Journal of Alloys and Compounds 858 (2021) 157732

Contents lists available at ScienceDirect

Journal of Alloys and Compounds

journal homepage: http://www.elsevier.com/locate/jalcom

Grain size mediated electrical and thermoelectric performances of mechanically alloyed Sb_2Te_3 nanoparticles

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ARTICLE INFO

Article history:
Received 18 September 2020
Received in revised form
21 October 2020
Accepted 25 October 2020
Available online 26 October 2020

Keywords:
Thermoelectric materials
Mechanical alloying
Sintering
Microstructure
X-ray diffraction
Thermoelectric properties

ABSTRACT

Antimony telluride (Sb_2Te_3) nanoparticles of different sizes were fabricated by mechanical alloying (MA) of elemental Sb and Te powers for different durations. The powder nanostructures were pelletized, annealed in Ar ambient, and characterized by XRD, FESEM, TEM to study the effect of milling time and thermal treatment on particle size, grain growth, and crystallinity. The annealed and unannealed pelletized nanostructures were analyzed in a PPMS to study the effect of grain growth on their electrical and thermoelectric properties. Room temperature electrical conductivity of the p-type semiconductor nanostructures improved significantly (from ~10^3 to ~ 10^5 mho/m) due to thermal annealing and results in the considerable improvement in thermoelectric figure of merit (ZT). Thermal annealing-induced grain growth also transforms the semiconducting nature of the sample to metallic. The reduced thermal conductivity of the nanostructures with reduced grain size improves the ZT. The temperature-dependent Lorenz number ($L_{effective}$) is used to find the electronic contribution of total thermal conductivity, and it is explained by the non-parabolic Kane model.

1. Introduction

Thermoelectric materials are efficient converters of waste heat into useable electrical energy due to their high Seebeck coefficients [1,2]. Thermoelectric figure of merit ZT defines the performance of a thermoelectric material in converting thermal energy to electricity. The ZT is defined as, $ZT = S^2\sigma T/K$, where S,σ, and K represent the Seebeck coefficient, electrical conductivity, the thermal conductivity of the material, respectively, and T is the temperature in K [3]. The $S^2\sigma$ term is defined as the power factor. Owing to the demand for alternative energy sources, the quest for new materials with an improved figure of merit (ZT) has increased globally at a rapid rate [4,5].

In general, semiconductors are better thermoelectric materials compared to metals [6]. According to Wiedemann-Franz law [7], most metals have a nearly constant electrical to thermal conductivity ratio, and increasing electrical conductivity is difficult without increasing their thermal conductivity. However, a good ZT value requires a high electrical conductivity and simultaneously a lower thermal conductivity. Hence, for metals or metallic alloys, the only possible way to obtain a significant figure of merit is to have a high value of the Seebeck coefficient. Unfortunately, most metals show very small Seebeck coefficients (~10 μV/K), and their thermoelectric efficiencies are only fractions of a percent. On the other hand, semiconductors with comparatively higher Seebeck coefficient values (~100 μV/K) had drawn strong attention as thermoelectric materials since 1920 [8]. Low bandgap semiconductors possess high electrical conductivity, comparable to metals. Compared to bulk materials, nanomaterials have low thermal conductivity because of lower lattice thermal conductivity resulting from the increased phonon scattering due to smaller grain size [9–12]. Thus, nanostructured semiconductors of smaller bandgaps are considered the most favorable thermoelectric materials as they produce a reasonably higher figure of merit values.

Antimony telluride (Sb_2Te_3), a low bandgap semiconductor, has been considered as one of the promising thermoelectric materials for low-temperature applications [13–15]. Nano-structured Sb_2Te_3 thin films fabricated by physical vapor deposition [16], metal-organic chemical vapor deposition [17,18], thermal co-evaporation [19], flash evaporation [20], electrochemical method [21], ion beam sputtering [22], molecular beam epitaxy [23] etc. have shown good thermoelectric conversion efficiency. On the other hand, single-phase Sb_2Te_3 nanoparticles synthesized by microwave-assisted

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https://doi.org/10.1016/j.jallcom.2020.157732
0925-8388/

Materials Chemistry and Physics 279 (2022) 125736

Contents lists available at ScienceDirect

Materials Chemistry and Physics

journal homepage: www.elsevier.com/locate/matchemphys

Improved thermoelectric performance of nanostructured Bi_2Te_3 fabricated by solvent-free mechanical alloying

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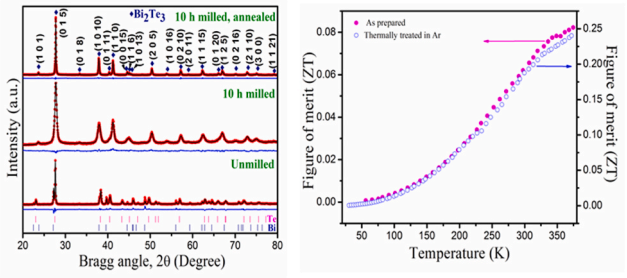
HIGHLIGHTS

- Nanostructured Bi_2Te_3 has been synthesized by facile mechanical alloying method.
- Microstructures of the samples are characterized by XRD and FESEM.
- The semiconducting nature of the sample changes to metallic after annealing.
- Grain growth and associated band gap reduction is noticed after annealing at 573K.
- About three times increase in thermoelectric figure of merit owing to annealing.

GRAPHICAL ABSTRACT



ARTICLE INFO

Keywords:
Nanostructures
Microstructure
X-ray diffraction
Thermoelectrics

ABSTRACT

Thermoelectric materials convert waste heat energy efficiently to electricity in an eco-friendly manner. Bi_2Te_3 is a known thermoelectric material, which can convert waste heat and solar energy into electricity in the 200–400 K temperature range. Bi_2Te_3 nanocrystals are prepared in powder form by solvent-free mechanical alloying of elemental Bi and Te powder mixtures under an inert Ar atmosphere. The crystallite size and composition of the Bi_2Te_3 nanocrystals are analyzed using X-ray diffraction, field-emission scanning electron microscope and energy-dispersive X-ray spectroscopy. Thermal and electrical behaviours and the effect of thermal annealing are studied on the 10 h ball-milled sample in a physical properties measurement system in the 30–375 K temperature range. It is observed that the high-temperature thermal annealing induces significant grain growth, reduces lattice strain, along with a reduction of bandgap energy of the mechanically alloyed Bi_2Te_3 nanostructures. Thermoelectric properties and the figure of merit of the nanostructures have improved significantly upon thermal annealing. Enhanced thermoelectric performance of the annealed nanostructures has been explained considering the change in their thermal conductivity, electrical resistivity, and crystallite size induced by thermal treatment.

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https://doi.org/10.1016/j.matchemphys.2022.125736
Received 21 August 2020; Received in revised form 23 December 2021; Accepted 11 January 2022
Available online 15 January 2022

SL. no. 25

COLLABORATION WITH BOTANICAL SURVEY OF INDIA (BSI), GOVERNMENT OF INDIA

NAME OF THE CANDIDATE	TITLE OF Ph.D. PROGRAMME	NAME OF THE BSI SCIENTIST INVOLVED	NAME OF THE GUIDE FROM THE UNIVERSITY OF BURDWAN	DATE OF THESIS SUBMISSION AND DATE OF AWARD	PUBLICATIONS RELATED TO THIS RSEARCH	COMMENT
Dr. Subhajit Lahiri	STUDIES ON ALPINE AND SUBALPINE VASCULAR PLANT DIVERSITY AND COMMUNITY STRUCTURE OF TWO LANDSCAPES OF SIKKIM HIMALAYA	Dr. Sudhansu Sekhar Das, Scientist F, BSI	Dr. Asok Ghosh, Professor, Department of Botany, B.U.	Date of Submission-25.02.2022 Date of award-17.05.2022	1. Lahiri, Subhajit & Dash, Sudhansu Sekhar & Ghosh, Asok. (2022). An Annotated Checklist to the Alpine and Sub Alpine Flowering Plant Diversity of Dzongri-Goecha La Area, West Sikkim, India. Nelumbo. 64. 29-55. 10.20324/nelumbo/v64/2022/170943 . 2. Dash, Sudhansu Sekhar & Lahiri, Subhajit & Ghosh, Asok & Sinha, Bk. (2020). Notes on two lesser known Codonopsis (Campanulaceae) from eastern Himalaya, India. Rheedea. 30. 286. 10.22244/rheedea.2020.30.02.05. 3. Lahiri, Subhajit & Dash, Sudhansu Sekhar & Ghosh, Asok & Sinha, Bk. (2019). A contribution to the flora of Kanchenjunga Biosphere Reserve, Sikkim, India. 61. 10.20324/nelumbo/v61/2019/146248	Registration No. R-Ph.D./Regn. /Sc/Bot./211 Dated-24.07.2019
Kasturi Chakraborty	SYSTEMATIC STUDIES ON	Dr. Avishek Bhattacharjee	Dr. Asok Ghosh,	Not yet, Registration	1. Chakraborty, Kasturi & Bhattacharjee, Bandana & Ghosh,	Registration No. R-

	THE SUBTRIBE CONYZINAE SCH. BIP. (ASTERACEAE) IN INDIA WITH SPECIAL REFERENCE TO MOLECULAR PHYLOGENY ALONG WITH MACRO- AND MICRO-MORPHOLOGY OF CYPSELA	, Scientist E, BSI	Professor, Depatment of Botany, B.U.	date- 26.07.2023	Asok & Bhattacharjee, Avishek. (2024). Rediscovery of Erigeron jaeschkei (Asteraceae: Astereae: Conyzinae) and notes on its correct protologue and typification. Phytotaxa. 674. 275-280. 10.11646/phytotaxa.674.3.4.	Ph.D./Pro.Regn. /Sc/2022/ E-6 Dated - 05.12.2024

SL.no. 25

Nelumbo Vol 64 (1): (29-55) 2022
DOI: 10.20324/nelumbo/v64/2022/170943

ISSN (Print) : 0976-5069
ISSN (Online) : 2455-376X

An annotated checklist to the alpine and sub alpine Flowering plant diversity of Dzongri-Goecha La area, West Sikkim, India

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भारत में पश्चिम सिक्किम के जोंगरी-गोएचा ला क्षेत्र के पुष्पीय पादप विविधता संबंधी अल्पाइन तथा सब-अल्पाइन का एक विस्तृत चेकलिस्ट

सुभाजित लाहिड़ी, सुधांसु सेखर दाश तथा असोक घोष

सारांश

पश्चिम सिक्किम के जोंगरी-गोएचा ला क्षेत्र से कुल 254 पादप जातियों को संग्रहित किया गया है जो 151 वंशों तथा 47 कुलों से संबंधित हैं। अध्ययन क्षेत्र में शामिल कुल वंशों के 52.75% में प्रथम दस कुलों की बहुलता है तथा 37. 74 % में प्रथम दस वंशों की बहुलता है। अध्ययन के दौरान इस क्षेत्र के लिए 22 नए टैक्सा ज्ञात किए गए हैं।

ABSTRACT

A total of 254 plant species belonging to 151 genera and 47 families were collected from alpine and subalpine regions of Dzongri Goecha La area. Of the total species collected, the first ten dominating family contributed more than 52.75% while the first ten dominating genera contributed 37.74 % of total genera of the studied area. 22 taxa have been reported new to region during the study.

Keywords: Checklist, flora, vascular plants, Khangchendzonga, Biosphere Reserve. Alpine plants

INTRODUCTION

One of the prerequisites for biodiversity assessments and strategy for plant conservation is to the document the plant diversity of a region. The Himalaya has a remarkable range of biodiversity in its diverse habitats and ecosystems. The distribution of plant species in fragile alpine ecosystems is dynamic and need to be recorded at different intervals to understand the pattern and potential migration of plant species to different habitats. Keeping in this in mind, this study has been carried out in the alpine and subalpine region of Dzongri-Goecha La of West Sikkim to document the plants occurring on the region. Exploration was done between July 2016 to September 2020 for collection of plant specimens along different altitudinal gradient towards the partial fulfilment of the objective of the project entitled "*Biodiversity Assessment through Long-term Monitoring Plots in Indian Himalayan Landscape*" under National Mission of Himalayan Studies.

The Dzongri-Goecha La area is well-known for its pristine natural landscapes and mesmeric meadows of alpine flowers. This is also one of the highest fragile ecosystems listed under UNESCO World Heritage Site *i.e.*, Khangchendzonga Biosphere Reserve (KBR). The vegetation of the area comprises of subalpine *Rhododendron* Forest, alpine scrubs and meadows. Though includes a smaller area, but due to high variations in elevation from 3000–4800 m asl. plant diversity of the area is remarkably high and unique. Recent study shows that, the biodiversity of this region under threat due to various factors such as heavy grazing, over exploitation of plant resources and high influx of tourist etc.

MATERIAL AND METHODS

The Dzongri Goecha La trekking starts from Yuksom, situated at an elevation of 1760 m asl. and ends at Goecha

Submitted : 18.07.2022 Accepted : 28.07.2022 Date of Publication 31.07.2022

sl.no....25

RHEEDEA
Journal of the Indian Association for Angiosperm Taxonomy

RESEARCH ARTICLE

Vol. 30(2): 286–292 (2020)
ISSN: 0971-2313 (Print edition)
ISSN: 2582-2438 (Online edition)
https://dx.doi.org/10.22244/rheedea.2020.30.02.05

Notes on two lesser known *Codonopsis* (Campanulaceae) from eastern Himalaya, India

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Abstract: Two lesser known species of *Codonopsis* Wall. (Campanulaceae), *viz*. *C. benthamii* Hook.f. & Thomson and *C. subsimplex* Hook.f. & Thomson were collected after a lapse of more than a century from Sikkim Himalaya, India. The authors evaluated the phenology of the above species in the last hundred years which shows a significance alteration. In this paper, information about the taxonomy, habitat, distribution and phenology are discussed along with photographic images.

Keywords: *Codonopsis benthamii*, *C. subsimplex*, Phenology, Rediscovery, Sikkim, Taxonomy.

Introduction

The genus *Codonopsis* Wall. (Campanulaceae) is widely distributed in temperate to alpine region of Asia and Europe and includes about 64 species (Hong, 2015b). The genus includes perennial erect herbs or herbaceous twiners characterized by solitary and large campanulate flowers, generally with a peculiar foul odour (Haridasan & Mukherjee, 1996; Hong, 2015a; Mabberley, 2017). Clarke (1881) reported 10 species of *Codonopsis* from the then British India under two sections: *Campanumoea* Blume and *Cyclocodon* Griff. Recent field studies in Himalayas (Dash, 2018), revealed the occurrence of 15 species in India, of which *C. ovata* Benth., *C. clematidea* (Schrenk) C.B.Clarke and *C. rotundifolia* Benth. show an extended distribution in Western Himalaya, while the rest 12 species are restricted to eastern Himalaya.

Received: 14.09.2019; *Revised & Accepted*: 10.04.2020
Published Online: 30.06.2020

During field explorations in the East district of Sikkim, two species of *Codonopsis* were came across in Kyongnosla Alpine Sanctuary. After consulting the relevant literature (Hooker & Thomson, 1858; Clarke, 1881; Komarov, 1908; Hong *et al*., 2011; Hong, 2015a), type specimens, protologue and other specimens housed in different herbaria (A, ARUN, ASSAM, BSHC, CAL, DD, E, GH, K, LWG, PE), they were identified as *C. benthamii* Hook.f. & Thomson and *C. subsimplex* Hook.f. & Thomson. *C. benthamii* is rediscovered after 110 years while *C. subsimplex* after a gap of 50 years after their last collection in India.

Material and Methods

Flowering specimens were collected from Kyongnosla Alpine Sanctuary (East district, Sikkim, India) and voucher specimens were prepared as per standard procedure (Jain & Rao, 1977). Photographs were taken in field with a Sony HX 400V camera. The micromorphological characters of flowers were studied using stereo-zoom microscope (Olympus SZ61, Japan). Detailed description was based on field observations and herbarium specimens (A, ARUN, ASSAM, BSHC, CAL, DD, E, GH, K and LWG; acronyms as per Thiers, 2020 continuously updated). To evaluate the change in flowering time of these two species in the last hundred years, Primack *et al*. (2004) was followed.

Taxonomic treatment

Codonopsis benthamii Hook.f. & Thomson, J. Proc. Linn. Soc., Bot. 2: 14. 1857. *Lectotype*

sl.no. 25

Nelumbo Vol 61 (1), (10-12) 2019
DOI : 10.20324/nelumbo/v61/2019/146248

ISSN (Print) : 0976-5069
ISSN (Online) : 2455-376X

A contribution to the flora of Kanchenjunga Biosphere Reserve, Sikkim, India

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कांचनजंधा जीवमंडल रिजर्व, सिक्किम, भारत की वनस्पतिजात में संयोजन

सुभोजित लाहिड़ी, सुधांशु शेखर दाश, अशोक घोष, बी. के. सिन्हा

सारांश

कांचनजंधा जीवमंडल रिजर्व, सिक्किम में बाइस पादप जातियों का संयोजन हुआ है । इसके अतिरिक्त सिक्किम हिमालय क्षेत्र से प्रथम बार रूबस लासियोस्टाइलस फोके यहां प्रतिवेदित किया गया है । सरल अभिनिर्धारण के लिए प्रत्येक जाति के पुष्पण अवधि व पारिस्थितिकी पर एक विस्तृत विवरण व जानकारी प्रदान की गई है ।

ABSTRACT

Twenty two species reported here as addition to the Flora of Kanchenjunga Biosphere Reserve, Sikkim. Besides *Rubus lasiostylus* Focke reported here for the first time from Sikkim Himalaya. A comprehensive description, information on phenology and ecology of each of the species has been provided here for easy identification.

Keywords: Floristic Diversity, KBR, New Additions, Sikkim

INTRODUCTION

The Kanchenjunga Biosphere Reserve (KBR) is located in West and North district of Sikkim between 27°15′-27°57′N latitude and 88°02′-88°40′E longitude. The biosphere reserve comprises an area of 2619.92 sq. km of which the core zone is about 1784 sq. km and the buffer zone is 835.92 sq. km. Due to its great biodiversity along with multi-ethnic culture, UNESCO acknowledged this biosphere reserve as World Heritage Site in the year 2018. The biosphere reserve falls within the Himalaya global biodiversity hotspot and shows an unrivaled range of sub-tropical to alpine ecosystems. Khangchendzonga Biosphere Reserve is covers 25% of the State of Sikkim, recognized as one of India's most noteworthy biodiversity concentrations. Maity & al., (2018) enumerated 1584 species of flowering plants from the area while dealing the Flora of Kanchenjunga Biosphere Reserve. However, certain parts of the KBR are yet to be explored and documented. Recently, during our visit to KBR in connection with setting up permanent plots under the project "Biodiversity Assessment through Long-term Monitoring Plots in Indian Himalayan Landscape" for monitoring of plant diversity change in the Dzongri-Gocha La area, we have collected a total of 400 plant specimens. Interestingly, 22 species belonging to 13

Received: 09.09.17 Accepted: 28.06.18 Date of Publication: 31.07.18

Phytotaxa 674 (3): 275–280
https://www.mapress.com/pt/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

https://doi.org/10.11646/phytotaxa.674.3.4

Rediscovery of *Erigeron jaeschkei* (Asteraceae: Astereae: Conyzinae) and notes on its correct protologue and typification

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Abstract

Erigeron jaeschkei (Asteraceae: Astereae: Conyzinae) has been rediscovered after more than 15 decades from the Spiti valley of Himachal Pradesh, India. The protologue of this species name had been cited wrongly in several published literature sources and online databases, which is corrected in the present treatment. Apart from a brief diagnosis and types, no detailed modern description, illustration or photograph was available for this species. Therefore, a detailed description and a colour photo-plate based on our collection are provided for the first time to facilitate identification of this less-known species. A lectotype is also designated from the original collection by Dr. Jäschke.

Key words: Compositae, endemic, Falori Pass, Jäschke, lectotype, recollection

Introduction

The genus *Erigeron* Linnaeus (1753: 863) belongs to the subtribe Conyzinae under the tribe Astereae of the family Asteraceae / Compositae (Nesom 2008). The genus has *c.* 390 species (Nesom 2006) with a cosmopolitan distribution, and is represented by 21 species with 2 varieties in India (Karthikeyan *et al.* 2020). In connection with a field survey (in search for species of *Aster* Linnaeus (1753: 872) and their look-alike taxa) under SERB-CRG project (CRG/2021/000790), few specimens of an uncertain species of *Erigeron* were collected from two locations in Spiti Valley, Lahaul and Spiti District of Himachal Pradesh, India. The species was later identified as *E. jaeschkei* Vierhapper (1926: 12) based on our detailed study of specimens, consultation of the protologue and original materials of *E. jaeschkei*, and also by our morphological comparisons with other related species of *Erigeron*.

While describing *E. himalajensis* Vierhapper (1906: 491) as a new species, Friedrich (Karl Max) Vierhapper compared it with another, yet unnamed species by stating "Am Faloripaß hat Jaeschke noch eine andere (einjährige?) Art gesammelt (Faloripaß, Jaeschke: hb. U. V.), welche vielleicht ebenfalls den *Pleiocephali* angehört. Sie unterscheidet sich von *E. Himalajensis* durch dünnere Stengel, viel länger gestielte Basalblätter mit bedeutend breiterer, breit elliptischer oder verkehrt-eiförmiger Lamina, breitere Stengelblätter und insbesondere durch das ziemlich gleichmäßige, abstehend dicht-haarige, nicht drüsige Indument der Vegetationsorgane". Later, Vierhapper validly published a name of that unnamed species as *E. jaeschkei* Vierhapper (1926: 12) by providing a diagnosis; he also cited specimens (syntypes) and indicated the herbarium where the specimens were preserved.

Erigeron jaeschkei is endemic to India with a very restricted distribution in Himachal Pradesh. The species was described based on the specimens collected by Heinrich August Jäschke from Falori Pass, Lahaul, Himachal Pradesh, either between 1856–1864 or 1865–1868. Though the year of collection is neither mentioned in the protologue, nor in the label data of Jäschke's collection, it has been traced out on a study of Jäschke's biography published by Bray (1983).

Accepted by Alexander Sennikov: 11 Nov. 2024; published: 28 Nov. 2024

sl.no. 25

Nelumbo Vol 64 (1): (29-55) 2022
DOI: 10.20324/nelumbo/v64/2022/170943

ISSN (Print) : 0976-5069
ISSN (Online) : 2455-376X

An annotated checklist to the alpine and sub alpine Flowering plant diversity of Dzongri-Goecha La area, West Sikkim, India

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भारत में पश्चिम सिक्किम के जोंगरी-गोएचा ला क्षेत्र के पुष्पीय पादप विविधता संबंधी अल्पाइन तथा सब-अल्पाइन का एक विस्तृत चेकलिस्ट

सुभाजित लाहिड़ी, सुधांसु सेखर दाश तथा असोक घोष

सारांश

पश्चिम सिक्किम के जोंगरी-गोएचा ला क्षेत्र से कुल 254 पादप जातियों को संग्रहित किया गया है जो 151 वंशों तथा 47 कुलों से संबंधित हैं। अध्ययन क्षेत्र में शामिल कुल वंशों के 52.75% में प्रथम दस कुलों की बहुलता है तथा 37. 74 % में प्रथम दस वंशों की बहुलता है। अध्ययन के दौरान इस क्षेत्र के लिए 22 नए टैक्सा ज्ञात किए गए हैं।

ABSTRACT

A total of 254 plant species belonging to 151 genera and 47 families were collected from alpine and subalpine regions of Dzongri Goecha La area. Of the total species collected, the first ten dominating family contributed more than 52.75% while the first ten dominating genera contributed 37.74 % of total genera of the studied area. 22 taxa have been reported new to region during the study.

Keywords: Checklist, flora, vascular plants, Khangchendzonga, Biosphere Reserve. Alpine plants

INTRODUCTION

One of the prerequisites for biodiversity assessments and strategy for plant conservation is to the document the plant diversity of a region. The Himalaya has a remarkable range of biodiversity in its diverse habitats and ecosystems. The distribution of plant species in fragile alpine ecosystems is dynamic and need to be recorded at different intervals to understand the pattern and potential migration of plant species to different habitats. Keeping in this in mind, this study has been carried out in the alpine and subalpine region of Dzongri-Goecha La of West Sikkim to document the plants occurring on the region. Exploration was done between July 2016 to September 2020 for collection of plant specimens along different altitudinal gradient towards the partial fulfilment of the objective of the project entitled "*Biodiversity Assessment through Long-term Monitoring Plots in Indian Himalayan Landscape*" under National Mission of Himalayan Studies.

The Dzongri-Goecha La area is well-known for its pristine natural landscapes and mesmeric meadows of alpine flowers. This is also one of the highest fragile ecosystems listed under UNESCO World Heritage Site *i.e.*, Khangchendzonga Biosphere Reserve (KBR). The vegetation of the area comprises of subalpine *Rhododendron* Forest, alpine scrubs and meadows. Though includes a smaller area, but due to high variations in elevation from 3000–4800 m asl. plant diversity of the area is remarkably high and unique. Recent study shows that, the biodiversity of this region under threat due to various factors such as heavy grazing, over exploitation of plant resources and high influx of tourist etc.

MATERIAL AND METHODS

The Dzongri Goecha La trekking starts from Yuksom, situated at an elevation of 1760 m asl. and ends at Goecha

Submitted : 18.07.2022 Accepted : 28.07.2022 Date of Publication 31.07.2022

RHEEDEA
Journal of the Indian Association for Angiosperm Taxonomy
RESEARCH ARTICLE
Vol. 30(2): 286–292 (2020)
ISSN: 0971-2313 (Print edition)
ISSN: 2582-2438 (Online edition)
https://dx.doi.org/10.22244/rheedea.2020.30.02.05

Notes on two lesser known *Codonopsis* (Campanulaceae) from eastern Himalaya, India

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Abstract: Two lesser known species of *Codonopsis* Wall. (Campanulaceae), *viz*. *C. benthamii* Hook.f. & Thomson and *C. subsimplex* Hook.f. & Thomson were collected after a lapse of more than a century from Sikkim Himalaya, India. The authors evaluated the phenology of the above species in the last hundred years which shows a significance alteration. In this paper, information about the taxonomy, habitat, distribution and phenology are discussed along with photographic images.

Keywords: *Codonopsis benthamii*, *C. subsimplex*, Phenology, Rediscovery, Sikkim, Taxonomy.

Introduction

The genus *Codonopsis* Wall. (Campanulaceae) is widely distributed in temperate to alpine region of Asia and Europe and includes about 64 species (Hong, 2015b). The genus includes perennial erect herbs or herbaceous twiners characterized by solitary and large campanulate flowers, generally with a peculiar foul odour (Haridasan & Mukherjee, 1996; Hong, 2015a; Mabberley, 2017). Clarke (1881) reported 10 species of *Codonopsis* from the then British India under two sections: *Campanumoea* Blume and *Cyclocodon* Griff. Recent field studies in Himalayas (Dash, 2018), revealed the occurrence of 15 species in India, of which *C. ovata* Benth., *C. clematidea* (Schrenk) C.B.Clarke and *C. rotundifolia* Benth. show an extended distribution in Western Himalaya, while the rest 12 species are restricted to eastern Himalaya.

Received: 14.09.2019; *Revised & Accepted*: 10.04.2020
Published Online: 30.06.2020

During field explorations in the East district of Sikkim, two species of *Codonopsis* were came across in Kyongnosla Alpine Sanctuary. After consulting the relevant literature (Hooker & Thomson, 1858; Clarke, 1881; Komarov, 1908; Hong *et al*., 2011; Hong, 2015a), type specimens, protologue and other specimens housed in different herbaria (A, ARUN, ASSAM, BSHC, CAL, DD, E, GH, K, LWG, PE), they were identified as *C. benthamii* Hook.f. & Thomson and *C. subsimplex* Hook.f. & Thomson. *C. benthamii* is rediscovered after 110 years while *C. subsimplex* after a gap of 50 years after their last collection in India.

Material and Methods

Flowering specimens were collected from Kyongnosla Alpine Sanctuary (East district, Sikkim, India) and voucher specimens were prepared as per standard procedure (Jain & Rao, 1977). Photographs were taken in field with a Sony HX 400V camera. The micromorphological characters of flowers were studied using stereo-zoom microscope (Olympus SZ61, Japan). Detailed description was based on field observations and herbarium specimens (A, ARUN, ASSAM, BSHC, CAL, DD, E, GH, K and LWG; acronyms as per Thiers, 2020 continuously updated). To evaluate the change in flowering time of these two species in the last hundred years, Primack *et al*. (2004) was followed.

Taxonomic treatment

Codonopsis benthamii Hook.f. & Thomson, J. Proc. Linn. Soc., Bot. 2: 14. 1857. *Lectotype*

sl.no.25

Phytotaxa 674 (3): 275–280
https://www.mapress.com/pt/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

https://doi.org/10.11646/phytotaxa.674.3.4

Rediscovery of *Erigeron jaeschkei* (Asteraceae: Astereae: Conyzinae) and notes on its correct protologue and typification

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Abstract

Erigeron jaeschkei (Asteraceae: Astereae: Conyzinae) has been rediscovered after more than 15 decades from the Spiti valley of Himachal Pradesh, India. The protologue of this species name had been cited wrongly in several published literature sources and online databases, which is corrected in the present treatment. Apart from a brief diagnosis and types, no detailed modern description, illustration or photograph was available for this species. Therefore, a detailed description and a colour photo-plate based on our collection are provided for the first time to facilitate identification of this less-known species. A lectotype is also designated from the original collection by Dr. Jäschke.

Key words: Compositae, endemic, Falori Pass, Jäschke, lectotype, recollection

Introduction

The genus *Erigeron* Linnaeus (1753: 863) belongs to the subtribe Conyzinae under the tribe Astereae of the family Asteraceae / Compositae (Nesom 2008). The genus has *c.* 390 species (Nesom 2006) with a cosmopolitan distribution, and is represented by 21 species with 2 varieties in India (Karthikeyan *et al.* 2020). In connection with a field survey (in search for species of *Aster* Linnaeus (1753: 872) and their look-alike taxa) under SERB-CRG project (CRG/2021/000790), few specimens of an uncertain species of *Erigeron* were collected from two locations in Spiti Valley, Lahaul and Spiti District of Himachal Pradesh, India. The species was later identified as *E. jaeschkei* Vierhapper (1926: 12) based on our detailed study of specimens, consultation of the protologue and original materials of *E. jaeschkei*, and also by our morphological comparisons with other related species of *Erigeron*.

While describing *E. himalajensis* Vierhapper (1906: 491) as a new species, Friedrich (Karl Max) Vierhapper compared it with another, yet unnamed species by stating "Am Faloripaß hat Jaeschke noch eine andere (einjährige?) Art gesammelt (Faloripaß, Jaeschke: hb. U. V.), welche vielleicht ebenfalls den *Pleiocephali* angehört. Sie unterscheidet sich von *E. Himalajensis* durch dünnere Stengel, viel länger gestielte Basalblätter mit bedeutend breiterer, breit elliptischer oder verkehrt-eiförmiger Lamina, breitere Stengelblätter und insbesondere durch das ziemlich gleichmäßige, abstehend dicht-haarige, nicht drüsige Indument der Vegetationsorgane". Later, Vierhapper validly published a name of that unnamed species as *E. jaeschkei* Vierhapper (1926: 12) by providing a diagnosis; he also cited specimens (syntypes) and indicated the herbarium where the specimens were preserved.

Erigeron jaeschkei is endemic to India with a very restricted distribution in Himachal Pradesh. The species was described based on the specimens collected by Heinrich August Jäschke from Falori Pass, Lahaul, Himachal Pradesh, either between 1856–1864 or 1865–1868. Though the year of collection is neither mentioned in the protologue, nor in the label data of Jäschke's collection, it has been traced out on a study of Jäschke's biography published by Bray (1983).

Accepted by Alexander Sennikov: 11 Nov. 2024; published: 28 Nov. 2024

SL. NO. 26

पश्चिमबङ्गा पश्चिम बंगाल WEST BENGAL

AB 960366

MEMORANDUM OF AGREEMENT

This MEMORANDUM OF AGREEMENT is made on this **twenty seventh** day of **June** Two thousand and **nineteen** BY AND BETWEEN President of India, acting through **Advisor & scientist 'G"**, Department of Biotechnology, Ministry of Science and Technology, Government of India, New Delhi, hereinafter referred to as the 'DBT' (which expression unless excluded by or repugnant to the subject shall mean and include its successor-in-office and assigns) of the ONE PART;

AND

The University of Burdwana society under the Societies Registration Act – 1860, having its registered office in/at **Rajbati, Burdwan,** hereinafter referred to as **BU** (which expression shall where the context so admits include its successors and permitted assigns) of the OTHER PART;

WHEREAS DBT being desirous of **Research on Human Genetics & Genomics** decided to support a project submitted by **Prof. Anupam Basu** for the attainment of the objectives, hereinafter described in the Annexure I annexed hereto;

This Memorandum of Agreement (MoA) defines the role and responsibilities of the participating agencies, monitoring and other matters related to the **"A Genetic Algorithm-Based Targeted Approach for Understanding the Phenotypic Heterogeneity of Thalassemia Syndromes in Northern and Eastern Indian Population"**

02.08.19
Dr. D. Mondal
Joint Registrar
The University of Burdwan

Dr. Anupam Basu
PROFESSOR
Department of Zoology
University of Burdwan

NOW THE PARTIES HERETO AGREE AS FOLLOWS:-

1.0 . ROLE OF DEPARTMENT OF BIOTECHNOLOGY, NEW DELHI

To provide funds to the extent of **7379121.00**over a period of **3** years from the date of sanction of the project, to **The University of Burdwan** for undertaking activities as detailed in Annexure 1. Details of the funds to be provided are given in Annexure II.

2.0. ROLE OF THE UNIVERSITY OF BURDWAN (Institute)

2.1. To provide their contribution of **NIL**for**NIL** years from date of sanction of the project as detailed in Annexure – II. *(if a jointly supported project)*

2.2. To provide existing facilities as mentioned in the project document.

2.3. To be responsible for accomplishing objectives identified and activities listed.

2.4. To allow the Scientists authorized by DBT to work with the Research & Development team of the center in all stages of process development and production.

2.5. To recruit all scientific and non-scientific staff as sanctioned by DBT.

2.6. To prepare and submit all periodical reports and other documents that would be required by DBT.

2.7. To maintain a separate audit head of account for the grants received from DBT for the project.

2.8. To submit an annual audited statement of expenditure incurred under the project.

2.9. To ensure effective utilization of the grant given by DBT for the purpose for which it was granted and to ensure timely progress of project work.

2.10. The manpower, both scientific and non-scientific, recruited shall be purely on contractual terms & conditions such that the contract for engagement of the manpower shall run concurrently with the said project period only.

3.0 DURATION OF PROJECT

3.1 Duration of project shall be **3** years from the date the Project has been sanctioned by DBT.

4.0 RIGHTS OF OWNERSHIP/TECHNOLOGY TRANSFER AND UTILIZATION

4.1 The know-how generated from the project by **Prof. Anupam Basu** will be the joint property of **The University of Burdwan** and DBT, Government of India. It shall be the responsibility of **Prof. Anupam Basu & The University of Burdwan** to take necessary action for protection of the intellectual property arising out of the PROJECT through proper instruments, such as, patents, copy rights, etc.

The know-how developed may be transferred to other entrepreneurs on a non-exclusive basis on such terms and conditions as may be determined by DBT.

02.08.19
Dr. D. Mondal
Joint Registrar
The University of Burdwan
Burdwan-713104, W.B.

Dr. Anupam Basu
PROFESSOR
Department of Zoology
University of Burdwan

4.3 All the assets including the equipment and produce acquired will be the property of DBT and shall not be utilized for purposes other than those for which the grant has been sanctioned. The rights of **The University of Burdwan**. under this MoA shall not be transferred to any other party without prior approval in writing of DBT.

4.4 It shall be the responsibility of **Prof. Anupam Basu** to ensure that support of DBT is suitably acknowledged in the publications (papers, reports, etc.) arising out of the PROJECT.

5. SECRECY

It is hereby agreed that the participating agencies shall keep information and data collected completely secret provided that the right to transfer the technology shall rest with the DBT.

6. MONITORING

6.1 The progress of implementation of the project and proper utilization of grant shall be reviewed by the DBT and by the Monitoring Committee set up by DBT.

6.2 The periodic progress of physical achievements and the utilization of funds, statement of expenditure shall be evaluated by the Monitoring Committee.

6.3 The Comptroller and Auditor General of India, at his discretion shall have the right of access to the books and accounts of **The University of Burdwan** for the grants received from DBT for this project.

6.4 The DBT may terminate the grant at any stage if it is convinced that the grant has not been properly utilized or appropriate progress has not been made. In the event, DBT terminates the grant, **Prof. Anupam Basu** shall hand over all documents including technical details and equipment purchased related to the project.

7.0 DURATION OF MEMORANDUM OF AGREEMENT

This MoA will remain inforce for the duration of the project and until all claims are settled between DBT and **The University of Burdwan.**

8.0 ARBITRATION

In the event of any question, dispute or difference whatsoever arising between the parties to this Agreement out of or relating to the construction, meaning, scope, operation or effect of this Agreement or the validity of the breach thereof shall be referred to an Arbitrator to be appointed by mutual consent of both the parties herein. If the parties cannot agree on the appointment of the Arbitrator within a period of one month from the notification by one party to the other of existence of such dispute, then the Arbitrator shall be nominated by the Secretary, Department of Legal Affairs, Ministry of Law & Justice, Government of India. The provisions of the Arbitration and Conciliation Act, 1996 will be applicable and the award made thereunder shall be final and binding upon the parties hereto, subject to legal remedies available under the law. Such differences shall be deemed to be a submission to arbitration under the Indian Arbitration and Conciliation Act, 1996, or of any modifications or amendments thereof.

02.08.19
Dr. D. Mondal
Joint Registrar
The University of Burdwan
Rajbati, Burdwan-713104 W.B.

Dr. Anupam Basu
PROFESSOR
Department of Zoology
University of Burdwan

9.0. GOVERNING LAW

This Contract shall be governed by the Law of India for the time being in force.

IN WITNESS WHEREOF the parties hereto have signed, sealed and delivered this Agreement on the day, month and year first above written in presence of:

Witnesses:

1.

2.

Signed by ----------

(Designation)

For and on behalf of The President of India

Witnesses:

1. Dr. SOUMENDRANATH CHATTERJEE Associate Professor & Head Department of Law The University of Burdwan Golapbag, Burdwan-713104

2. Anupam Basu 27/6/19 Dr. Anupam Basu PROFESSOR Department of Law The University of Burdwan

Signed by 02.08.19

Dr. D. Mondal
Joint Registrar
The University of Burdwan
Golapbag, Burdwan-713104, W.B.

UNIVERSITY OF BURDWAN RAJBATI BURDWAN 713104

For and on behalf of
The University of Burdwan

TERMS & CONDITIONS OF THE GRANT

(To be signed and enclosed with concern filled proforma)

1. Approval of the Research proposal and the grant released would be for the specific project mentioned in paras I to V of this proposal and grant should be exclusively spent on the project for which it has been sanctioned within the stipulated time. The Institute is not permitted to seek or utilize funds from any other organization (Government, Semi Government, Autonomous or Private) for this research project. Any unspent part of amount would be surrendered to the Govt. of India through an account payee demand draft drawn in favor of the "Drawing and Disbursing Officer, Department of Biotechnology, New Delhi", and carry forward of funds of the next financial year for utilization for the same project may be considered only with the specific approval of the Department of Biotechnology (DBT).

2. For permanent/semi-permanent assets acquired solely or mainly out of the grant, an audited record in the form of a register in the prescribed proforma (enclosed at **Appendix-'A'**) shall be maintained by the Institute. The term **"assets"** means (I) immovable property and (II) movable property of a capital nature, where the value exceeds Rs. 1000/- The grant will not be utilized for construction of any immovable property, Full facilities by way of accommodation, etc. for the project will be given by the Institute.

3. All the assets acquired from the grant will be the property of Govt. of India and should not without the prior sanction of the Dept. of Biotechnology, be disposed of, or encumbered or utilized for purpose other than those for which the grant has been sanctioned.

4. At the conclusion of the project, the Govt. of India will be free to sell or otherwise dispose of assets which are the property of the Government. The Institute shall render to Govt. necessary facilities for arranging the sale / disposal of these assets. **The Government may, however, consider the request of host institutions to retain the assets created under a project for carrying out similar work for the promotion of science.**

5. The implementing Institute/PI will furnish progress report of work on the project every six months. The progress of the project will also be reviewed/monitored at least once a year by the concerned Task Force/Project Monitoring Committee, etc. In addition the DBT shall designate Scientists/Specialists to visit the Institute periodically for reviewing the progress of work and for suggesting such measures as to ensure early realization of the objectives of the project. On completion of the project five copies of a consolidated report of the work done on the subject would be submitted to the Department of Biotechnology.

6. The Institute is required to send to DBT a list of assets referred to at Sl. No. 2 above at the end of each financial year as well as at the time of seeking further installments of the grant.

7. The Institute would furnish to the Dept. of Biotechnology a Utilization Certificate and an audited statement of expenditure duly signed by the P.I., the Head of the Institute and the Head of the Finance wing, pertaining to the grant at the end of each financial year as well as a consolidated statement of expenditure at the end of the completion of the project.

A stamped receipt be sent to the Dept. of Biotechnology on receipt of the Cheque/ Demand draft towards each release.

02.08.19

Dr. D. Mondal
Joint Registrar
The University of Burdwan
Rajbati, Burdwan-713104, W.B.

Dr. Anupam Basu
PROFESSOR
Department of Zoology
The University of Burdwan

9. The Comptroller and Auditor-General of India at his discretion shall have the right of access to the books and accounts of the Institute for the grant received from the Government.

10. The Institute would maintain separate audited accounts for the project. If it is found expedient to keep a part or whole of the grant in a bank account earning interest, the interest thus earned should be reported to the Dept. of Biotechnology.

11. Sale proceeds, if any, as a result of the development of the project arising directly from funds granted by the Dept. of Biotechnology shall be reported to the Govt. of India. The Govt. of India may at its discretion allow a portion of such receipt to be retained by the Institute for its utilization for the project activities.

12. Investigators/Institutes wishing to publish papers based on the research work done under Dept. of Biotechnology projects should acknowledge the financial support received from the Dept. of Biotechnology.

13. Investigators/Institutes may utilize various resources such as the Bioinformatics resources, experimental materials, reagents, cell lines, animals, etc. from the National facilities/Institutes/Centers established by this Department as per the terms of transactions followed by them. More information may be obtained about such facility from DBT websites: http://www.dbtindia.org// www.dbtindia.nic.in, www.btisnet.ac.in.

14. Investigators / Institutes shall follow the detailed instructions on technology transfer and Intellectual Property Rights (IPR) as given at Annexure - V. The same has the approval of the Ministry of Finance, Govt. of India vide Dept. of Expenditure, Plan Finance II – Division Letter No. 33 (5) /PF.II/99 dated 22nd February, 2000. Any deviation from these instructions may be brought to the notice of this Department.

15. Investigators / Institutes may file patents with the help of the Biotechnology Patents Facilitating Cell (BPFC) established at DBT on priority bases. The format for filing the patents may be seen at Annexure –VI.

16. The Govt. of India (Dept. of Biotechnology) will have the right to call for drawings, specifications and other data necessary to enable the transfer of know-how to other parties and the Institute shall supply all the needed information at the request of the Department of Biotechnology which will ensure confidentiality. The information required for commercializing Biotechnologies may be furnished to this Dept. as per the format enclosed at Annexure – VII. More information on commercialization can be found at the website www.ebc.nic.in.

17. The Institute may not entrust the implementation of the work for which the grant is being sanctioned to another institution and to divert the grant receipts as assistance to the latter institution. However, in such situations the express permission of DBT may be obtained. In case the grantee is not in a position to execute or complete the project, it may be required to refund forthwith to the Govt. of India (Department of Biotechnology) the entire amount of grant received by it.

02-08-09

Dr. D. Mondal
Joint Registrar
The University of Burdwan
Rajbati, Burdwan-713104, W.B.

18. The human resources that may be engaged for the project by the Institute are not to be treated as employees of the Govt. of India and the deployment of such human resource at the time of completion or termination of project, will not be the concern/responsibility of the Govt. of India. The Organization may make reservations for Scheduled Castes, Schedule Tribes etc. in the human resource to be engaged for the project in accordance with the instruction issued by the Govt. of India from time to time.

27/6/09

Dr. Anupam Basu
PROFESSOR
Department of Zoology
The University of Burdwan

19. The Dept. of Biotechnology reserves the right to terminate the grant at any stage and also to recover the amounts already paid if it is convinced that the grant has not been properly utilized or the work on the project has been suspended for any unduly long period or appropriate progress is not being made.

20. The project will become operative with effect from the date of release of the first installment for the project.

21. If the Investigator to whom a grant for a project has been sanctioned leaves the institution where the project is being implemented, he shall submit five copies of complete and detailed report of the work done by him on the project and the money spent till the date of his/her release and shall also arrange to refund the unspent balance, if any.

22. The organization should maintain subsidiary accounts of the Govt. of India grant and furnish it to the Audit Officer as and when the recurring and non-recurring expenditure exceeds the limits of Rs. 5.00 lakhs.

Signature of Project Coordinator
(Applicable only for multi-Institutional projects)

Date: 27/6/19

Dr. Anupam Basu
PROFESSOR
Department of Zoology
The University of Burdwan

02.08.19

Signature of Registrar
of Univer[illegible]

Joint Registrar
The University of Burdwan
[illegible]-713104, W.B.

Date:

Signature and stamped of Principal Investigator
The University of Burdwan

Date: 27/06/19

Dr. Anupam Basu
PROFESSOR
Department of Zoology
The University of Burdwan

UNIVERSITY OF BURDWAN
RAJBATI
BURDWAN
713104
WEST BENGAL

SL. NO. 26

पश्चिमबङ्गा पश्चिम बंगाल WEST BENGAL

Z 816631

MEMORANDUM OF AGREEMENT

This MEMORANDUM OF AGREEMENT is made on this **twenty first** day of **May** Two thousand and **Eighteen** BY AND BETWEEN President of India, acting through **Secretary**, Department of Biotechnology, Ministry of Science and Technology, Government of India, New Delhi, hereinafter referred to as the 'DBT' (which expression unless excluded by or repugnant to the subject shall mean and include its successor-in-office and assigns) of the ONE PART;

AND

The University of Burdwan , a society under the Societies Registration Act – 1860, having its registered office at **Rajbati, Burdwan,** hereinafter referred to as **BU** (which expression shall where the context so admits include its successors and permitted assigns) of the OTHER PART;

REGISTRAR (Officiating)
THE UNIVERSITY OF BURDWAN
BURDWAN-713104

WHEREAS DBT being desirous of cancer immunology decided to support a project submitted by **Dr. Anupam Basu** for the attainment of the objectives, hereinafter described in the Annexure I annexed hereto;

This Memorandum of Agreement (MoA) defines the role and responsibilities of the participating agencies, monitoring and other matters related to the **"Study on the role of TLR-4 signaling in breast cancer progression"**

NOW THE PARTIES HERETO AGREE AS FOLLOWS:-

1.0 . ROLE OF DEPARTMENT OF BIOTECHNOLOGY, NEW DELHI

To provide funds to the extent of **81,30,600/-** over a period of **3** years from the date of sanction of the project, to **The University of Burdwan** for undertaking activities as detailed in Annexure 1. Details of the funds to be provided are given in Annexure II.

2.0. ROLE OF THE UNIVERSITY OF BURDWAN (Institute)

2.1. To provide their contribution of **81,30,600/-** for **3** years from date of sanction of the project as detailed in Annexure – II. *(if a jointly supported project)*

2.2. To provide existing facilities as mentioned in the project document.

2.3. To be responsible for accomplishing objectives identified and activities listed.

2.4. To allow the Scientists authorized by DBT to work with the Research & Development team of the center in all stages of process development and production.

2.5. To recruit all scientific and non-scientific staff as sanctioned by DBT.

2.6. To prepare and submit all periodical reports and other documents that would be required by DBT.

2.7. To maintain a separate audit head of account for the grants received from DBT for the project.

2.8. To submit an annual audited statement of expenditure incurred under the project.

2.9. To ensure effective utilization of the grant given by DBT for the purpose for which it was granted and to ensure timely progress of project work.

2.10. The manpower, both scientific and non-scientific, recruited shall be purely on contractual terms & conditions such that the contract for engagement of the manpower shall run concurrently with the said project period only.

REGISTRAR (Officiating)
THE UNIVERSITY OF BURDWAN
BURDWAN-713104

3.0 DURATION OF PROJECT

3.1 Duration of project shall be **3** years from the date the Project has been sanctioned by DBT.

Dr. Anupam Basu
PROFESSOR
Department of Zoology
The University of Burdwan

4.0 RIGHTS OF OWNERSHIP/TECHNOLOGY TRANSFER AND UTILIZATION

4.1 The know-how generated from the project by **Dr. Anupam Basu** will be the joint property of **The University of Burdwan** and DBT, Government of India. It shall

4.2 be the responsibility of **Dr. Anupam Basu & The University of Burdwan** to take necessary action for protection of the intellectual property arising out of the PROJECT through proper instruments, such as, patents, copy rights, etc.

4.3 The know-how developed may be transferred to other entrepreneurs on a non-exclusive basis on such terms and conditions as may be determined by DBT.

4.4 All the assets including the equipment and produce acquired will be the property of DBT and shall not be utilized for purposes other than those for which the grant has been sanctioned. The rights of **The University of Burdwan** under this MoA shall not be transferred to any other party without prior approval in writing of DBT.

4.5 It shall be the responsibility of **Dr. Anupam Basu** to ensure that support of DBT is suitably acknowledged in the publications (papers, reports, etc.) arising out of the PROJECT.

5. SECRECY

It is hereby agreed that the participating agencies shall keep information and data collected completely secret provided that the right to transfer the technology shall rest with the DBT.

6. MONITORING

6.1 The progress of implementation of the project and proper utilization of grant shall be reviewed by the DBT and by the Monitoring Committee set up by DBT.

6.2 The periodic progress of physical achievements and the utilization of funds, statement of expenditure shall be evaluated by the Monitoring Committee.

6.3 The Comptroller and Auditor General of India, at his discretion shall have the right of access to the books and accounts of **The University of Burdwan** for the grants received from DBT for this project.

6.4 The DBT may terminate the grant at any stage if it is convinced that the grant has not been properly utilized or appropriate progress has not been made. In the event, DBT terminates the grant, **Dr. Anupam Basu & The University of Burdwan** shall hand over all documents including technical details and equipment purchased related to the project.

REGISTRAR (Officiating)
THE UNIVERSITY OF BURDWAN
BURDWAN-713104

Dr. Anupam Basu
PROFESSOR
Department of Zoology
University of Burdwan

7.0 DURATION OF MEMORANDUM OF AGREEMENT

This MoA will remain inforce for the duration of the project and until all claims are settled between DBT and **The University of Burdwan**

8.0 ARBITRATION

In the event of any question, dispute or difference whatsoever arising between the parties to this Agreement out of or relating to the construction, meaning, scope, operation or effect of this Agreement or the validity of the breach thereof shall be referred to an Arbitrator to be appointed by mutual consent of both the parties herein. If the parties cannot agree on the appointment of the Arbitrator within a period of one month from the notification by one party to the other of existence of such dispute, then the Arbitrator shall be nominated by the Secretary, Department of Legal Affairs, Ministry of Law & Justice, Government of India. The provisions of the Arbitration and Conciliation Act, 1996 will be applicable and the award made thereunder shall be final and binding upon the parties hereto, subject to legal remedies available under the law. Such differences shall be deemed to be a submission to arbitration under the Indian Arbitration and Conciliation Act, 1996, or of any modifications or reenactments thereof.

9.0. GOVERNING LAW

This Contract shall be governed by the Law of India for the time being in force.

IN WITNESS WHEREOF the parties hereto have signed, sealed and delivered this Agreement on the day, month and year first above written in presence of:

Witnesses:

1.

REGISTRAR (Officiating)
THE UNIVERSITY OF BURDWAN
BURDWAN-713104

Signed by ----------

(Designation)

For and on behalf of The President of India

Witnesses:

Dr. Anupam Basu
PROFESSOR
Department of Zoology
University of Burdwan

Dr ANANDAMAY BARIK
Associate Professor & Head
Department of Zoology
The University of Burdwan
Golapbag, Burdwan-713104

Signed by ----------

Registrar (officiating)
THE UNIVERSITY OF BURDWAN
For and on behalf of
The University of Burdwan

TERMS & CONDITIONS OF THE GRANT

(To be signed and enclosed with concern filled proforma)

1. Approval of the Research proposal and the grant released would be for the specific project mentioned in paras I to V of this proposal and grant should be exclusively spent on the project for which it has been sanctioned within the stipulated time. The Institute is not permitted to seek or utilise funds from any other organisation (Government, Semi Government, Autonomous or Private) for this research project. Any unspent part of amount would be surrendered to the Govt. of India through an account payee demand draft drawn in favour of the "Drawing and Disbursing Officer, Department of Biotechnology, New Delhi", and carry forward of funds of the next financial year for utilization for the same project may be considered only with the specific approval of the Department of Biotechnology (DBT).

2. For permanent/semi-permanent assets acquired solely or mainly out of the grant, an audited record in the form of a register in the prescribed proforma (enclosed at **Appendix-'A'**) shall be maintained by the Institute. The term **"assets"** means (I) immovable property and (II) movable property of a capital nature, where the value exceeds Rs. 1000/- The grant will not be utilised for construction of any immovable property, Full facilities by way of accommodation, etc. for the project will be given by the Institute.

3. All the assets acquired from the grant will be the property of Govt. of India and should not without the prior sanction of the Deptt. of Biotechnology, be disposed of, or encumbered or utilised for purpose other than those for which the grant has been sanctioned.

4. At the conclusion of the project, the Govt. of India will be free to sell or otherwise dispose of assets which are the property of the Government. The Institute shall render to Govt. necessary facilities for arranging the sale / disposal of these assets. **The Government may, however, consider the request of host institutions to retain the assets created under a project for carrying out similar work for the promotion of science.**

5. The implementing Institute/PI will furnish progress report of work on the project every six months. The progress of the project will also be reviewed/monitored at least once a year by the concerned Task Force/Project Monitoring Committee, etc. In addition the DBT shall designate Scientists/Specialists to visit the Institute periodically for reviewing the progress of work and for suggesting such measures as to ensure early realisation of the objectives of the project. On completion of the project five copies of a consolidated report of the work done on the subject would be submitted to the Department of Biotechnology.

6. The Institute is required to send to DBT a list of assets referred to at Sl. No. 2 above at the end of each financial year as well as at the time of seeking further installments of the grant.

7. The Institute would furnish to the Deptt. of Biotechnology a Utilization Certificate (Copy enclosed at **Appendix - 'B'**) and an audited statement of expenditure (**Copy enclosed at Appendix - 'C'**) duly signed by the P.I., the Head of the Institute and the Head of the Finance wing, pertaining to the grant at the end of each financial year as well as a consolidated statement of expenditure at the end of the completion of the project.

8. A stamped receipt be sent to the Deptt. of Biotechnology on receipt of the Cheque/ Demand draft towards each release.

9. The Comptroller and Auditor-General of India at his discretion shall have the right of access to the books and accounts of the Institute for the grant received from the Government.

10. The Institute would maintain separate audited accounts for the project. If it is found expedient to keep a part or whole of the grant in a bank account earning interest, the interest thus earned should be reported to the Deptt. of Biotechnology.

11. Sale proceeds, if any, as a result of the development of the project arising directly from funds granted by the Deptt. of Biotechnology shall be reported to the Govt. of India. The Govt. of India may at its discretion allow a portion of such receipt to be retained by the Institute for its utilisation for the project activities.

12. Investigators/Institutes wishing to publish papers based on the research work done under Deptt. of Biotechnology projects should acknowledge the financial support received from the Deptt. of Biotechnology.

13. Investigators/Institutes may utilize various resources such as the Bioinformatics resources, experimental materials, reagents, cell lines, animals, etc. from the National facilities/Institutes/Centres established by this Department as per the terms of transactions followed by them. More information may be obtained about such facility from DBT websites: http://www.dbtindia.org// www.dbtindia.nic.in, www.btisnet.ac.in.

14. Investigators / Institutes shall follow the detailed instructions on technology transfer and Intellectual Property Rights (IPR) as given at Annexure - V. The same has the approval of the Ministry of Finance, Govt. of India vide Deptt. of Expenditure, Plan Finance II – Division Letter No. 33 (5) /PF.II/99 dated 22nd February, 2000. Any deviation from these instructions may be brought to the notice of this Department.

15. Investigators / Institutes may file patents with the help of the Biotechnology Patents Facilitating Cell (BPFC) established at DBT on priority bases. The format for filing the patents may be seen at Annexure –VI.

16. The Govt. of India (Deptt. of Biotechnology) will have the right to call for drawings, specifications and other data necessary to enable the transfer of know-how to other parties and the Institute shall supply all the needed information at the request of the Department of Biotechnology which will ensure confidentiality. The information required for commercializing Biotechnologies may be furnished to this Deptt. as per the format enclosed at Annexure – VII. More information on commercialization can be found at the website www.ebc.nic.in.

17. The Institute may not entrust the implementation of the work for which the grant is being sanctioned to another institution and to divert the grant receipts as assistance to the latter institution. However, in such situations the express permission of DBT may be obtained. In case the grantee is not in a position to execute or complete the project, it may be required to refund forthwith to the Govt. of India (Department of Biotechnology) the entire amount of grant received by it.

18. The human resources that may be engaged for the project by the Institute are not to be treated as employees of the Govt. of India and the deployment of such human resource at the time of completion or termination of project, will not be the concern/responsibility of the Govt. of India. The Organisation may make reservations for Scheduled Castes, Schedule Tribes etc. in the human resource to be engaged for the project in accordance with the instruction issued by the Govt. of India from time to time.

19. The Deptt. of Biotechnology reserves the right to terminate the grant at any stage and also to recover the amounts already paid if it is convinced that the grant has not been properly utilized or the work on the project has been suspended for any unduly long period or appropriate progress is not being made.

20. The project will become operative with effect from the date of release of the first installment for the project.

21. If the Investigator to whom a grant for a project has been sanctioned leaves the institution where the project is being implemented, he shall submit five copies of complete and detailed report of the work done by him on the project and the money spent till the date of his/her release and shall also arrange to refund the unspent balance , if any.

22. The organisation should maintain subsidiary accounts of the Govt. of India grant and furnish it to the Audit Officer as and when the recurring and non-recurring expenditure exceeds the limits of Rs. 5.00 lakhs.

Signature of Executive Authority of Institute/ University With seal

REGISTRAR (Officiating)
THE UNIVERSITY OF BURDWAN
BURDWAN-713104

Date :

Signature and stamped of Principal Investigator :
Date :

Dr. Anirban Basu
Professor
Department of Zoology
The University of Burdwan

Signature and stamped of Co-Investigator
Date :

Dr ANANDAMAY BARIK
Associate Professor & Head
Department of Zoology
The University of Burdwan
Golapbag, Burdwan-713104

बैंक ऑफ़ बड़ौदा
Bank of Baroda

SL NO. 27

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr. Arijit Saha**, student of University of Burdwan of MBA (Financial Management), Burdwan has successfully completed his summer internship in our Bank as a part fulfilment of the academic requirement and under Bank's Scheme for imparting Summer Training to the students of Management University.

The internship project was titled **'Job Description vis-à-vis Financial Management'** and its Analysis at Bank of Baroda, Burdwan Region and the study was carried out in the Burdwan Region from 15.05.2023 to 08.07.2023 under guidance of Branch Head of Bank of Baroda, Burdwan Branch under Regional Office, Burdwan Region.

His conduct during the internship was found to be satisfactory.

We wish him all the best in all the future endeavours'.

Yours faithfully,

(Amiya Kumar Mondal)
Dy Regional Manager
Regional Office, Burdwan Region

बर्द्धमान क्षेत्रीय कार्यालय, द्वितीय तल, 54, जी. टी. रोड, भांगाकुठी, जिला - बर्द्धमान, पिन-713101, पश्चिम बंगाल (भारत)
Burdwan Regional Office, 2nd Floor, 54, G.T. Road, Bhangakuthi, Dist. - Burdwan, Pin-713101, W.B. (India)
दूर./Ph.: 0342-2658287, ई./Email: rm.wbengalsikkim@bankofbaroda.com, वेब/Web: www.bankofbaroda.com

SL NO. 27

BFH/HR-Comm/2023/687

29 June, 2023

TO WHOM IT MAY CONCERN

This is to certify that **Mr. Aakash Dhara** student of The University of Burdwan pursuing his MBA has successfully completed his training period at our institute.

He worked as an Intern with Bengal Faith Hospital from **22nd May 2023** to **28th June,2023** as part of the training required for his academic pursuit.

During this period, he has worked diligently in the assigned area (Department of Marketing) and has shown keenness to learn.

We wish him success in all future endeavors.

Thanking You,

For *Bengal FAITH Hospital*

Authorized Signatory

SL NO. 27

TO WHOMSOVER IT MAY CONCERN

To,

Mr./Ms. Souvik Ghosh
The University of Burdwan

Subject: Internship Completion Certificate

This is to certify that Mr./Ms. Souvik Ghosh student of The University of Burdwan has successfully completed internship with India Post Payments Bank from 22/05/2023 to 30/06/2023 at Burdwan, West Bengal.

As part of internship, he/she has done project on " Understanding financial inclusion through a behavioral finance lens: insights from IPPB internship".

During his/her tenure with IPPB, Mr./Ms. Souvik Ghosh was found to be sincere and result oriented.

India Post Payments Bank wishes Mr./Ms. Souvik Ghosh all the best for future endeavours.

Date: 26-04-2024

Place- New Delhi

Authorised Signatory

India Post Payments Bank Ltd.

SL NO. 27

TO WHOMSOVER IT MAY CONCERN

To,

Mr./Ms. Molla Sayem Mostafa
The University of Burdwan

Subject: Internship Completion Certificate

This is to certify that Mr./Ms. Molla Sayem Mostafa student of The University of Burdwan has successfully completed internship with India Post Payments Bank from 22/05/2023 to 30/06/2023 at Burdwan, West Bengal.

As part of internship, he/she has done project on " Promotion of India Post Payments Bank in the Rural Sector of India ".

During his/her tenure with IPPB, Mr./Ms. Molla Sayem Mostafa was found to be sincere and result oriented.

India Post Payments Bank wishes Mr./Ms. Molla Sayem Mostafa all the best for future endeavours.

Date: 26-04-2024 Place- New Delhi

Authorised Signatory

India Post Payments Bank Ltd.

Centre For HRD
Durgapur Steel Plant

SL NO. 27

rom
SM(HRD)
Centre for HRD

Ref. No.: 202

The vacation training of SHUBHRA SHANKHA MANDAL of BURDWAN UNIVERSITY having College Roll/Id No. BUR MBA 2023/026 as re
Mr./Ms. SUBRATA BASU THAKUR, T/No. 334999 is hereby confirmed from 27-05-2024 to 07-06-2024 for 11 working days approximately

The student must report at Centre for HRD (CHRD), Durgapur Steel Plant, Durgapur, West Bengal, on the starting date at 10:00AM comply
following:

1. To bring two recent passport sized color photos of the student with blue background.
2. To bring original student's Photo ID Card as issued by college/institution.
3. To bring this original confirmation slip, Aadhar Card along with a photo copy.
4. ~~To bring DSP Medical Booklet (only for Diploma Engg. student)~~
5. Must come wearing industrial safety shoes from reporting date.

Centre for Human ... DSP

विनांक
Date 8/5/24

Signature of CHRD Official
(with date & stamp)

Note : **Starting date and/or time as given in this confirmation slip may be changed/cancelled due to unforeseen circumsta**

10.141.4.76/chrd/vtonline/main.php#

Centre For HRD
Durgapur Steel Plant

SL NO. 27

From
GM(HRD)
Centre for HRD

Ref. No.: 20

The vacation training of ANNESHA CHANDRA of BURDWAN UNIVERSITY having College Roll/Id No. BUR MBA 2023/003 as requested PRADIP DAS, T/No. 342401 is hereby confirmed from 27-05-2024 to 07-06-2024 for 11 working days approximately.

The student must report at Centre for HRD (CHRD), Durgapur Steel Plant, Durgapur, West Bengal, on the starting date at 10:00AM comply following:

1. To bring two recent passport sized color photos of the student with blue background.
2. To bring original student's Photo ID Card as issued by college/institution.
3. To bring this original confirmation slip, Aadhar Card along with a photo copy.
4. To bring DSP Medical Booklet (only for Diploma Engg. student)
5. Must come wearing industrial safety shoes from reporting date.

दिनांक –
Date

Signature of CHRD Official
(with date & stamp)

Note : **Starting date and/or time as given in this confirmation slip may be changed/cancelled due to unforeseen circumsta**

10.141.4.76/chrd/vtonline/main.php#