial isolates capable of utilizing

hydrocarbons as sole source of carbon, reveal that 2 isolates belong to genus *Arthrobacter*, 2 to *Nocardia* and one each to *Aeromonas*, *Brevibacterium*, *Corynebacterium*, *Micrococcus*, *Mycobacterium* and *Serratia*. The isolates are studied for biomass formation in kerosene oil specificities for petroleum hydrocarbons and fermentation of kerosene by a *Arthrobacter* sp. The hydrocarbon utilizing ability of the strain *Aeromonas* is not known previously.

A large number of bacterial isolates capable of utilizing petroleum hydrocarbons as sole carbon source have been isolated during the extensive screening programme. The present communication describes the morphological, cultural and biochemical characteristics as well as the growth characteristics on hydrocarbons of 10 bacterial isolates belonging to 8 genera. Bacterial cultures were isolated (by enrichment technique using a mixture of diesel and kerosene (50:50) as sole carbon source in a synthetic medium[1]) from the soil samples collected from different districts of West Bengal. The isolates were studied for their morphological, cultural and biochemical characteristics using standard methods[2] and identified upto the genus level[3]. Methodology for studying the growth on hydrocarbons in shake flasks, cultural conditions, harvesting of cell mass, etc. were described earlier[4].

Morphological, cultural and biochemical properties:

Cells were gram positive except for strains B146 and B245, non-spore forming, non-capsulated, aerobic, rods except for strain D104, able to grow at 20 and 37° C. Their optimum temperature for growth was 35° C for strains B146, D104 and M04, 32° C for B010, H12, H14 and M68 and 30° C for B062, B226 and B245. Almost spherical cells of D104 were single or in pair or in irregular grouping. Cells of strains B010 and B226 were short or long, straight or curved rods, branched, branches rudimentary, old rods fragments into short rods. Cells in old cultures of B062 and H14 were cocci, cocci germinate into rods, straight or curved rods grew in angles in one or more points from the cocci, young cultures composed of rods only, rods broken into cocci when grew old and followed a definite growth cycle from cocci to rods and again cocci. Cells of M68 were single, aggregated in palisade or chinese letter form. Straight or curved rods of M04 and H12 were single or in chains, unbranched. Two strains M04 and B226 were acid fast positive. Except B010, B062, H14 and M68 all strains were uniformly stainable in carbol-fuchsin strain. All the strains were non-motile except for strains B146 and B245.

Strains produced circular, entire margined, opaque, lare, non-adherent, raised colonies except B226 and B245 which were small, punctiform and strain B146 produce transluscent, smooth and mucoid colonies. Except strains of D104 and M04 rest of the strains had rough surfaced colonies. Non-diffusible chromogenesis produced by the strains were magenta red by B245, reddish gray by M68, red by B226 and reddish brown by H14; white to gray by B010, B062, D104, H12 and M04. The colony of strain B146 was colourless but diffuse bluish green fluorescent colour in the medium. Agar strokes of the strains were abandunt and viscid excpet for membranous growth of strains B146, B245 and M68. The type of growth on agar strokes was beaded for B010, B062, B226, H12 and H14; echinulate for strains B146, M04 and M68 and filiform for rest of the strains. During in growth in nutrient broth the strains B010, B062, B146, B226, D104 and M68 formed pellicle and H12 ring on the top; no surface growth in B245 and M04, abundant sedimentation in H12, H14 and M68, membranous growth only in H14 occured. All the strains grew abundantly on potato plugs except B245 and D104 and no growth took place in strains of B146 and M104.

Test for indole production, methyl red reaction, and voges proskauer reaction were negative for all the strains except VP positive strains of B146, H12 and H14; positive catalase test, urease test, nitrate reduction and gelatin liquifaction were shown by all the strains except the strains B245 and M68 did not produce urease, B010, H14 and M68 did not reduce nitrate, and strins B226, H12, H14, M04 and M68 did not liquify gelatin. Starch hydrolysed by the strains of B245, D104, H12, H14 and M68. No change took place in litmus milk by strains of B010, H12, M04 and M68; LM coagulated by strains of B146, B245 and D104; acidic reaction produced by B245; peptonized by B062, B226 and H12; reduced by B062, B146 and H12. No gas was produced by the strains of cultures from arabinose, glucose, fructose, galactose, lactose, sucrose, maltose, starch, mannitol and inositol; acid produced from arabinose only by the strain of B146, from glucose and fructose by all strains except B062 and M04 from glucose and H12 from fructose; acid was produced from galactose, lactose and sucrose by strains of B146, H14 and M68; from galactose by B226 and D104; from lactose by B245 and from sucrose by B010, B062, B226 and B245. Acid was not produced from maltose by B062, D104 and M04. Acid was produced from starch by D104 and H12; from mannitol by B010, B062, B146, H14 and M68, and from inositol by B146, H14 and M68. The cell size and identification of the isolates are depicted in table 1 below.

Growth on kerosene oil:

The strains were grown in shake flasks in the medium (loc. cit) containing 2% kerosene at optimum temperature and the growth was classified in various categories. The results are depicted in table 1. *Arthrobacter* sp. B062 showed highest growth on kerosene and the degree of kerosene utilization was different for all the strains.

TABLE 1

Cell size of isolates and their growth on kerosene

Strains	Identified as	Cell size (Um)	Growth on kerosene
B010	*Nocardia sp.*	1.0–7.0 × 0.4–0.6	+ + +
B062	*Arthrobacter sp.*	1.4–4.2 × 0.7–0.8 and 0.5 × 0.8	+ + + +
B146	*Aeromonas sp.*	1.4–2.1 × 0.5–0.7	+
B226	*Nocardia sp.*	1.5–7.0 × 0.4–0.6	+ +
B245	*Serratia sp.*	0.3–0.4 × 1.4–2.2	+
D104	*Micrococcus sp.*	1.9 × 1.4–1.9	+ +
H12	*Brevibacterium sp.*	2.4–3.8 × 0.4–0.8	+ + +
H14	*Arthrobacter sp.*	1.0–4.2 × 0.7–0.8 and 0.7 × 1.0	+ + +
M04	*Mycobacterium sp.*	1.4–7.0 × 0.5–0.8	+ +
M68	*Corynebacterium sp.*	2.3–2.5 × 0.4–0.7	+ +

+ , definite growth; + +, good growth, + + + , better growth; + + + +, best growth.

TABLE 2

Substrate specificity of isolates for hydrocarbons

Strains	*n*-Hexane	*n*-Heptane	*n*-Octane	*n*-Decane	*n*-Tetra-decane	*n1-Hexa-*decane	*n*-Octa-decane	*n*-Cyclo-hexane	Phenol
B010	—	—	—	—	+ +	+ + +	+ + +	—	—
B062	+	+	+	+ +	+ + + +	+ + + +	+ + + +	—	—
B146	+	+	+	+	+	+	+	+	—
B226	—	—	—	—	+ +	+ + +	+ + +	—	—
B245	—	—	—	—	+	+ +	+ +	—	—
D104	±	±	±	±	+ +	+ +	+ +	—	—
H12	±	±	±	+	+ + +	+ + + +	+ + + +	—	—
H14	—	—	—	+	+ + +	+ + +	+ + +	—	—
M04	—	—	—	+	+ +	+ +	+ +	±	±
M68	—	—	—	—	+	+ +	+ +	—	—

—, no growth; ± , doubtful growth; + , definite growth; + + , good growth; + + + , better growth; + + + +, best growth.

Substrate specificity for hydrocarbons:

The studies were performed in shake flasks at optinum temperature for 72 hr and the results are given in able 2. The strains showed a wide range of substrate pecificity for the members of the hydrocarbons ested. B062 was selected and studied further on series of *n*-alkanes and mixed hydrocarbons (table 3). The train showd highest biomass formation on *n*-iexadecane and *n*-octadecane and among the mixed ıydrocarbons tested kerosene supported best growth of the strain. In general strain B062 grew better on long chain *n*-alkanes as compared to the short chain ones.

For comparatively low cost of kerosene and for easy recovery of the cells from fermented broth by solvent treatment[4] and also for the best growth of the organism in kerosene, the substrate was selected for large scale production of cells. The cells contain a high amount of protein (69%) and a favourable profile of essential amino acids as reported earlier[5].

TABLE 3

Substrate specificity of Arthrobacter sp. B062 for hydrocarbons

Substrates	Dry biomass (g/litre)	Substrates	Dry biomass (g/litre)
n-Decane	0.7	*n*-Hexadecane	2.61
n-Undecane	1.45	*n*-Octadecane	2.62
n-Dodecane	1.52	Kerosene	2.58
n-Tridecane	1.78	Diesel	2.55
n-Tetradecane	2.45	Straight run gas oil	1.05

The abilities of strains of the genus *Arthrobacter* to utilize petroleum hydrocarbons is well known[6,7]. However, reports on the strains of the genera *Aeromonas* and *Serratia* to utilize petroleum hydrocarbons are scanty in literature, particularly, the utilization of petroleum hydrocarbons as sole source of carbon and energy by the strain of the genus *Aeromonas* was not previously known.

13 April 1982

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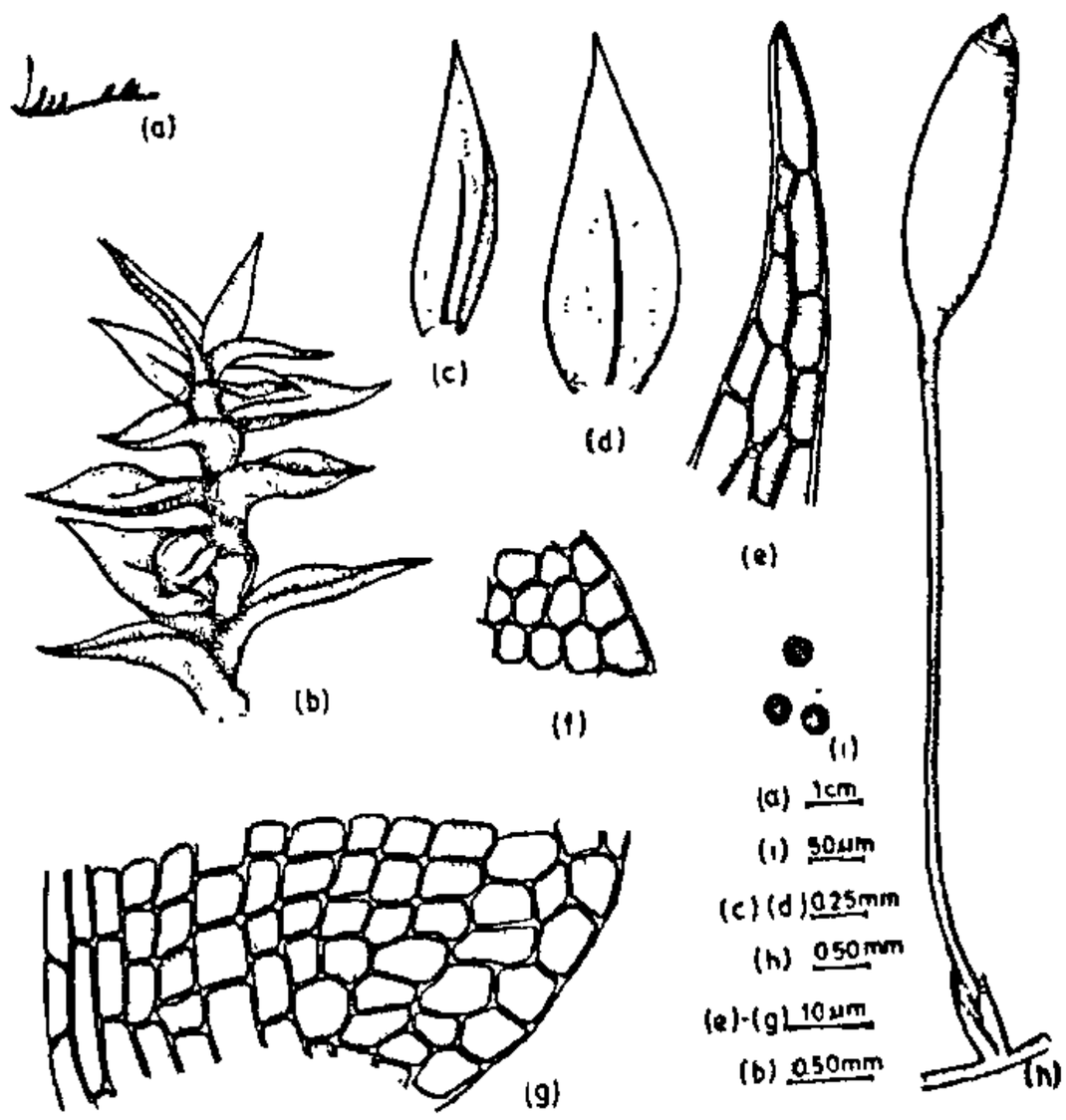
REGMATODON DECLINATUS (HOOK.) BRID.—A NEW RECORD FOR THE NORTH-WESTERN HIMALAYA, INDIA

B. D. VASHISTHA AND R. N. CHOPRA
Department of Botany, University of Delhi, Delhi 110 007, India.

DURING a plant collection trip to Himachal Pradesh, India, in October 1981, one species of *Regmatodon* (Leskeaceae) was collected from a temperate, evergreen, coniferous forest near Manali (c. 2000 m alt.). Subsequently, the species was identified as *R. declinatus* (Hook.) Brid. It is the first record of this species from North-western Himalaya. The morphological features are given below:

The light green plants grow in loose tufts. The main stem is creeping and gives rise to erect branches (figure 1a). The latter are less than 1.5 cm tall. Leaves are dense, imbricate, appressed to the stem in dry condition but erectopatent when moist (figure 1b). These are slightly concave (figure 1c), ovateapiculate (figure 1d), ± 1.5 mm long and ± 0.6 mm wide with entire margin. The costa is single and covers more than half the length. Leaf cells are incrassate and variable in shape (figures 1e-g). Seta arises from lateral perichaetial buds (figure 1h). It is ± 0.9 cm long and is rough, especially below the capsule. Capsule is erect, ovate-cylindrical, ± 2.25 mm long and ± 0.95 mm in diameter. Peristome is double and is deeply inserted. Endostome is much larger than exostome. Spores are brown, round, coarsely papillose with average diameter 26 μm (figure 1i).



Figures 1a-i. *Regmatodon declinatus* (Hook.) Brid. (**a**) Dry plant; (**b**) Portion of a wet plant; (**c,d**) Lateral and surface view of leaf; (**e**) Leaf apex; (**f,g**) Cells from middle margin, and base; (**h**) Portion of gametophyte with sporophyte; (**i**) Spores.

The genus *Regmatodon* with 14 valid species forms a tropical belt round the globe. As per published records this taxon is represented in India by four