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The Value of Plant Science Field Photographs

A thesis submitted in partial satisfaction
of the requirements for the degree Master of Science
in Library and Information Science

by

Brandy Watts

2017

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ABSTRACT OF THE THESIS

The Value of Plant Science Field Photographs

by

Brandy Watts

Master of Science in Library and Information Science

University of California, Los Angeles, 2017

Professor Johanna R. Drucker, Chair

This thesis will argue for the value of plant science field photographs. More specifically, it will consider David Turnbull's notion of 'knowledge as movement' through space while discussing field collecting as a type of knowledge production in motion and the field photograph a unique record of that.¹ Likewise, it will look at Helen Verran's notion of imaginaries as they relate to knowledge systems while discussing field photographs as visual records.²

Likewise, it will argue that the field photographs that botanists take while out in the field contribute to and are part of constructing our imaginaries. Taken together, they knit an uneven, inconsistent, and heterogeneous view of nature that collides with science. They are not objective

¹ David Turnbull. "Messy Assemblages, Emergent Protocols, and Emergent Knowledges." *4S Conference*. Pasadena. 2005.13-15.

² Helen Verran. "Re-Imagining Land Ownership in Australia." *Postcolonial Studies*. The Institute of Postcolonial Studies. (1998) v.1, n. 2. 237-254. <http://www.dourish.com/classes/readings/Verran-ReimaginingLandOwnershipAustralia-PostcolStudies.pdf>

nor absolute. They are not fixed nor refined. They are irregular records of knowledge production, which do not fit nicely into plant science research. Though ubiquitous within research, in some ways they are outliers of research. Knowledge occurs in tandem and is tangential as does movement through space, like field collecting.³

³ David Turnbull. "Messy Assemblages." 13-14.

The thesis of Brandy Watts is approved.

Ellen Pearlstein

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Johanna R. Drucker, Committee Chair

University of California, Los Angeles

2017

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Acknowledgements

Permission of use for the Alain H. Liogier specimen images has been provided by Barbara M. Thiers, Director of the William and Lynda Steere Herbarium at the New York Botanical Garden.

Permission of use for the Biodiversity of Hengduan Mountains online database images has been provided by David E. Boufford, Director of the Harvard Herbaria at Harvard University.

Permission of use for the Mildred E. Mathias slide images has been provided by Phillip W. Rundel, Director of the Mildred E. Mathias Botanical Garden as well as Distinguished Professor of Ecology and Evolutionary Biology at University of California, Los Angeles.

Introduction

Field photographs are central to plant science research. They are taken *in situ* primarily for two reasons. The first relates to the specific environment of collection: some aspect of the geography, microclimate, and ecosystem of the specimen locality is valuable to the identification of the specimen. The second pertains to the structure of the plant: some physical element of the specimen will not be preserved in its collection, pressing, and drying.¹ Once a plant is located for collecting, a photograph is typically taken before the plant is collected.² Plant science field photographs include photographs of plants as well as photographs of habitats.

The plant science field photograph metadata can provide the date/time, location/GPS, and photographer/botanist. The associative field collecting material like field notebooks, field notes, and specimen collection information, can also provide correlative dates, locations, and specific information concerning the botanist's field research. An additional aspect of plant science field photographs that is central to their value is that field photographs are visual records. They provide a visual trace of an event, which is evident in the image. While field photographs are valuable as single records, part of their value is in relation to each other and the collection material associated with them. The information that the metadata and collection material provide can function as evidence for the following statements concerning plant science field photographs:

¹ Barbara Thiers, "Field Photographs in Plant Science Research." *Interview with the Director of the New York Botanical Garden Herbarium*. Unpublished Interview. The William and Lynda Steere Herbarium at the New York Botanical Garden. Sep. 2013.

² Barbara Thiers. "Field Photographs in Plant Science Research."

The plant science field photograph is a record of:

1. the botanist's field research.
2. a botanist's view at a particular moment.
3. an individual's (botanists) lifetime.
4. the plant's (species) presence, where the plant is part of a larger ecosystem, geography, climate, and geological time.
5. a locality within a given region.
6. how a technology is used for purposes of recording and studying data.

By way of comparison with other field photographs and associative material, the field photograph is a record:

7. of how the environmental elements have continued to change since the photograph was taken.
8. of plant science research, photographic technology, plant species adaptation, habitat transformation, land conservation, climate change.
9. that makes the plant's (species) history present and in so doing makes it relevant across time.
10. of the botanist's movement and thus knowledge in motion.
11. of knowledge production that arises from the botanist's engagement with the environment.
12. is indexical of a particular occurrence, which is unique and unrepeatable.

The field photograph is a record in multiples, which approximates and reflects: the botanist's perception, the landscape and of a specific locality within a given region, and the camera technology at the time. In this way, the field photograph traces three types of history: knowledge, geography, and technology, which triangulate dialectically through time in the form of a record. Plant science field photographs allow us to see our varying views of nature, as they are constructed, practiced, and understood, and thus constitute an unmatched knowledge resource.

Collectively, field photographs construct an evolving view, a visual chronology, of the transformation of the geography, ecology, climate, land use, and human development in specific regions around the world. They are a progressive view that shows a range of environments that are thriving at different levels over time. In this way, they are an invaluable resource for numerous research fields because they represent a century and a half land survey on a global scale.

Plant Science Field Photograph Case Studies

This thesis will include three case studies, which will examine the value of plant science field photographs based on the information in their metadata, in conjunction with the associative collection material, and as visual records. The first case study will consider the plant science field photographs of the botanist Henri Alain Liogier. More specifically, it will look at the uncommon and largely obsolete method of attaching field photographs to herbarium specimen sheets, a method which Liogier used within his research.³ The second case study will look at

³ Alain H. Liogier, "Plant Science Specimen Sheets." *The William and Lynda Steere Herbarium*. New York Botanical Garden, Bronx, New York. Accessed 2012-2014.

field photographs from the Biodiversity of the Hengduan Mountains of south-central Asia.⁴ It will consider them in relation to the associative collection information provided with the field photographs in the Hengduan Mountains online database. The third case study will involve the plant science field photographs of botanist Mildred Mathias. More precisely, it will look at the field photographs in conjunction with their associative field notebooks.⁵ Taken together, these three case studies will consider how field collecting, field photographs, and field collection material are co-constitutive with regard to knowledge production in plant science research.

Thesis Format

This thesis will be presented in two parts. The first part will present the theoretical framework of the thesis. More precisely, it will give attention to Helen Verran's notion of imaginaries as they relate to knowledge systems in indigenous cultures as well David Turnbull's notion of 'knowledge as movement through space.'⁶ Verran and Turnbull's ideas will be discussed in relation to plant science field photographs, field collecting more broadly, and their value. Likewise, the second part of the thesis will focus on three case studies in plant science research, which focus on to the value and function of field photographs within the research of two botanists and one plant science research survey: Alain H. Liogier, the Hengduan Mountain Region Survey, and Mildred E. Mathias. Taken together, the two parts (theoretical and case studies) revolve around and illustrate the value of the field photographs in plant science. In doing

⁴ Biodiversity of the Hengduan Mountains. Plants and Fungi of South-Central China. Biodiversity of the Hengduan Mountains. Accessed 1 Oct 2016. <http://hengduan.huh.harvard.edu/fieldnotes>

⁵ Mildred E. Mathias, "Plant Science Research Material Collection." *The UCLA Herbarium*. University of California Los Angeles, Los Angeles, California. Accessed: Jan 2017.

⁶ David Turnbull, "Messy Assemblages." 13-15.

so, they bi-directionally link through their illustrations and discussion, making them less distinct parts and more an interlinked conversation.

Part I: Theoretical Framework

Field Photographs As Records of Knowledge In Motion

When a botanist goes out into the field to collect, through a range of actions and processes, she synthesizes an array of information as she goes.⁷ Typically when out collecting, a botanist collects within a specific region. This is selected ahead of time. The criteria for choosing a region varies. It usually relates to seed dispersal, plant distribution patterns, and past collecting. Field collecting involves geography; studying its characteristics. It requires reading many elements within the environment in relation to each other. It involves traversing the land. Moving through a range of climatic, ecological, and vegetative zones and perceiving variations.⁸ Synthesizing dispersed and disordered stimuli while in motion.⁹ This specific type of field acuity through specific collecting behaviors and activities is a form of knowledge production.¹⁰

This section will begin with arguing that field collecting is a specific type of knowledge production that is spatial- co-produced with the environment while moving through it.¹¹ Meaning

⁷ David Turnbull, "Messy Assemblages." 13-15.

⁸ Barbara Thiers, "Field Photographs in Plant Science Research." *Interview with the Director of the New York Botanical Garden Herbarium*. Unpublished Interview. William and Lynda Steere Herbarium at the New York Botanical Garden. Sep. 2013.

⁹ David Turnbull. "Messy Assemblages." 13-15.

¹⁰ Helen Verran, "A Postcolonial Moment in Science Studies: Alternative Firing Regimes of Environmental Scientists and Aboriginal Landowners." *Social Studies of Science*. SAGE. (2002) 32; 754. CCLE.

¹¹ David Turnbull, "Messy Assemblages." 13-15.

that, it generates a unique kind of knowledge in motion.¹² Likewise, this section will look at the question in what ways are field photographs a reflexive and indexical trace of this particular type of knowledge in motion?

Field Collecting as Knowledge in Motion

Field collecting is guided by research questions, framed within plant science and taxonomy. Through the complex nature of field collecting results in it always being in disarray to a certain degree. In other words, it is a state of order, ordering, and disorder concerning research information. With the plant science framing and recording of information comes a certain degree of order. That said, with the amount of stimuli, the botanist is continually assessing and reassessing environmental components and variables as she moves through it. Some elements may escape either her attention or assessment and so are more peripheral and scattered. Rarely is field collecting stationary, and when it is it is typically temporary. Because of this, field collecting is a type of information gathering and synthesizing while moving.¹³ And due to the framing and degree of stimuli, field collecting is a type of non-static hybrid state of both order and disorder.¹⁴

In his book *Maps Are Territories: Science Is An Atlas*, while discussing the nature of maps, David Turnbull turns to Ludwig Wittgenstein's idea of 'forms of life.'¹⁵ Specifically, Turnbull refers to the idea as "all language, communication and shared experience has to be based in

¹² David Turnbull, *Maps Are Territories: Science Is An Atlas*. Deakon University: Deakon University Press. (1989). 27 Print.

¹³ David Turnbull, "Messy Assemblages." 13-15.

¹⁴ Helen Verran, "A Postcolonial Moment." 729-761.

¹⁵ David Turnbull, *Maps Are Territories*. 10.

doing, in practical action...knowledge can be seen as a practical, social, and linguistic accomplishment, a consequence of the bringing of the material world into the social world by linguistic and practical action.”¹⁶ In this way, knowledge arises out of a network of socio-linguistic actions through the environment. Field collecting is a series of actions that give rise to knowledge, which moves, transforms, and does not always transfer completely into data.

Additionally, in his text “Messy Assemblages, Emergent Protocols, and Emergent Knowledge,” Turnbull discusses knowledge as dialogic and coproduced through the engagement between people and the environment.¹⁷ Knowledge arises from people, places, and practices as relational assemblages. More specifically, Turnbull says: “The ways we order reality, our interactions experiential, social and linguistic, shape the ways we experience the environment, just as the environment shapes our experiences and interactions. It is a continuous, contingent, construction process, a coproduction in which knowledge is emergent”¹⁸ Knowledge arises through the interlinked nature of our actions with the environment. The inseparability of the two coproduces knowledge. There is a certain immediacy to field collecting in how it is a generative process in which the botanists and the environment together, through a very situated type of engagement produce knowledge.

Likewise, and by way of Humberto Maturana and Francisco Varela, Turnbull discusses the notion of equating living with knowing. Knowing is an emergent relational process that is

¹⁶ David Turnbull, *Maps Are Territories*. 10.

¹⁷ David Turnbull, “Messy Assemblages.” 4.

¹⁸ David Turnbull, “Messy Assemblages.” 4.

biological and spatial, occurring through movement.¹⁹ In this way, knowledge production is a process that is alive. It ‘furthers itself’ recursively as a type of ongoing relational-spatial momentum. Which occurs through a certain dynamism linking people, places, and practices. Again Turnbull: “We make knowledge as we move through space.”²⁰ Knowing is engagement in motion. Through overlapping, intersecting, and interrupting trajectories of relational practice we become what we know. We write, rewrite, and overwrite our understandings through spatial interactions.²¹ Field collecting necessitates a very dispersed and discursive view of the space; a physical synthesis of the environment while moving through it.

Additionally, through discussing tagging, mapping, and cartography in relation to ‘knowledge as movement’ Turnbull references Tim Ingold.²² Specifically, his discussion of geographical representations as they relate to knowledge: “...people’s knowledge of the environment undergoes continuous formation in the very course of their moving about it...we know as we go.”²³ Our unfixed and faceted worlds, linked and littered with stimuli, arise from our movements. Our sense of understanding emerges and evolves constitutively with our surroundings. It is through movement with our environment, as botanists do, that we become what we know.

¹⁹ David Turnbull, “Messy Assemblages.” 8-9.

²⁰ David Turnbull, “Messy Assemblages.” 13.

²¹ David Turnbull, “Messy Assemblages.” 13-14.

²² David Turnbull, “Messy Assemblages.” 14.

²³ David Turnbull, “Messy Assemblages.” 14.

Plant Science Field Photographs

Each botanical field photograph represents a very particular kind of information. It is a type of multiple record. It reflects many things: a botanist's field research, a locality within a given region, a botanist's view at a particular moment, a technology used for purposes of recording and studying data. It also is a record of the plant's history where the plant is part of a larger ecosystem, geography, climate, and geological time that continues. These environmental elements that the field photograph reflects are dynamic and have evolved as it has remained relatively the same. In this way, it becomes a record, by way of comparison, of their change: of that which has continued to change since the photograph was taken. Any point along a continuum can provide information concerning the larger system that the continuum is part of, be it ecological or technological. Each field photograph marks a point within diverging and overlapping trajectories: plant science research, photographic technology, plant species adaptation, habitat transformation, land conservation, climate change, a particular botanist's research, an individual's lifetime. The field photograph makes the plant's history present and in so doing makes it relevant across time.²⁴

What is interesting about the field photograph, as a means for recording information, is that it does not necessarily order information in the way that writing down a specific taxonomic name, locality, or elevation does. Field photographs, while they include a certain amount of information within the frame, are still disordered with regard to how that information is interpreted.

Likewise, before a botanist takes a photograph, he observes, pauses, pivots, meaning that he is in motion. In this way, the field photograph, while reflecting his specific angle and view, is also a

²⁴ Brandy Watts, "Historical Assessment of the LuEsther T. Mertz Library Photo Vault."

trace of his movement and thus knowledge in motion.²⁵ Additionally, the plant and environment, which co-constitute each other, and which are the focus of the photograph, are also alive, relational, and influx. Thus, the photograph comes out of and reflects intersecting information. This dynamic of information does not cease once the photograph is taken. The photograph does not still that information. An image emerges; co-produced by the photograph and the observer of the photograph. The information that a photograph reflects is not fixed. It arises from a visual exchange between the image and the viewer of the image. Therefore, there is a certain disorder to a photograph, making it always somewhat indefinite. Photographs have a way of continuing beyond their frames because of how we engage with them. They are dialogic with memory, narratives, stories, imaginaries, relations, and other images.

Plant Science Field Photographs and Imaginaries

With this in mind, Helen Verran's notion of 'knowledge making' will be considered as a segue to discussing imaginaries. Within Verran's text "Re-Imagining Landownership in Australia," she discusses knowledge making.²⁶ She suggests this as a possible entry point with regard to considering landownership negotiations between Australian pastoralist and the Aborigine.²⁷ The Aborigine sense of owning the land comes out of their understanding that they "...came into being with the land itself. The land was made meaningful as it was peopled in a network of interconnected places. Through these places the land owns them as they own the land. Owning the land is publically articulating the stories through which the land is meaningful as a set of

²⁵ David Turnbull, "Messy Assemblages." 13-14.

²⁶ Helen Verran, "Re-Imagining Land Ownership in Australia." 242-243.

²⁷ Helen Verran, "Re-Imagining Land Ownership in Australia." 242-243.

interconnected places.”²⁸ An emergent symbiotic network of relations. In contrast, Western notions of land ownership involve titles, which are used as official documents of exclusion.²⁹

Before proceeding further, an idea of David Turnbull’s from his text “Maps Are Territories” will briefly be considered. It relates to his discussion of the function of spatiality as it relates to knowledge and experience. In particular, he stresses that although spatiality is elemental to all cultures, the notion of ‘relative location’ varies.³⁰ Relative location may in part be what distinguishes experience between cultures. Specifically, the idea of natural objects as arising relationally out of a cultures’ episteme or ontology as opposed to being fixed in nature.³¹ Giving certain attention to Western culture, Turnbull says: “Those who are imbued with what is sometimes called ‘the Western world view’ think of objects as having fixed characteristics and defined boundaries and as having a position specifiable by spatial coordinates.”³² This describes the pastoralists’ notion of land as unequivocally constant in terms of space and perimeter. It is finite and absolute. A static terrestrial commodity. An object to be owned.³³

For the Aborigine, knowledge is a performative process of engagement and negotiation with the local land, people, rituals, relations, and dreaming.³⁴ The imaginary is a central part of the Aborigine knowledge systems. By contrast, for the pastoralists, and Westerners more broadly,

²⁸ Helen Verran, “Re-Imagining Land Ownership in Australia.” 241.

²⁹ Helen Verran, “Re-Imagining Land Ownership in Australia.” 241.

³⁰ David Turnbull, *Maps Are Territories*. 2.

³¹ David Turnbull, *Maps Are Territories*. 2.

³² David Turnbull, *Maps Are Territories*. 2.

³³ Helen Verran, “Re-Imagining Land Ownership in Australia.” 241.

³⁴ Helen Verran, “Re-Imagining Land Ownership in Australia.” 242-243.

the imaginary is not part of knowledge and instead considered aesthetic.³⁵ Likewise, knowledge is not seen as local and embedded in practice, nor performative, to the pastoralists as it is for the Aborigine. For the pastoralist “reasoning men are knowers of truth; nature can only be known about.”³⁶ This is premised on a certain separation of both humans and nature as well as knowledge and nature.

Verran argues that central to land ownership negotiations is the pastoralists understanding three elements of the Aborigine knowledge system: imaginary, local, and performative.³⁷ Pastoralists need a new construction, with categories and in the form of stories and pictures, from which land can be understood and engaged with.³⁸ Through looking closely at Kant, Verran shows how philosophy tacitly denies the imaginary. By looking at his metaphor of the island, the ‘exclusion of the imaginary’ becomes the distinguishing characteristic of reason.³⁹ In light of this, and as a possible practical means for the pastoralists, Verran stresses that careful consideration be given to this metaphor. “I suggest we take Kant’s metaphor in full, and treat it seriously. To take it in full is to see the island and the seas which surround it as integral to each other. To take the metaphor seriously is to see that it is through being lived space that both the island and the seas become meaningful. Taking the metaphor seriously makes the notion of empty space untenable.”⁴⁰ Simultaneously, Verran suggests that the imaginary and knowledge are central to

³⁵ Helen Verran, “Re-Imagining Land Ownership in Australia.” 243.

³⁶ Helen Verran, “Re-Imagining Land Ownership in Australia.” 243.

³⁷ Helen Verran, “Re-Imagining Land Ownership in Australia.” 243.

³⁸ Helen Verran, “Re-Imagining Land Ownership in Australia.” 243.

³⁹ Helen Verran, “Re-Imagining Land Ownership in Australia.” 244-245.

⁴⁰ Helen Verran, “Re-Imagining Land Ownership in Australia.” 245.

each other and meaning arises from ‘being lived space.’ More precisely, since meaning is part of knowledge, then it follows that knowledge arises from ‘being lived space.’ This also suggests that nature is not separate from knowledge nor humans from nature. Likewise, in arguing that the reintegration of the imaginary into Western notions of knowledge could facilitate negotiations of landownership, Verran says the following: “Doing without imaginaries, denying the pictures and stories inherent in our knowing, is a luxury which can no longer be justified, if indeed it ever could be. I suggest that moderns need to bring back into view our denied imaginaries so we can more easily get on with the business of working knowledge traditions together and recognizing non-human agents, as we make knowledge and remake worlds.”⁴¹ The division between reason and the imaginary is indefensible. As is the separation of knowledge, nature, and humans.

Likewise, and turning again to Turnbull’s discussion of maps in relation to knowledge and experience to discuss field photographs further. Specifically, he says: “Our experience and our representations are formative of each other and are only separable analytically.”⁴² This applies to images as well as imaginaries, to song lines as well as field photographs. Our experience becomes our representations and vice versa; their dialogue never ceases and they are not strictly separable, only in language. They are part of our knowledge. When we divide our experiences and our representations in language we create artificial and questionable limits: “The limits of my language mean the limits of my world.”⁴³ These divisions constrain our experiences and understanding of knowledge; like the notion of land titles.

⁴¹ Helen Verran, “Re-Imagining Land Ownership in Australia.” 243.

⁴² David Turnbull, *Maps Are Territories*. 61.

⁴³ Ludwig Wittgenstein, from David Turnbull. *Maps Are Territories*. 2.

Likewise, both our scientific sense of nature and our more informal understandings have largely been constructed with the lens, in images. Representations are part of how we actualize, articulate, and understand our worlds. Additionally, again Turnbull, “It is now recognized that theories and observations are inseparable, ...To see science as a ‘field of practices’ rather than a network of theories makes a profound difference... (it) highlights the importance of skills and tacit knowledge, which are often overlooked or suppressed when the purely theoretical is emphasized. Skills and tacit knowledge are modes of knowing the world...”⁴⁴ Practices, whether through *gurrutu* or field collecting, are how we navigate, engage with, and make sense of phenomena, which we make meaningful in diverging ways, including through representations. These diverging ways, enable us to understand our ourselves, each other, and our myriad knowledge systems. Plant science field photographs allow us to see our varying views of nature, as they are constructed, practiced, and understood, and thus constitute an unmatched knowledge resource.

Field photographs are, as Turnbull describes within the context of discussing scientific theories and maps, indexical.⁴⁵ Each field photograph is an instantiation of itself as indexical of a particular occurrence, which is unique and unrepeatably. More precisely, it indexes a collision of simultaneous micro-events in one moment: the biodiverse ecosystems, which overlaps with others; the field collecting relative to the botanists’ research; the plants’ life within a specific setting; the position of the botanist in relation to the plant and his photographic sensibilities; the time of day relative to the season; this list could continue. The point is, the field photograph is

⁴⁴ David Turnbull, *Maps Are Territories*. 61.

⁴⁵ David Turnbull, *Maps Are Territories*. 27.

not universal. An event cannot be universal. Turnbull elaborates further on indexicality: “Another way of capturing the notion of indexicality is to recognize its connection to ‘forms of life.’ All indexical statements are embedded more or less explicitly in a form of life. Non-indexical statements attempt to transcend or deny a form of life. In an attempt to maximize the objectivity of scientific theories and to display them as universal truths they are increasingly distanced from their forms of life and consequently lose their connections to the world.”⁴⁶ The process by which a ‘form of life’ becomes non-indexical is one of careful and crass practices, which refine it into data allowing the complexities and complicatedness of context to be left out.

Again Verran: “...collective picturing and storytelling about the land with its possibilities for emotional ladenness and material embeddedness is an inherent part of knowing ...we must...include our use of imaginaries in our accounts of our knowledge.”⁴⁷ The field photographs that botanists take while out in the field contribute to and are part of constructing our imaginaries. Taken together, they knit an uneven, inconsistent, and heterogeneous view of nature that collides with science. They are not objective nor absolute. They are not fixed nor refined. They are irregular records of knowledge production, which do not fit nicely into plant science research. Though ubiquitous within research, in some ways they are outliers of research. Knowledge occurs in tandem and is tangential as does movement through space, like field collecting.⁴⁸ It would prove fruitful for plant science research to re-imagine field photographs from their periphery to include them within their knowledge perimeter.⁴⁹

⁴⁶ David Turnbull, *Maps Are Territories*. 27.

⁴⁷ Helen Verran, “Re-Imagining Land Ownership in Australia.” 249.

⁴⁸ David Turnbull, “Messy Assemblages.” 13-14.

⁴⁹ Helen Verran, “Re-Imagining Land Ownership in Australia.” 249.

Thus far, this thesis has argued for the value of plant science field photographs. More specifically, it has considered David Turnbull's notion of 'knowledge as movement' through space while discussing field collecting as a type of knowledge production in motion and the field photograph a unique record of that.⁵⁰ Likewise, it has looked at Helen Verran's notion of imaginaries as they relate to knowledge systems while discussing field photographs as visual records.⁵¹

With this framework in mind, this thesis will consider three case studies involving plant science field photographs. More specifically, it will examine the value of plant science field photographs based on the information in their metadata, in conjunction with the associative collection material, and as visual records and be discerning of when the field photograph information is correlative and when it is supplemental and how. The first case study will consider the plant science field photographs of the botanist Henri Alain Liogier. It will look at the uncommon and largely obsolete method of attaching field photographs to herbarium specimen sheets, a method which Liogier used within his research. This case study will involve reviewing 217 of Liogier's plant specimen sheets with field photographs and consider the information function of the field photograph in relation to the locality map, collection information, and specimen. The second case study will look at field photographs from the Biodiversity of the Hengduan Mountains of south-central Asia, which reflects the research of Harvard botanist David Boufford among others.⁵² It will consider the field photographs in relation to the associative collection

⁵⁰ David Turnbull, "Messy Assemblages." 13-15.

⁵¹ Helen Verran, "Re-Imagining Land Ownership in Australia." 237-254.

⁵² Biodiversity of the Hengduan Mountains. Plants and Fungi of South-Central China. Biodiversity of the Hengduan Mountains. Accessed 1 Oct 2016. <http://hengduan.huh.harvard.edu/fieldnotes>

information provided with the field photographs in the Hengduan Mountains online database. The third case study will involve the plant science field photographs of botanist Mildred Mathias. It will look at the field photographs in conjunction with their associative field notebooks and examine in what ways the field photograph and field notebook information overlap and in what ways they do not. Taken together, these three case studies will consider the value of field photographs by looking at how field collecting, field photographs, and field collection material are co-constitutive with regard to knowledge production in plant science research.

Part II: Three Case Studies In Plant Science Research

Three Case Studies: Introduction

What follows are three case studies involving plant science field photographs. More specifically, these case studies examine the value of plant science field photographs. This is based on the information in their metadata, which is considered in conjunction with the associative collection material, and as visual records. Inherent to the examination is discerning when the field photograph information is correlative and when it is supplemental and how.

The first case study considers the plant science field photographs of the botanist Henri Alain Liogier. It looks at the uncommon and largely obsolete method of attaching field photographs to herbarium specimen sheets, a method which Liogier used within his research. This case study involves reviewing 217 of Liogier's plant specimen sheets with field photographs and considers the information function of the field photograph in relation to the locality map, collection

information, and plant specimen. The field photographs discussed in the first case study can be found in Appendix I.

The second case study looks at field photographs from the Biodiversity of the Hengduan Mountains of south-central Asia. This online database reflects the research of Harvard botanist David Boufford among many other affiliate botanists.⁵³ This case study considers the field photographs in relation to the associative collection information provided with the field photographs in the online database. The field photographs discussed in the second case study can be found in Appendix II.

The third case study involves the plant science field photographs of botanist Mildred Mathias. It looks at the field photographs in conjunction with their associative field notebooks and examines in what ways the field photograph and field notebook information overlap and compliment each other and in what ways they do not. More precisely it looks at the value of considering these two elements, which are part of the broader field collecting information, together. The field photographs discussed in case study three can be found in Appendix III.

Taken together, these three case studies consider the value of field photographs by looking at how field collecting, field photographs, and field collection material are a co-constitutive type of knowledge production in plant science research.

⁵³ Biodiversity of the Hengduan Mountains. Plants and Fungi of South-Central China. Biodiversity of the Hengduan Mountains. Accessed 1 Oct 2016. <http://hengduan.huh.harvard.edu/fieldnotes>

Case Study I: The Plant Specimen Sheets with Field Photographs of Alain H. Liogier

Context:

Alain Liogier was a French botanist whose research primarily focused on the Caribbean region—specifically Cuba, the Dominican Republic, and Puerto Rico. Liogier’s research was extensive and prolific. He was a Guggenheim Fellow for Studies in Plant Science as well as an affiliate of New York Botanical Garden, the Smithsonian Institute, Harvard University, University of Puerto Rico, and the National Botanical Garden in the Dominican Republic. Over the course of his career he published widely and described more than 300 plant species to science.

Of the many research trips throughout Liogier’s career and part of what distinguishes him among botanists, is a collection of field photographs that he took over a 15-month period between 1968-1969. During this time, Liogier conducted extensive field research throughout the Dominican Republic. This particular research was funded by a National Science Foundation grant for research on the plants of the Dominican Republic. Over the course of this research, Liogier took field photographs of the plant specimens that he collected while out in the field. What sets this particular collection of field photographs apart from others is that they are 2 in x 3 in Kodachrome prints, which reflect a specific region and period of field research. Toward the very end of his NSF grant in 1969, Liogier sent his field photographs, along with the plant specimens he collected, from the Dominican Republic to the William and Lynda Steere Herbarium at the New York Botanical Garden to be part of their collection. This is where the field photographs are currently held. Each one is affixed to a specimen sheet along with the original plant specimen, collection information, and a small map for noting the locality. And then each specimen sheet is filed within the herbarium.

There are approximately 20,000 plant specimens that Liogier collected over the course of his career that are held in the NY Herbarium. Of those, 217 have field photographs attached to the plant specimen sheets.

Method:

The 217 plant specimens of Liogier's with field photographs attached were identified using Emu database onsite at NY. A list was compiled and the specimens were located and pulled from the herbarium and digital scans were made. The analysis of this case study relies on the digital scans of the plant specimen sheets. In particular, this analysis gives attention to the collection material that is available on the specimen sheet. This material reflects information gathered while collecting and takes a variety of forms. This material includes the following: the plant specimen, the collection label, the locality map, and the field photograph. Within this analysis, focus will not be given to any annotation labels or any packets containing additional plant specimen matter.

Collection Material on Specimen Sheets: Overview

The following will provide a detailed description of the collection material that is available on the specimen sheets.

Plant specimens are collected while conducting field research. The specimens are foundational to plant systematics, population and community ecology, genetics, and molecular biology. They are collected primarily for the following reasons: when a species that is new to science and to further

knowledge of species distribution, flora ecology, and biodiversity as it changes.⁵⁴ Once a plant is collected, it is usually flattened and dried between pieces of newspaper on drying racks in the field. When the plants are completely dry, they are stacked, separated by newspaper, and bundled between two pieces of cardboard. This allows for safe transport, usually to affiliate institutions, resulting in minimal damage to the plants. Once the specimens arrive at the affiliate institution, they are frozen for approximately a week and then either processed or stored as bundles until they can be processed. The processing of specimens includes mounting each specimen onto archival paper and attaching any collection material to the specimen sheet, which includes specimen labels, locality maps, and field photographs. When mounted, the plant specimen is laid out onto the paper to maximize plant surface space (leaves, stems, flowers, fruits, seeds, and roots) visibility.

Collection labels include information concerning the collection of the specimen in the field. More precisely, they list the collection number, the species determination (if determined, by whom, and the date of determination), a description of the plant, and details concerning the habitat and locality. The plant description includes the type of plant (shrub, tree, vine, etc.), its height, and the specifics (characteristics) of the flowers and fruits. The habitat and locality information detail the plants' surroundings (ecological niche), substrate, elevation, and proximity to the nearest prominent geographical feature, town, or city. The collector and date of collection are also indicated on the collection label. The heading of the collection label usually includes the name of the institution where the specimen is held and the title of the research project. Lastly, if

⁵⁴ Mare Nazaire, Research at RSA." *Interview with the Manager of the Rancho Santa Ana Herbarium*. Unpublished Interview. Rancho Santa Ana Herbarium, Rancho Santa Ana Botanic Garden, Claremont, California. 15 Jul 2016.

the research is funded by a specific agency, like the NSF, then that is oftentimes listed at the bottom of the label.

Locality maps are less common on specimen sheets. When they are present, they are usually on small pieces of paper that are adhered to the specimen sheet. Less common are maps that have been stamped onto the specimen sheet. Additionally, the degree of detail varies across the types of maps with some listing place names and markers and others just presenting the outline of a country. Regardless of the degree of detail, the location of the collecting event is typically marked with a dot somewhere on the map.

Plant science field photographs represent the plant and/or habitat usually before, though sometimes after, the plant is collected. Some field photographs include the botanist or other members of the field research expedition or trip. The reasons for doing so vary, though often this is done for either scale or association. Likewise, some botanist put objects beside the plant to indicate scale as well.

Field photographs that are attached to plant science specimen sheets span the history of the photographic print. Although a less common practice within plant science, both broadly and historically speaking, they range to include black and white and color prints as well as analog or digital technology. The prints vary in size from 1 in x 1 in prints to the prints almost the size of a specimen sheet. The size of the print primarily depends on the camera technology used at the time as well as the nature of the specimen. Sometimes the collection number of the collection event is written on the photograph print along the edge, though not always. Occasionally the

taxonomic name is written on the print as well. Most field photographs are affixed to the specimen sheet with some type of archival adhesive.

Plant Science Field Photographs As Visual Records:

The history of plant science research is grounded in empiricism. All research elements of this particular biological field rest in this specific type of inquiry based on observation. Observation coupled with analysis give rise to understanding. But observations occur in increments, which can be discursive as well as dispersed. Regardless of their particular nature though, these empirical increments are not discrete, rather tie into each other and transform understanding into knowledge. Each observation informs the next and the following can retroactively recast the pervious.

Visual records provide evidence in support of arguments. With field photographs specifically, they provide evidence of a collection event, which consists of a series of observations. In this way, the field photographs are visual records of the very act of observing from which the research is based. On the one hand, they are records of the habitat, geography, and plant at a specific moment in time, though on the other, they are records of the specific botanist's observation, empiricism in action, in that moment. So while they show the ecological condition of particular locations in the field, which can be compared with the present as well as any other point in time, they also show an empirical instant within the unceasing process of observing, which is integral to plant science research in the field.

Part of what is distinct about field photographs is in how they become a type of referent for what they do not include. More specifically, by way of occlusion or partial inclusion, of the multitude of elements populating the immediate surroundings of the collection event, the field photograph shows a particular and limited view, which could have been taken from any number of vantage points in relation to the plant. The field photograph shows a facet of the botanist's view at the time: a plant with white flowers on a sea cliff above the ocean, though an ocean, cliff, and vegetation which continue within the botanist's perspective as he survey's the land. In this way, the field photograph becomes a record of what it is not, though suggests exists outside the frame.

Likewise, each field photograph is a record of a unique event. An event that is dynamic and complicated in many ways because it is situated within a natural setting. It is a record that is alive in how it suggests the informational complexity of the field event glimpsed in the photographed. There are limitations though to the degree to which the botanist's experience and understanding of the event can be measured and translated into recorded data. The field photograph is a record of information that has not been reduced, rather the information seems to arise and skate along the surface in varying ways depending on the observer of the image. It is a visual approximation of a collection of impressions of an empirical event teaming with and revolving around biological phenomena, which is unrepeatable. Unlike the other collection material on the specimen sheet, the field photograph seems to hint at this very notion by way of self-implication: life continues beyond and outside of the field photograph.

Liogier Collection Material on Specimen Sheets:

The heading on the collection labels found on the Liogier specimen sheets have “The New York Botanical Garden” listed as the institution. Below this is the title of the NSF grant funded project, which is the “Plants of Hispaniola Dominican Republic.” The collection number is listed underneath the title as is the original species determination of the plant (taxonomic name) with the determiner and date of determination. With the exception of ten specimens, which were determined by other botanists and six, which were not determined at the time, all of the Liogier specimens were originally determined by Liogier. Of those determined by Liogier, fourteen were newly described to science. The collection information, which includes the specimen description, habitat, and locality, is below the determination either as one paragraph or two. The collection information begins with the specimen description and is followed by the habitat and locality information. At the bottom of the label is Liogier’s name listed as the collector as well as the date of collection. Directly below this the funder, NSF, is indicated. Both the header and footer are preprinted on the label. The collection information, including the collection event number and determination are typed by hand.

The maps present on Liogier’s specimen sheets are of the stamped variety. The map is relatively simple. It consists of an outline of the island of Hispaniola as well as the two countries that is comprised of: Haiti and the Dominican Republic. There is a total of fifteen small dots on the map across both countries (without place names) with ten on the Dominican Republic and five on Haiti. Both the outline and dots are in black stamp ink. The dots represent geographical locations. The location of the collection event pertaining to the specimen sheet is indicated within the country of the Dominican Republic with a red dot marked with ball point pen ink.

This dot was applied once the map was stamped onto the sheet. The location of the collection event dot varies across specimens, though remains within the country of the Dominican Republic.

The field photographs that are found on the Liogier specimen sheets are 2 in x 3 in Kodak Kodachrome prints. These were taken during the years of 1968-1969. The photographs are in color. The specific quality of the color is particular to 35 mm Kodachrome film. Most of the photographs are of the plant specimens in its natural environment before having been collected. The proximity to the plant varies with some being only inches away from the plant while others are several yards. Those photographs that are taken further away from the specimen include more of the surrounding vegetation, habitat, and geography. Those photographs that are taken closer to the specimen show more details of the plant's specific characteristics and substrate. Some of the field photographs show the collected plant specimen in someone's hand- held out to be photographed by someone who is outside the frame of the image. Vary rarely is a person in the field included in the frame of the photograph. Usually the image is only of the plant.

Occasionally, the plant specimen has been placed on a surface (paper, cloth, or skin) and then photographed after having been collected. With the exception of a few, all of the photographs were taken outside while collecting in the field. There are several instances in which an object (or hand) is placed beside a plant, or vice versa, to show scale. The majority of the specimen sheets have only one photograph of the plant attached. Those specimen sheets that have two field photographs attached, show the plant from different vantage points and proximities. Often times, one photograph is a close-up view of one plant characteristic like a flower with another taken

from further away to show the entirety of the plant. Most of the photographs are of specimens with flowers and/or fruits.

The orientation of the photographs varies between vertical (portrait) and horizontal (landscape). Likewise, most of the photographs have been placed on the specimen sheet right side up, with the plant growing according to the laws of gravity and the specific limitations of its species. There are however, several photographs that have been affixed to the specimen sheet upside down. This is primarily due to the collection event number having been mistakenly written on the photograph when it is not properly oriented.

The collection event number is most often located just below the image on the bottom right side of the frame. Approximately 10% of the images are slightly out of focus, though not to a degree that prevents being able to discern that plant characteristics. The overall quality of both the contrast range as well as color range of the photographs is good. There are some images that are over exposed, making them appear blown out in places. Likewise, some have noticeably limited color range, resulting in the photographs having a color imbalance (making them appear too cyan, magenta, or orange).

As visual records, Liogier's field photographs are indexical of his 15-month field research encompassing much of the remote areas of the Dominican Republic. More precisely, they reveal how he observed by way of a lens and recorded his observations with the camera to become records of his collecting events. In this way, the field photographs provide visual traces of these events. Likewise, they are evidence of his field collecting trajectory: where he was at a given

time and day and what he was looking at. In this way, the field photographs show the collecting events as points of knowledge production as he traverses the uncommonly traveled areas of the DR looking at plants.

Collection Material: A Collection of Representations

While the placement of the collection material on specimen sheets varies, generally the arrangement of the material is relatively similar across specimen sheets. The plant specimen, having already been dried and flattened, is usually placed in the center of the sheet. The size of the plant specimen determines how much of the sheet it covers. Usually the specimen occupies anywhere from one-fourth to two-thirds of the sheet. The collection label is most often found toward the edge of the sheet, usually along the bottom. The precise placement of the collection label varies across specimens. Additional collection material, like a map or field photograph, are frequently placed near the collection label, though can also be found elsewhere along the edge of the sheet. How the plant specimen is arranged on the sheet and the amount of space that it takes up usually dictates where the additional collection material is placed.

The plant specimen is a physical representation of the plant in dried form. It is a representation of the plant after having been collected and shows it in isolation, outside of its habitat, having been removed from the soil. Affixed with barely noticeable glue and in some cases thread, the plant's partially preserved structure and slightly diminished three-dimensionality makes it appear like a slice of its original growing existence. In this way, this representation of the plant is a compressed version of its previous form, making it a symbol of its life in the field and therefore a type of equivalence.

By providing several types of information (plant description, habitat, locality, date), the collection label functions in a number of ways. In text form, it describes the plant's characteristics, including a precise measurement of its height, distinct aspects of the ecological setting, the location and proximity to locations nearby, and the altitude. Likewise, it also provides the collection event date, collection number, and taxonomic name. These field collection notations found on the label, in the form of typed text, become written symbols of what they describe and thus textual representations of the plant specimen.

The field photograph is a lens-based visual representation that shows the plant growing in its environment among other species. It shows the plant thriving and what that looks like: its structure, color, characteristics, and size while it is still alive in the natural elements (sunlight, wind, precipitation, shade, etc.), which are integral to its success as a species. Likewise, it shows its particular growing tendencies and the specific micro-habitat where it is located. It is also a visual record of the collection event as well as the botanist's research and perspective at a specific time and place.

The locality map is a visual representation of the island, countries, and approximate locality of where the plant was collected. It is a stamped outline that shows scale by way of their varying perimeters. Since the red dot, which indicates the collection event location, was applied with a pen, then the representation is a drawing as well as symbol of the plant: where it grew and was located.

Taken together, the plant specimen is a physical description of the plant, the collection label a textual description, the map a delineated description, and the field photograph a pictorial as well as perspectival description. Each describe the plant differently by distinct means. The plant specimen provides details of the plants physicality. The collection label gives details of the appearance of the plant upon collection as well as specifics of the exact location of the collection. The map provides an approximation of the area of the plant's collection. The field photograph shows visual details of how the plant looked in its environment when collected as well as specific details of the botanists' view in that moment. Each material offers a different set of descriptions with allowances and limitations specific to the representational form. Taken together the collection materials describe the plant specimen in multiples as analogous to how its presence is understood in space.

The specific nature of how these materials are arranged as well as the diversity of information that they provide through their varied representational forms, results in a certain horizontal as opposed to hierarchical reading of the material. Their placement on the same 11 in x 14 in paper where all materials are visible at once, levels the materials in such a way that lateralizes how they are read. More precisely, the reading of a specimen sheet occurs in diagonals by criss-crossing between the collection materials, tracing and retracing, linking the information present because each material is distinct in the kind of information that it provides while also being similar. In this way, it is a reading where the materials finish each other's sentences precisely because they provide different representational descriptions of an event that is actually two events: the collection of the plant as well as the plant itself.

In this way, each of these elements together give rise to a type of concurrent situating where several instantiations of the plant are present at once. As a consequence, the specimen sheet becomes a collection of multiple and simultaneous, yet distinct representations of the plant, which are correlative, relational, and interdependent, filling in where information is missing and overlapping where similar information is provided. Each type of collection material presents a different description of the plant specimen. In this way, the specimen sheet is a collection of variegated descriptions in varied form.

Liogier Specimens Sheets with Field Photographs:

The following provides discussion of five Liogier's specimen sheets with field photographs attached. The plant specimen collection numbers of the specimen sheets discussed include: 16153, 13732, 13525, 15195, and 13395. The collection material available on each of the specimen sheets is considered with regard to the function and value of the information that is available. Likewise, each type of collection material is discussed individually and then a selection of collection material is discussed in relation to each other to bring attention to particular ways in which the information is functioning relationally.

Plant Specimen Collection No. 16153:

The first example considers a specimen sheet with a plant specimen from the Asteraceae family (more commonly known as the aster family). The dried plant specimen covers approximately half of the sheet and is diagonal oriented with regard to placement. The specimen includes the pressed and intact stalk, stems, leaves, and flowers of the plant, which provide information concerning these particular characteristics of the plant specimen.

The collection label is in the bottom right corner of the specimen sheet. The collection number listed on the label is 16153. The taxonomic name of the plant specimen is *Eupatorium obtusissimum* DC. Below this is Liogier's full name as the determiner of the specimen with the determination date as September of 1969. The collection information provided on the label is as follows:

Herbaceous, or shrubby, up to 1.25 m high, flowers whitish to pinkish. Common in thickets, on top of the cliff. Limestone cliffs, facing the sea, Cabo Frances Viejo, to Cabela. From sea level to about 100 m alt.

This collection information includes both a specimen description as well as information concerning the locality. The specimen description describes the type of plant (herb and shrub) as well as more specific characteristics (height and flower color). It also indicates the habitat and micro-climate (thickets, limestone cliffs, by the ocean). Lastly, the locality description indicates the proximity of the collection event locality to nearby locations (Cabo Frances Viejo and Cabrera) as well as the altitude. Below the collection information is Liogier's name listed as the collector as well as the date of collection as September 28, 1969.

The field photograph is adjacent to the collection label on the left side at the very bottom of the specimen sheet with the plant specimen directly above it. The photograph shows a plant with clustering white bulbous flowers growing in the sunlight among other types of plants on a cliff above the ocean. While the focus of the image appears to be on the plants in the foreground the remaining half of the image is the ocean, which is foamy white near the shore becoming more turquoise further out. In being both a seascape and a landscape, the image shows an edge area

where two ecosystems overlap- where a greater diversity of species are generally known to thrive.

Additionally, in centering the specimen in the image, it brings immediate attention to it as does the contrast between the specimen in the foreground and the ocean in the background, which has a way of framing it. Likewise, in positioning the specimen flower, like a flora umbrella, with the water below and behind it, this tends to accentuate and emphasize its height as does the slightly downward slanting point of view and the proximity of the camera to the specimen a few feet away.

By association with the other collection material, this field photograph is visual evidence of this species of plant *Eupatorium obtusissimum* DC found by Liogier in September of 1969. It is a micro-view of how this area, somewhere between Cabo Frances and Cabera, looked at the time. It is a visual impression of the degree to which the ocean and vegetation along the shore in this northern coastal region were thriving. It shows how this species of Asteraceae was growing among other plant species within this intertidal zone along the Caribbean Ocean during the fall.

The locality map is located at the very top of the specimen sheet in the center just above the specimen. The red dot indicating the locality is marked in the north-central part of the country, on the coast of the island.

A characteristic of this specimen sheet, as well as most of the specimen sheets within this case study, is in how the collection material tacitly cross references itself by way of descriptive

reiteration. Looking more closely at the ocean location of the collection event for this particular specimen will make this clearer. The coastal locality is specified on the collection label with relational phrases like “facing the sea” and “from sea level,” which indicate orientation and proximity of the plant to the ocean. Likewise, the ocean is visible in the background of the field photograph with the plant growing above it. Lastly, by placing the red dot on the perimeter of the country on the locality map, which indicates where land and sea meet, it specifies that the collection event occurred along the coast. Each of these materials provide similar informational descriptions, though by different representational means.

Plant Specimen Collection No. 13732:

The second example considers a specimen sheet with a plant specimen from the Lamiaceae family (more commonly known as the mint family). The dried plant specimen covers approximately half of the sheet and is vertically oriented with regard to placement. The specimen includes two pressed and intact thin stalks as well as stems, leaves, and flowers of the plant, each of which provide information concerning these particular characteristics of the plant specimen.

The collection label is in the bottom right corner of the specimen sheet. The collection number listed on the label is 13732. The taxonomic name of the plant specimen is *Salvia selleana Urb.* Below this is Liogier’s full name as the determiner of the specimen with the determination date as August of 1969. The collection information provided on the label is as follows:

Shrubby, up to 2 m high; flowers: calyx pale purple, corolla purple; common in pine forest, Canote – Los Guiritos, W of Aceitiller Sierra de Baoruco, alt. 1400 m. On limestone mixed with bauxite.

This collection information includes both a specimen description as well as locality information. The specimen description describes the type of plant (shrub) and more specific characteristics (height and flower part details). It also indicates the habitat (pine forest) and substrate. Lastly, the locality description indicates the proximity of the collection event to nearby locations (Los Guiritos and Aceitiller Sierra de Baoruco) as well as the altitude. Below the collection information is Liogier's name listed as the collector as well as the date of collection as February 9, 1969.

The locality map is adjacent to the collection label on the left side. The red dot indicating the locality is marked in the south-east part of the country, slightly inland from the coast.

The field photograph is along the right edge of the specimen sheet in the center with the plant specimen directly beside it and the collection label below it under the specimen packet. The photograph shows the plant specimen growing in an open field among other species of plants during the daytime. The specimen is in the foreground and appears to be the focus of the photograph with the field habitat receding into the background. The proximity of the camera to the specimen allows for this. The noticeable lack of contrast between the specimen and the field around it has a way of conveying a certain inextricability between the two as well as underscores the terrestrial nature of the micro-environment. Additionally, by situating the plum hued salvia in the center of the image as well as orienting the camera vertically, so that the photograph has a portrait position, it gives a certain emphasis to the specimen's height and the length of the vertically clustered crimson corollas.

By association with the other collection material, this field photograph is visual evidence of this species of plant *Salvia selleana Urb.* found by Liogier in February of 1969. It is micro-view of how this area near Los Guiritos and Aceitiller Sierra de Baoruco looked at the time. It gives a visual impression of the field vegetation in this south-eastern inland region. It shows how this species of Lamiaceae was growing among other plant species within this shrubland zone during the winter.

One distinct aspect of this specimen sheet is the relation between the collection label and the field photograph with regard to the habitat. Both the collection information and the field photograph provide information concerning the habitat. The habitat implied by the collection label is indicated by the phrase “common in pine forests.” The field photograph however shows the specimen growing in what appears to be an open field. It may be that a pine forest exists at the edge of the field or that the specimen in this field is a type of outlier for this species of plant. Neither can be concluded from the information provided. Although some of the information available through these collection materials coincides, other information seems to conflict with this particular specimen sheet.

Plant Specimen Collection No. 13525:

The third example is a specimen sheet with a plant specimen from the Agavaceae family (more commonly known as the agave family). The dried plant specimen covers approximately half of the sheet and is vertically oriented with regard to placement. The specimen includes the stalks, leaves, and flowers of the plant, which provide information concerning these particular characteristics of the plant specimen.

The collection label is in the bottom right corner of the specimen sheet. The collection number listed on the label is 13525. The taxonomic name of the plant specimen is *Agave intermixta* Trel. Below this is Liogier's full name as the determiner of the specimen with the determination year as 1970. The collection information provided on the label is as follows:

Shrubby, 4-5 m high, flowers orange-colored, on slopes, from Santiago to La Bicara. Alt. 400 m.

This collection information includes both a specimen description as well as information concerning the locality. The specimen description describes the type of plant (shrub) as well as more specific characteristics (height and flower color). It also indicates the habitat/substrate (slopes). Lastly, the locality description indicates the proximity of the collection event locality to nearby locations (Santiago and La Bicara) as well as the altitude. Below the collection information is Liogier's name listed as the collector as well as the date of collection as January 26, 1969.

There are two field photographs attached to this specimen sheet. One photograph is located in the center of the sheet between two pieces of the specimen and the other photograph is located just above the collection label to the right of the specimen. The two photographs have different image orientations. One has a landscape orientation and the other has a portrait orientation. The portrait photograph is a view further away from the plant specimen by a few yards. The landscape photograph is a close-up view of the plant specimen. The closer view is taken from above the specimen and shows the flower from a few inches away.

The portrait photograph shows a specimen growing in the winter sunlight on an embankment among other species of plants and trees. The image is taken from below at the base of the exposed and sloping rock strewn ground. This vantage point with the small gold globed florets towering above emphasizes both the height and habitat of the specimen. Likewise, the image is evenly bisected by the horizon line, which serves to divide the image in half with the habitat occupying the foreground and the sky occupying the background. This gives a certain equal image weight to these two geographical and atmospheric elements of the collection event. It also serves to provide a certain mutual framing of these environmental elements by way of division and contrast. Additionally, by situating the specimen with its yellow flower clusters upright and hovering with the sky behind it, it functions to create a certain equivalence between the height of the clouds and the specimen blossoms.

The landscape image shows the crowded and clumped agave specimen corollas situated like a brilliant flora crown on top of the sandy soil of the collection site. This serves to provide a selected view of this particular part of the plant. With the lens only inches away, this vantage point allows for seeing an alternate view of the plant's anatomy: the specific details of the plant's flowering characteristics. Likewise, the contrast between the muted tones of the granular ground and the bright bulbous florets further frames and accentuates the slightly spikey specimen flower.

By association with other collection material, this field photograph is visual evidence of this species of plant *Agave intermixta* Trel. found by Liogier in January of 1969. It provides a micro-view of how this area near Santiago and La Bicara looked at the time. It gives a visual impression of the slope vegetation in this north-eastern inland region. It shows how this species

of Agavaceae was growing among other plant and tree species within this mixed shrubland zone in the winter.

The locality map is adjacent to the collection label on the left side. The red dot indicating the locality is marked in the north-east part of the country, inland from the coast.

One element of this specimen sheet of particular interest is the relation between the collection label and field photograph with regard to the habitat. The collection label provides little information concerning the habitat. The extent of the habitat information pertains to the substrate, which is specified as “on slopes.” The field photograph that shows the plant specimen from a distance also shows the habitat as an open forest with a diversity of plants and trees growing at various heights. In this way, the field photograph provides additional visual information concerning the habitat that is not present on the collection label. Likewise, the close-up photograph provides additional visual information concerning the specific characteristics of the flower, which are not available in the other photograph due to its further distance from the plant. Additionally, since the dried specimen flower is available on the specimen sheet, its structure and attributes can be correlated with the close-up photograph showing the specimen flower characteristics as they appear while growing in the field.

Plant Specimen Collection No. 15195:

The fourth example considers a specimen sheet with a plant specimen from the Lamiaceae family (more commonly known as the mint family). The dried plant specimen is relatively small, covers approximately one fourth of the sheet, and is vertically oriented with regard to placement.

The specimen includes the pressed and intact thin stalk, stems, leaves, and flowers of the plant, which provide information concerning these particular characteristics of the plant specimen.

The collection label is in the bottom right corner of the specimen sheet. The collection number listed on the label is 15195. The taxonomic name of the plant specimen is *Scutellaria havanensis* Jacq. Below this is Liogier's full name as the determiner of the specimen with the determination date as May of 1969. The collection information provided on the label is as follows:

Herbaceous, erect, about 10 cm high, flowers deep blue. On rocks, in exposed places, common. Limestone hills, Jaiqui Picado, about 20 miles W of Santiago. Alt. 300-400 m.

This collection information includes both a specimen description as well as information concerning the locality. The specimen description describes the type of plant (herb) as well as more specific characteristics (growing tendency, height, and flower color). It also indicates the habitat and substrate (rocks, exposed areas, limestone, hills). Lastly, the locality description indicates the proximity of the collection event locality and nearby locations (Jaiqui Picado and Santiago) as well as the altitude. Below the collection information is Liogier's name listed as the collector as well as the date of collection as May 14, 1969.

The field photograph is adjacent to the collection label on the upper left side of it at the very bottom of the specimen sheet. The photograph shows the plant specimen in the foreground growing amid rocks. With its indigo hued petals suspended and draping among the foliage filled stalks, this species of Lamiaceae occupies just over half of the image, offset by the rocks that it grows in front of, which serves to both accentuate the specimen as well as give of sense of scale.

There are additional species of plants present both around the specimen as well as further back in the background among more rocks. By including these environmental elements within the frame, it serves to give a sense of the micro-habitat of the specimen. The image of the specimen is moderately close-up; approximately a foot or two away, which allows for seeing particular characteristics of the plant: the violet fluted flowers and leaves that layer over each other and around the stems in the late spring light. Although the view of the habitat is limited, the stone substrate is visible, which gives a sense of the particular landscape of the collection area. The vantage point of the places the specimen directly parallel and facing the lens, which at once directs the attention as well as creates a certain leveling between the viewer and the specimen.

By association with other collection material, this field photograph is visual evidence of this species of plant *Scutellaria havanensis* Jacq. found by Liogier in May of 1969. It provides a micro-view of how this area near Jaiqui Picado and Santiago looked at the time. It gives a visual impression of the mild mountain vegetation in this north-eastern inland region. It shows how this species of Lamiaceae was growing among other plant and tree species within this rocky shrubland zone in the spring.

The locality map is located directly below the field photograph and adjacent to the collection label. The red dot indicating the locality is marked in the north-east part of the country, inland from the coast.

One distinct aspect of the specimen sheet is the relation between the plant specimen and the field photograph. The dried specimen that is attached to the sheet is a thin stalk with small flowers and

leaves that have been pressed. One informational element that the field photograph provides, which is not necessarily evident by looking at the specimen or collection label is that there is a certain clustering that occurs with this species of plant. In this way, the field photograph not only shows how the specimen appears while growing in its natural habitat, it also shows a specific growing tendency of this particular species.

Plant Specimen Collection No. 13395:

The fifth example considers a specimen sheet with a plant specimen from the Bromeliaceae family (more commonly known as the pineapple family). The dried plant specimen covers approximately two-thirds of the sheet and is diagonal oriented with regard to placement. The specimen includes the pressed and intact stalk, leaves, and flowers of the plant, which provide information concerning these particular characteristics of the plant specimen.

The collection label is in the bottom right corner of the specimen sheet. The collection number listed on the label is 13395. The taxonomic name of the plant specimen is *Tillandsia hotteana* Urb.. Below this is Liogier's full name as the determiner of the specimen with the determination date as 1970. The collection information provided on the label is as follows:

Epyphytic; flower bracts bright red; in open place on slopes of Loma de la Sal. Jarabacoa. Alt. 1300-1400 m.

This collection information includes both a specimen description as well as information concerning the locality. The specimen description describes the type of plant (epiphytic) as well as more specific characteristics (flower color). It also indicates the habitat (open area and slope). Lastly, the locality description indicates the proximity of the collection event locality to nearby

locations (Loma de la Sal and Jarabacoa) as well as the altitude. Below the collection information is Liogier's name listed as the collector as well as the date of collection as October 30-31, 1968.

The field photograph is adjacent to the collection label on the upper left side of it at the very bottom of the specimen sheet. The photograph shows the crimson specimen growing in the autumn sunlight on a sloping field among various species of shrubs and grasses. The brilliant Bromiliaceae specimen in the foreground is accentuated by the sand hued scrubland habitat. As the background recedes behind the scarlet saturated flora spike encircled with leaves it is bisected at an angle by the lightly clouded cerulean sky. By situating the plant such that its length continues the length of the landscape and into the atmosphere, it gives a certain emphasis to its height in relation to the habitat. Likewise, by placing it in the center, upright and directly opposite the lens it becomes vertically leveled with the viewer.

By association with other collection material, this field photograph is visual evidence of this species of plant *Tillandsia hotteana Urb.* found by Liogier in October of 1969. It provides a micro-view of how this area of Loma de la Sal and Jarabacoa looked at the time. It is a visual impression the sloping shrub vegetation in this central eastern inland region. It shows how this species of Bromiliaceae was growing among other plant and tree species within this scrubland zone in the mid-fall.

The locality map is located directly below the field photograph and adjacent to the collection label. The red dot indicating the locality is marked in the north-east part of the country, inland from the coast.

As with plant specimen 16153, a characteristic of this specimen sheet is in how the collection material tacitly cross references itself by way of descriptive reiteration. This is evident with the field photograph and collection label in how they provide details of the collection event. The photograph and collection information parallel each other regarding their representations of the plant specimen and habitat: “flower bracts bright red” and “in open place on slopes,” both of which are visible in the photograph. The two types of collection material, one textual and one visual, provide similar informational descriptions, though by different representational means. They are read in concert with each other, which broadens understanding of the collection event through its discursiveness.

Further Discussion:

Although the collection label describes the plant specimen and location, with the locality map doing more so the latter than the former, the plant specimen and field photograph *show* what the specimen and locality look like. In this way, the specimen and photograph provide further information. They continue the descriptions provided by the collection label and map, though in a different form. The inverse is also the case. Meaning that, if the specimen and field photograph are considered before the collection label and map, the latter continue the description of the former by different descriptive means. In the way, the collection material, regardless of the order

they are read, are additive to each other and extend each description, thus enhancing understanding through providing further information through different representational forms.

As a form of representation, the collection label describes the plant specimen and location in an economic style, which though succinct, tends to read poetically because of its descriptive nature. This in turn gives rise to imagining the plant and locality characteristics as described. Likewise, the map provides a similarly pithy visual indication of the locality. However, the red dot is read in relation to the provided perimeters and the space it is circumscribed by, leaving one to imagine further about the place where the plant was collected. The field photograph gives a glimpse of the plant growing in its natural environment before becoming a specimen. The plant specimen is the physical form of the plant after having been collected and dried. Whether one considers the materials singularly or as a collection of suggestions (representation as a suggestion of something by way of likeness, which functions as a type of equivalence), there are always spaces, or rather gaps, in the information provided where the viewer's imagination considers the information that is not present on the specimen sheet, which comes with being present and seeing the plant growing in the field.

Case Study II: Field Photographs of the Biodiversity of the Hengduan Mountains Online Database

Context:

The Hengduan Mountain Region is located in south-central and south-western China. It is considered a biodiversity hotspot, of which there are only 35 worldwide.⁵⁵ David Boufford, a Harvard botanist and leading researcher of this region, describes it as follows:

This hotspot occurs at the juncture of mountain systems where precipitation can vary tremendously due to a combination of topography, climate, and hydrology. The terrain forms topographic channels that funnel seasonal monsoon rains up through the river valleys from the lowland tropics of southern China, India, and Myanmar (Burma) to the southeastern edge of the 5,000- plus-meter-high (16,400-plus-foot) Qinhai-Tibet Plateau. The region also receives vast amounts of water from the five major rivers that drain the plateau: the Yarlung Zangbo Jiang, the Ayayerwaddy; Nu Jiang, Lancang Jiang, and Jinsha Jiang....Extreme topographic relief is a characteristic feature of the Hengduan region.⁵⁶

The Biodiversity of the Hengduan Mountains Project was initially funded by the National Science Foundation's Biotic Surveys and Inventory Program through the Arnold Arboretum at Harvard University. The primary purpose of the project was to survey the diversity of flora and fungi of the Hengduan Mountain Region, particularly those areas that had yet to be explored. In doing so, the project relied primarily on the collaborative work of American and Chinese botanists.⁵⁷ As a consequence of this extensive field research, over 85,000 plant specimens

⁵⁵ David E. Boufford, "Biodiversity Hotspot: China's Hengduan Mountains." *Arnoldia*. 72/1. Jul 2014. Accessed 1 Nov 2016. 1. <http://arnoldia.arboretum.harvard.edu/pdf/articles/2014-72-1-biodiversity-hotspot-china-s-hengduan-mountains.pdf>

⁵⁶ David E. Boufford, "Biodiversity Hotspot: China's Hengduan Mountains." 1.

(vascular, fungi, and bryophyte) were added to Chinese herbaria, the Harvard University Herbarium, as well as numerous herbaria throughout the world.⁵⁸

The Biodiversity of the Hengduan Mountains website was developed in 1998 and went live in 1999. The online database reflects primarily five provinces within the Hengduan region. These include: Gansu, Qinghai, Xizang, Xizang (Tibet), Sichuan, and Yunnan. The online database is sourced from an offline non-publicly accessible database located at Harvard Herbaria, which includes additional specimen records reflecting provinces outside of the Hengduan Region. There is a total of 85,009 plant specimen records in the offline database. Only those specimen records, localities, and images from the Hengduan Region are hosted on the website.⁵⁹

There is a total of 17,755 images on the website. This amount continues to increase, though to a lesser degree in years when there are no field expeditions. There is a total of 4,661 collecting localities across the five provinces. The localities are divided as follows: Gansu 14, Qinghai 220, Xizang 273, Sichuan 495, and Yunnan 3659.⁶⁰

Method:

The method used for this case study focuses primarily on the field photographs that are part of the Biodiversity of the Hengduan Mountains online database. The field photographs are

⁵⁷The Arnold Arboretum, "Biodiversity of the Hengduan Mountain Region, China." *The Arnold Arboretum of Harvard University*. Accessed 1 Nov 2016. <https://www.arboretum.harvard.edu/research/asia-programs/biodiversity-of-the-hengduan-mountain-region-china/>

⁵⁸ David E. Boufford, "The Biodiversity of the Hengduan Mountain Region Project." *Interview with the Director of the Harvard Herbaria*. Harvard University, Cambridge, MA. Data provided through interview and email. 25 Sept 2016 – 27 Jan 2017.

⁵⁹ David E. Boufford. "The Biodiversity of the Hengduan Mountain Region Project." Interview.

⁶⁰ David E. Boufford. "The Biodiversity of the Hengduan Mountain Region Project." Interview.

considered in relation to the collecting localities, collection information, and specimens. Likewise, specific attention is given to the varying ways that the collection material is made accessible in relation to each other within the database and how these varying ways function differently.

This study gives minimal attention to the members, funding and support, participants, and collaborator sections of the website and instead focuses on how the online database functions and serves to make the collection material accessible.

Biodiversity of the Hengduan Mountains Website: Overview

The main page of the website features a general map of the Hengduan region as well as a description of the main function of the online database: to provide data focusing on the Hengduan Region plants and fungi as well as from contiguous areas of south-central China (Gaoling Mountains and Tibetan Himalaya inclusive).⁶¹ Below this are links for searching for specimens, place names that have been georeferenced, and collecting localities. Lastly, there is a statement regarding the National Science Foundation's support of the Biodiversity of the Hengduan Mountains Project.

Along the left side of the main page, there is a column for navigating the site, which includes six folders and three additional links that direct the user toward information concerning the project, database, and data. The six folders have the following focuses: members, expeditions, collecting localities, specimens, and gazetteer and historical maps. The three remaining links include

⁶¹ Biodiversity of the Hengduan Mountains. Plants and Fungi of South-Central China. <http://hengduan.huh.harvard.edu/fieldnotes>

information regarding funding and support, participants, and collaborators. Below this is a field for searching for specimens as well as a random field photograph image generator, which includes the name of the species of plant or location. At the very bottom of the page there are login fields for those who manage the database. The members folder has never served a function for the website. It was originally designed for special interests, though was never used.⁶²

The collecting localities folder links to a page that allows for searching collecting localities either by expedition or by province. Expeditions are listed in a drop-down menu by year and region and range from 1984-2014. The province menu offers a list of eight provinces to choose from: Chin State, Gansu, Kachin, Qinghai, Sichuan, Sichuan-Gansu Border, Xizang (Tibet), and Yunnan.

The Specimens folder provides the options to either browse or search the database for specimens. Each of these search options are subfolders within the specimen folder. The specimen folder links to a page with the plant groups: angiosperms, gymnosperms, pteridophytes and lycophytes, bryophytes, fungi, and algae. The plant groups are presented in grids which list a selection of families, genera, and number of specimens within the plant groups. Below each plant group grid is a link to a comprehensive list of all families within that group that are available within the online database. Although algae is listed among the plant groups, there are no families, genera, or specimens listed under this plant group, which indicates that thus far, no algal specimens have been collected for the Biodiversity of the Hengduan Mountains project. The option to browse or search the database directly is also available on this page.

⁶² David E. Boufford. "The Biodiversity of the Hengduan Mountain Region Project." Interview.

When the browse subfolder is selected, the option to browse specimens by name within a specified plant group is made available. The six plant groups are listed as is the option to browse only those specimens with DNA material. Once a plant group is selected, a family drop-down menu appears. Likewise, the search results can be further specified to specifically list specimens or to generate an image gallery.

When the search subfolder is selected, the option to search for specimens by plant group in conjunction with search terms is made available. The search terms can include collector number, date, or taxon. More than one plant group can be selected for a given search. The search can be further restricted to include only those specimens with DNA material.

The images folder provides access to the images within the online database. They are presented in as thumbnail images in a grid format in sets of twenty. They are sequenced according to date added with those most recently added appearing first. The name of the collector and collection date appear below each thumbnail. In addition to viewing the images in sets of twenty, the option to jump to the last images as well as the first within the collection is available as well.

Hengduan Mountains Online Database: Images

What follows are further details of the image section of the Hengduan Mountain Online Database. There is a total of 17755 images within the database. This number continues to increase, though to a lesser degree in years when research in the region is less active. The images are sequenced according to date added, with those most recently added appearing first.

Selecting a thumbnail from the image gallery leads to a page with a larger version of the image with the photographer's name, the date, the species of the specimen as well as a collection number link to the specimen.

Clicking on the collection number link provides a page with the family, genus, and species of the specimen, the determiner, the collection information, which includes the locality/habitat description and the specimen description, as well as the collectors and collection event number. To the right of the collection information is a link to the Flora of China (FOC) eflora listing for that species of plant. Below the collection information, the collection event date is listed as well along with a thumbnail of the original specimen image selected. Likewise, below this thumbnail is a map with the locality georeferenced, the precise location of which is indicated with a red marker. The map is a Google map, which can be viewed in either map or satellite mode, can be zoomed in or out, as well as can be viewed from the ground.

Lastly, to the left of the locality and habitat description, there is a yellow locality marker, which when clicked on, directs the user to the locality page for that collection event. This page provides the locality number as well as all the field photographs taken at that specific locality during the collection event. This includes both habitat as well as images of additional specimens collected. The habitat images are listed first with the additional specimen images below. Underneath these are drop-down lists by plant group (angiosperms, gymnosperms, pteridophytes and lycophytes, bryophytes, and fungi) with those specimens collected at the site. The specimen list includes family, binomial, collection number, and collection date. It also indicates with icons whether an

image is available as well as DNA material for the specimen. Underneath the list of plant groups is the georeferenced map with the collection event indicated on the map with a red locality pin.

Hengduan Mountains Online Database: Collecting Localities

What follows are more details concerning the collecting localities section of the Hengduan Mountain Online Database. There is a total of 4665 collecting localities across the five provinces in Hengduan Mountain Region and two in Myanmar. The latter were made near the border in an area where the border is unclear. The localities are divided as follows across the provinces: Chin State 1 (Myanmar), Gansu 14, Kachin 3 (Myanmar), Qinghai 220, Xizang 273, Sichuan 495, and Yunnan 3659. There is a total of twenty-three expeditions which range from 1984-2014.⁶³

Collecting localities can be found primarily two ways, either by expedition or by location through specifying either or both the province and county. Expeditions titles are listed by year, country, and province with some also listing botanists as well as funder or affiliate institution. When an expedition is selected, the option to further specify the province is made available, though is not required. Searching for an expedition yields all of the collecting events which were made during that year and within that region. This is presented in table format with locality number, province, county, city, stop (date and location), habitat, and elevation listed. A map is below the collection event table with all of the collection events georeferenced.

The locality numbers listed in the collection localities table link to the locality page for that collection event. As specified previously, this page includes the collection information, field

⁶³ David E. Boufford. "The Biodiversity of the Hengduan Mountain Region Project." Interview.

photographs of the habitat and specimens, as well as specimens collected at the site, which are listed with totals and grouped with drop-down arrows according to plant group, and lastly, a map with the red geo-referenced locality pin where the collection event occurred.

When a province is selected for searching for collecting localities, the option to further specify the county is made available, though is not required. The results are presented in the same table format as the previous search, though include the collecting events within that province across years and expeditions. The collection events are geo-referenced on the locality map below the table.

Hengduan Mountains Online Database: Specimens

What follows are more details concerning the specimen section of the Hengduan Mountain Online Database. There is a total of approximately 42500 specimens within the online database. They are from five provinces in Hengduan Mountain Region and two provinces in Myanmar. The provinces includes: provinces: Chin State (Myanmar), Gansu, Kachin (Myanmar), Qinghai, Xizang, Sichuan, and Yunnan. There is a total of twenty-three expeditions which range from 1984-2014.⁶⁴

There are primarily two options for locating specimens. They can be either browsed or searched. When searching, a significant range of specificity is possible. A user can search as specifically as collection number, date, or taxon or as broadly as plant group (Angiosperm, Gymnosperm, Pteridophytes and Lycophytes, Bryophytes, Fungi, or Algae). The results from searching

⁶⁴ David E. Boufford, "The Biodiversity of the Hengduan Mountain Region Project." Interview.

according to plant group without providing additional search terms, predominately yields results with collection number and collection date only, thus just collection events. When a collection number from the results is clicked on, the user is taken to a collection event page often without an image, though with collection information, yellow collecting locality marker, and georeferenced map with red locality pin. By clicking on the yellow locality marker, the user is then taken to the locality page, which provides all the images for that specific locality and collection event.

Conversely, the results from searching using specific search terms (collection number, date, or taxon), primarily yields results with family, binomial, collection number, collection date, and therefore specimens. Providing the collection number, date, or taxon for a specified plant group or including all the plant groups, yields results consisting of multiple specimens. These are accompanied with a map with the collection event(s) geo-referenced with a red locality pin(s). Depending on the type of search term used, either the collection date, collection number, or taxon will be the same among the specimen results listed. The specimen listing allows the user to select the family, binomial, or collection number for further study.

When browsing for specimens, a general range of specificity is possible. Browsing can be done at the plant group, family, genus, species, and DNA material level. Once the level of specificity for the browsing is selected, then there is the option for specifying how the results will be provided: as a list of specimens or as an image gallery of specimens.

The specimen list option generates a list of specimens in a grid that gives the family, binomial, collection number, and collection date, as well as indicates, with DNA and camera icons, whether there is DNA material or an image available for the specimen. The specimen collection number links to the collection number page for that specimen. The information provided includes the collection information, the images, as well as a locality map with the locality of the collection geo-referenced. The yellow locality marker next to the collection information links to the locality page for that specimen. This page provides the collection information, the habitat and specimen images, lists of the specimens collected by plant group, and a georeferenced map.

The image gallery option produces a gallery, in grid view, of those specimens images that are available given the specified browsing terms.

Hengduan Mountain Online Database: Image, Specimen, and Locality Pages

While there are many features and allowances of the Hengduan Mountain Region online database, attention will be given to the affordances of one feature in particular in relation to the field photographs and collection information. This feature is the linked yellow locality marker that is available along with the collection information on the specimen page. As previously mentioned, this yellow locality icon navigates the user to the locality page. The locality page provides the collection material from the specific site indicated by the number. The collection material includes the collection information, habitat and specimen field photographs, specimen lists (of those specimens collected on site), and a georeferenced map.

One way in which a specimen page can be accessed on the website is through the image gallery, which is sequenced based on upload date with most recent first and oldest last. Clicking on a thumbnail image links to the image page. The image page includes the name of the photographer, collection date, and taxon with the collection number in parenthesis, which links to the specimen page. Of the pages that include images within the online database (image, specimen, and locality), the image page provides the least amount of information related to the collection event. In doing so, it allows the viewer to consider the image as a type visual introduction to the collection event, which is detailed on the linked specimen page.

In this way, it allows the viewer to see the specimen first, as the botanists did. Thus, this distinct type of visual record provides a unique sense of field memory. A particular kind of botanical field memory that is immeasurable and that invites the viewer to consider what it was like to be there at that time, in that moment. In this way, the visual record is a record that both transports the viewer to a place/time while also suspending the viewer from that very place/time. It is a place/time that resembles the botanists' original place/time, though is actually a liminal and imaginative space that arises between the viewer and the photograph. The field memory that is glimpse-able by way of the field photograph, provides traces of a collection event that while partially recordable in visual form are not reducible into data. In this way, the field photograph becomes a record of witnessing something wondrous which is unrepeatable.

The specimen page includes the family, genus, and species of the specimen, the determiner and date of determination, the collectors, the collection information, the collection date, a link to the FOC, an image of the specimen (if available), and a map of the specimen geo-referenced. The

image of the specimen can be viewed with this collection information either as a thumbnail or as larger image with the thumbnail and collection information above it and the map below. This page provides the user with details concerning the collection of this particular specimen: when it was collected, who collected it, where it was located when collected, what it looked like while growing in its natural environment, the nature of the habitat where it was collected, its taxonomy, who determined it, and its locality marked on a map.

Through providing additional collection information in the form of taxon, specimen descriptions, precise longitudinal and latitudinal coordinates, elevation ranges, proximity to prominent geographical features whether natural or more urban in nature, the user views the field photograph relationally to this information. This in turn, facilitates a fuller reconstruction of the collection event, which is not possible when viewing the image page. The specimen page allows the viewer to piece the collection material together into an imaginative assemblage of a field event revolving around one specimen while involving an immense and dynamic environment.

In allowing the user to navigate from the specimen page to the locality page, the locality marker gives the user access to significantly more information concerning the specimen collection event. Each specimen collected is treated as one collection event, assigned a collection/specimen number, and given a collection page specific to that specimen. Each locality page includes all the specimens collected at a given locality. In this way, the locality page functions as a collection of collection events within the same locality. Likewise, when the user clicks on the yellow locality marker, they are immediately linked to a welter of habitat and specimen images for that specific locality where the specimen was collected.

The habitat images provide a range of views of the habitat where the specimen was collected. Through providing additional vantage points of the locality, this gives the user a greater understanding of the geography, micro-climate, and ecosystem of the specimen locality. Likewise, in seeing the breadth of images of specimens collected at the given location, the user gains a more complex understanding of the flora of the area. In this way, the locality page provides both micro and macro views of both the collection event and the locality as a collection of collection events.

Likewise, in providing a collection of visual records of the environment where the specimen collections occurred, the locality page becomes a diverse assortment of botanical navigating in record form, whether facing fern flowers or a fjord. In this way, the field photograph is a visual bidirectional device for recording environmental relational positioning: of a botanist as well as of the flora. The locality page gives access to a multitude of images that visually describe movements of flora research. The field photographs found on the locality page allow the viewer to stitch together these unique instances of research: as a wild array of witnessing and collecting life while moving through it.

Hengduan Mountain Region Collection Localities:

What follows is a discussion of three locality pages from the online database of the Hengduan Mountain Region website. An overview is provided of the collection material available on each of the locality pages. Specific attention is given to the field photographs as distinct among the collection material in terms of the field research information that they provide as visual records. Further discussion of field photographs is also provided at the end as a conclusion to the three

locality examples. The locality pages were selected from the random image generator that is available on the Hengduan Mountain Region website. The three locality pages consist of locations within Hengduan Mountain Region provinces and are as follows: Locality 74 (Sichuan), Locality 459 (Yunnan), and Locality 2794 (Xizang). Links are provided below to each locality page. Locality page images are also available in the appendix.

Locality 74 (Sichuan):⁶⁵

The first locality page reflects field collecting that occurred within the province of Sichuan, China. Sichuan is north of the province of Yunnan in south-central China. This field collecting took place within the south-west part of the province. More precisely it is in the county of Daocheng. The collection material available on the page includes the locality information, five habitat images, six specimen images, four drop-down specimen lists by plant group of specimens collected on site: angiosperms (26), pteridophytes and lycophytes (1), bryophytes (14), and fungi (1), as well as a geo-referenced Google map with a red pin marking the exact collecting locality. All specimens were collected on July 5th 1998, with the exception of one, which was collected ten days later on the 15th.

The six specimen images link to five separate specimen pages, which provide details of their collection. Two of the images are of the same specimen, hence the number discrepancy. All of the specimen pages for the images provide the same locality description (below) as provided on the locality page.

⁶⁵ http://hengduan.huh.harvard.edu/fieldnotes/localities/locality_detail.zpt?locality_id=74&full_image=boufford00312

Sichuan: Daocheng Xian. Bowa pass on road from Daocheng to Gongling. Dwarf Rhododendron scrub, alpine meadows and gravelly slide areas. 28°53'57"N, 100°17'8"E; 4460-4650 m.

The specimen pages also include the family, genus, species, collectors, specimen description, and date specific to the plant specimen in the image. The plant families of the specimens in the images range to include: Primulaceae, Lamiaceae, Orobanchaceae, Liliaceae, and Polygonaceae (two images).

Taken together, these habitat and specimen field photographs provide a visual relay of uncommon ecological vantage points. The habitat images show a series of views of rolling fields and hills within the high altitude mountains of the Hengduan Region. The alpine clouds appear to be an extension of the sloping and slanting verdant terrain strewn with rocks, scrub flora, and vernal pools. The images show views of astonishing distance, which continue in such a way that the land layers over itself to the horizon. The specimen images include dwarfed neon flora vibrant with moisture and varied in drape. The proximity of the botanist to the plants is relatively consistent throughout, only a few feet away if that. The minimal distance from the plants, allows for showing the particular characteristics of the specimens as they thrive among the marshy mountain vegetation.

Additionally, looking more closely at one of the six the specimen field photographs provides further insight into the precise value of field photographs as visual records. Of the forty-two plant specimens collected at this cite, only one is from the family Liliaceae, also known as the lily family, of which a field photograph was taken. The plant species for the specimen is *Lilium lophophorum*. Within the photograph, this species of lily is centered in the frame while among

the fern laden microhabitat of the collection cite, which makes it the primary focus of this image. Likewise, the specimen occupies one third of the photograph and thus becomes framed by the foreground below and the background above. The contrast between the somewhat drenched and draping chartreuse petals of the plant and the fern fronds behind it, further accentuate the specimen, bringing specific emphasis to the distinct characteristics of the slightly iridescent flower. The image provides a sense of the mid-summer climate and weather as the lily grows in the overcast high mountain light. The micro-climate appears moderately moist given the verdance of the varying sized entire margin leaves of the surrounding vegetation and the presence of precipitation on the plants. The vantage point of the image is roughly at the level of the specimen situating it just a few inches away. This visual leveling and close proximity, gives a particular attention to its size.

Within this province of Sichuan, David E. Boufford, the photographer and botanist, walked through these fields and hills scanning both the periphery as well as the immediate surroundings for biological outliers and anomalies. He reflected on the geography that he traversed while considering the flora. These considerations of his informed each other and extended his research. And while so much of what he saw on that day is not visible in the images, these photographs are individual field facets with the imprint of many more.

Locality 459 (Yunnan):⁶⁶

The second locality page reflects field collecting that occurred within the province of Yunnan, China. Yunnan is in south of Sichuan province in south-central China. This field collecting took

⁶⁶ http://hengduan.huh.harvard.edu/fieldnotes/localities/locality_detail.zpt?locality_id=459&full_image=boufford00881

place in the north-west part of the province. More precisely it is in the county of Dali. The collection material available on the page includes the locality information, six habitat images, five specimen images, two drop-down specimen lists by plant group of specimens collected on site: angiosperms (24) and pteridophytes and lycophytes (1), as well as a geo referenced Google map with a red pin marking the precise collecting locality. All of the specimens were collected on July 10th 1984.

The five specimen images link to four separate specimen pages, which provide details of their collection. Two of the images are of the same specimen, hence the number discrepancy. All of the specimen pages for the images provide the same locality description (below) as the locality page.

Yunnan:Dali Xian. E side of Diancang Shan mountain range. Vicinity of Yinglofeng. Disturbed shrub covered slopes and Pinus plantation. 25°42'0"N, 100°7'0"E; 2900-3050 m.

The specimen pages also include the family, genus, species, collectors, specimen description, and date specific to the plant specimen in the image. The plant families of the specimens in the images range to include Asteracea, Ranunculaceae (two images), Iridaceae, and Asparagaceae.

Together, the habitat and specimen field photographs provide a visual account of research through the upper reaches of a range rarely seen. The habitat images show coniferous cliffs that sharply descend with falling streams. Thin cut gravelly roads bisect rocky mountain sides. A shrub meadow grows in the clouds and a lake valley is visible through pines. The specimen

images show flora with tiny pastel florets and bronze fruits only inches away from the lens. A collection of varied micro spaces where the specimens grew.

Additionally, looking more closely at one of the five the specimen field photographs provides further insight into the precise value of field photographs as visual records. Of the twenty-five plant specimens collected at this cite, only one is from the family Ranunculaceae, also known as the buttercup family. The plant species for this specimen is *Thalictrum delavayi*. Two field photographs were taken of this specimen. The photographs have different image orientations. One has a landscape orientation and the other has a portrait orientation. Within the former of the two photographs, as if blowing over in the wind, a pink petaled branch bisects the landscape image horizontally. The tiny florets in the foreground, a foot from the lens, allow for seeing the precise plant anatomy with its minuscule sprays of translucent stamens. The habitat in the background is a blur of grasses and other vegetation growing along a slope among rocks.

Occupying half of the image, the specimen's pastel plant characteristics appear bright against the darker background. Under an overcast summer light, the specimen is situated parallel to the camera, which has a way of emphasizing the breadth of the branching buttercup species. The portrait field photograph presents the specimen with a perpendicular orientation. With only inches from the lens, the closer proximity allows for seeing the small unopened specimen flowers dangle like drupes as well as the details of other plant characteristics at a different angle. Likewise, the clarity of focus of the corollas in the immediate foreground, are offset by the obscured ecology of plants in the background, blurred by the depth of field and distance from the

camera. In this way, the second field photograph provides additional details of the specimen's particular plant anatomy, which is complimentary to the first field photograph.

Among these pine covered cliffs, exposed in places and atmospherically obscured from view in others, David E. Boufford collected specimens within this steeply situated ecological region located in the province of Yunnan. Although, he observed many more elements of the environment than these images reveal, this collection of field photographs is a selection, a miniscule slice like a slip through his memory, of all the things he saw in that particular micro-habitat in the mountains.

Locality 2794 (Xizang):⁶⁷

The third locality page reflects field collecting that occurred within the province of Xizang, China. Xizang is north-east of Sichuan province in central China. This field collecting took place within the north-east part of the province. The collection material available on the page includes the locality information, three habitat images, eleven specimen images, one drop-down specimen list by plant group of specimen collected on site: angiosperms (37) as well as a georeferenced Google map with a red pin marking the exact collecting locality. All of the specimens were collected on August 3rd 2009.

The eleven specimen images link to nine separate specimen pages, which provide details of their collection. The images are of specimens from two plant families: Asteraceae and Orbanhaceae.

⁶⁷ http://hengduan.huh.harvard.edu/fieldnotes/localities/locality_detail.zpt?locality_id=2794&full_image=admin20100303130420

Two images each were taken for two of the specimens, hence the number discrepancy. All of the specimen pages for the images provide the same locality description (below) as the locality page.

Xizang (Tibet):Jiangda (Gyamda) Xian. Ca. 21 km W of the city of Jiangda on highway 314 (to Changdu), then N on road to Yushu, Qinghai Province. Gravelly slopes along stream, flat Kobresia-Bistorta meadows, and slopes with dwarf Rhododendron (< 0.5 m tall) and Sibiraea. 31°34'29"N, 98°3'19"E; 4000-4100 m.

The specimen pages also include the family, genus, species, collectors, specimen description, and date specific to the plant specimen in the image. The plant families of the specimens in the images range to include Amaryllidaceae, Apiaceae, Asteraceae (two images), Boragaceae, Campanulaceae, Crassulaceae, Fabaceae, Gentianaceae, Juncaceae, Lamiaceae, Orchidaceae, Orobanchaceae (two images), Papaveraceae, Primulaceae, and Renunculaceae.

Taken together, the habitat and specimen images provide a variegated visual narrative of biological research. The habitat field photographs show alpine meadows with flowers through the grasses and mountains with cloud shadows. There are scrubland hills with tiny florets among tufts and shrubs unevenly clumped together. And layers of sediment overgrown with small patches of dwarf vegetation. The specimen field photographs, most of which are from the Aster family, show several composite flowers with thistle like petals. Most appear to be thriving in thickets with some in the company of pollinators.

Additionally, looking more closely at one of the eleven the specimen field photographs provides further insight into the precise value of field photographs as visual records. The field photographs are of specimens from two plant families: Asteraceae and Orbanchaceae. Of the

thirty-seven plant specimens collected at this site, eight are from the Asteraceae family, also known as the aster family, of which six field photographs were taken. The aster species for the field photograph under consideration is *Anaphalis xylorhiza*. The vertical orientation of the image gives a certain attention to the height of the stalky stemmed specimen while also providing a micro-view of the habitat. In the late summer light, the flurry of fine petaled flowers appear bright as if flora bulbs hovering above the varied verdant ground. The depth of field of the image, allows for seeing elements of the foreground and background, which provides a sense of the complexity of the plant community where the specimen thrives. In this way, while a certain focus is given to the characteristics of the plant, the degree of detail visible regarding the immediate ecology of plants makes this photograph a hybrid image of both.

While in the remote mountains regions of the Xizang province, Richard H. Ree, the photographer and botanist, carefully observed these specific characteristics of the habitat and elevation as well as many others not evident in the images. In this ecological edge area where the tree line becomes more pronounced, his research arose through analyzing the natural elements that he was among. In this way, these images provide a parallax means for reconstructing his field collecting and the field acuity it necessitated.

Further Discussion:

Field photographs provide an expansive and intricate sense of the flora ecology and the natural elements. The nature of the environment and its characteristics, like the intensity of light, the variation of terrain, the cloud cover, the geographical features, the visibility, the horizon line, etc., which were assessed and synthesized by the botanist. The field photograph, whether of the

habitat or specimen, shows what the botanist was seeing while traversing through the varied land. In this way, field collecting is distinct as a research practice in how the researcher's point of view and understanding is changed by the landscape as her/his geographical positioning changes.

Part of the value of field photographs is that they show what the botanists saw and the environment she/he engaged with. Of the collection material presented from the field collecting, whether the specimen description or the locality coordinates, the field photograph, as a visual record of the event, comes closest to conveying what that event was like. Field collecting is about witnessing and closely observing specificity as well as spatial biological synergy within the dynamism of life. The field photograph partially preserves those elements of the field research which are not containable nor reducible into data, though which inform the research as it occurs and as it continues. In many ways field collecting is navigated by the flora environment; through the botanist's reading and interacting with her/his surroundings in the field. In this way, the field photograph becomes a visual record of field witnessing, field memory, and field movement with the flora environment.

Case Study III: The Field Photographs of Mildred E. Mathias

Context:

Mildred Mathias (1906-1995) devoted her life to plant science research as well as academia. With a particular interest in horticultural research, she became an expert on Umbelliferace (Apiaceae), which is also more commonly known as the carrot/parsley family. Just under ten

years after Mathias accepted a position as an Herbarium Botanist at UCLA, she was appointed director of the UCLA Botanical Garden. During this time she also taught in the Department of Biology, holding the position of Vice Chair from 1955-1963. Mathias continued as Director of the Botanical Garden until she retired in 1974. For twenty years following her retirement, Mathias lead student trips through UCLA Extension to well over 30 countries, with Costa Rica and the Amazon being the most frequented.⁶⁸

On the third floor of the UCLA Herbarium is the office of Mildred E. Mathias. It has largely remained undisturbed since her death in February of 1995. Within her office are the books, academic files, research publications, field notebooks, photograph prints, and field photograph slides related to her academic career and life of research as a botanist.

There are numerous types of field notebooks scattered throughout Mathias' office. Some were written in while in the field collecting and are predominately pocket-size notebooks. They include the country and year of research on the cover of the notebook and the date, locality, collection number, taxon, and some collection details for each specimen inside in list format.

There are additional field notebooks that are more detailed versions of those notebooks that were written in while in the field. These are much larger in size (7in x 9in) and include dates, locality, collection number, taxon, habitat, and specimen description. Not all the previously listed types of information are specified for every specimen collected. This varies per specimen. Lastly, there is an additional type of field notebook of the same style and size as the previously mentioned notebook, which is more narrative in nature and includes dates, localities, activities, travel, and

⁶⁸ Arthur C. Gibson, "Mildred Esther Mathias Hassler (1906-1995)." *Neotropical Biodiversity and Conservation* Occasional Publication of the Mildred E. Mathias Botanical Garden. ix-xi

general flora seen (often mentioned by genera or common name). There are approximately thirty field notebooks in total of the various types mentioned in Mathias' office.

The timeframe for these field notebooks span from 1959-1994. This is also the timeframe for the 35mm field photograph slides located in her office. The estimated number of her field photograph slides is 35,000. The regions for both the field notebooks and the slides range to include the Amazon (Peru and Chile), Americas (Canada, U.S., Mexico, Ecuador, Galapagos) Costa Rica, the Pacific (Indonesia, Australia, South East Asia, New Zealand, Papua New Guinea, Japan, and China), Africa, Madagascar, and Europe.

Method:

For a five-year period from 1959 -1964, Mathias conducted research on the native medicinal uses of plants through the Amazon, particularly Ecuador and Peru, as well as East Africa (Tanganyika and Zanzibar). The research involved collecting and analyzing the plants of lowland tropical forests for medicinal properties as well as meeting with native herbalists and medicine men to discuss their medicinal methods and practices with plants.⁶⁹

There are seven field notebooks from this five-year period. Six of the notebooks focus on Peru with one of those also including Ecuador. The field notebooks from Peru span 1959-1964. The last field notebook involves research in Africa during 1963.

⁶⁹ Arthur C. Gibson, "Mildred Esther Mathias Hassler (1906-1995)." x.

Of the six field notebooks from Peru, the earliest two field notebooks provide the most field collecting details and correspond to each other as well as to the field photograph slides from the same region and years. Likewise, of the seventeen field photograph slide cases devoted to research in the Amazon region (each of which include 250 slides) the earliest case of slides, both in terms of sequence and timeframe (case #1 from 1959/1960), provides the most slide details within its slide index (which is loosely placed in the lid of the slide case).

For this case study, a closer look is given to case # 1 in conjunction with the two earliest field notebooks as well as to the Peru Identification Index, which is a notebook that lists all the specimens that Mathias collected while in Peru. This is done in an effort to examine in what ways the field photograph and field notebook information overlap and in what ways they do not. More precisely it looks at the value of considering these two elements, which are part of the broader field collecting information, together.

The Field Photograph Slides and Field Notebooks of Mildred E. Mathias:

Consideration is given to Mathias' field research in Peru specifically within the timeframe of approximately a month over June and July of 1959. Five field photograph slides are considered in relation to three dates with entries in the two earliest field notebooks.

One of the field notebooks is narrative in nature, providing specifics about travel, collecting, and flora seen in new areas and regions. The other field notebook is in the form of a specimen collecting list with brief descriptions for each specimen listed including a specimen collection number. With both the narrative field notebook and the specimen field notebook, more details are provided in the first half of the notebooks as is with the second half of the notebooks. The

decrease in entry details, whether about collecting throughout the day or descriptions of plants, is gradual though noticeable. This may be due to increasing familiarity with the flora and region over time.

The narrative and specimen field notebooks are from the same time frame and therefore compliment each other as well as the field photograph slides. The field photograph slides and field notebook entry dates considered in relation to each other are as follows: *Cecropia Sapling* and *Palmetto* slides 66 and 117, June 19; *Paullina Josecuartri Mack* and *Passiflora*, slides 75 and 118, July 2; and *Mallow*, slide 10, July 13. The field photograph slides were located by cross referencing the slide index, which is loosely placed in the lid of slide case #1, with the field notebooks.

The following links found between the field photograph slides and the field notebooks required a method that was somewhat more circuitous and time consuming than anticipated. This is not meant to imply that a multitude of links could not be made between the field slides and field notebooks from this timeframe and region or even more broadly between all the field slides and notebooks over the course of Mathias' research career. Establishing the links would just take some time. Instead this is meant to point to a certain style, or rather tendency, of record keeping by Mathias. While she was diligent with regard to keeping multiple and detailed indexes of her specimens and accounts concerning their collection, she was much less assiduous with regard to indexing her field photograph slides. As a result, drawing connections between the field slides and field notebooks proved somewhat tedious.

Field Notebook Entries for June 19, 1959 and Cecropia and Palmetto Slides 66 and 117:

Narrative and Specimen Field Notebook Entries, June 19, 1959:

The narrative field notebook entry for June 19, 1959 indicates that Mathias traveled to Aquaytia, collecting on the way through Cordillera Azul, both located in central Peru. Flora that she encountered throughout the day includes “Cecropia forests” as well as “palmettos.” The specimen field notebook indicates a Cecropia specimen was collected on that day with the specimen collection number of 3446. Among the Cecropia specimen notes, specific medicinal uses are mentioned: “Tea prepared from bark in boiling water. Used for stomach irritation.” Specimen 3446 is also listed in the Peru Identification Index, which is a notebook that lists all the specimens that Mathias collected while in Peru.

The narrative notebook entry for June 19, 1959 gives a sense of the trajectory of travel and collecting. The distance between Aguaytia and Cordillera Azul is approximately 30 miles. Mathias’ narration indicates that a diversity of tropical forest vegetation was seen throughout the collecting trip. The specimen notebook confirms the collection of a Cecropia specimen and further elaborates on its medicinal use, primarily through brewing the bark of the tree to be consumed as tea for upset stomach.

Palmettos, from the Aracacea family, are a certain type of palm that is common to Peru and northern parts of South America. Although a specimen from this family is not listed under this day in the specimen notebook, its inclusion in the narration provides a sense of the habitat and

flora of the collecting area. In this way, it serves to broaden understanding of the collecting environment and habitat.

Cecropia and Palmetto Field Photograph Slides 66 and 117:

The field photograph slide for the Cecropia has the locality, region, and year written on it. In the slide index, the Cecropia specimen is listed as “Cecropia sapling” on the line for slide 66. On the border of the slide the locality of “Cordillera Azul” is written along with the year “1959” below it. The region abbreviation of “AMZ” for Amazon is written in the border as well.

Within the field photograph slide for Cecropia, there are two saplings of Cecropia in the foreground. The smaller of the two is completely visible with the taller one only partially in the frame; its leaves can be seen along the very edge of the image silhouetted by the clouded sky. The sapling that is completely in view is among vegetation of varying heights and varieties in an opening that overlooks forested hills. The leaves of the young tree fan over each other in a cluster above the ground under the midday cloud light. With verdurous valleys in the background, the young Cecropia habitat in the foreground appears to be relatively hydrous.

The vegetative foreground, the middle-ground composed mostly of hills, and atmospheric background trisect the image into thirds. With the sapling in the foreground not centered, while the habitat is, this image provides a slightly greater focus on the setting above the sapling. In this way, the image’s primary function is to show the natural habitat of this species of plant while also showing the plant as it grows. More precisely it shows the degree to which this ecosystem

and species of plant were thriving within this specific region of central Peru during summer season at the very end of the 1950s.

The slide for palmettos has the locality, region, and year written on it. The field photograph slide for the palmettos is listed as “palm” on the line for slide 117. On the border of the slide “Palmetto” is written as well as the locality of “Aquaytia” with the year “1959” below it. The region abbreviation of “AMZ” for Amazon is written in the border as well. In providing the region, year, locality, and plant common name (palmetto) on the slide frame, it situates the slide, linking it to a time, place, and particular plant specimen of a specific collection event.

In the field slide, the palmetto appears to be along a dirt road in an open area on the outer edge of a savannah forest. With a horizon of clouds in the back ground, the palm grows in the midday light among a tangle of brambles and grasses. The pinnate leaves angle and spike in all directions. The clustering palm is situated several feet from where the photograph was taken on the dirt road.

The palm is centered in the slide image in such a way that the image becomes loosely composed of thirds: the ground, the tree, and the sky. This is a commonly used compositional device. In this way, the tree becomes framed by the land and the sky. The contrast between the palm fronds and the blue sky give a certain emphasis to the palmetto foliage as opposed to the tree trunk, which is partially hidden behind the undergrowth. The photograph provides a sense of the early summer habitat of this species of palm as it grows in the midday sunlight. The vantage point is at the level of the Mathias’ height, thus below and looking up toward the tree, which emphasizes its

size and height. On the one hand this photograph is a record of Mathias' view of the palmetto while as the same time it shows how this variety of palm grew in this region of Peru during the month of June just under sixty years ago in 1959.

Taken together, the narrative and specimen field notebooks as well as the field slides provide collection event information that compliments each other and further extends understanding of Mathias' field research in Peru. More precisely, the narrative and specimen notebook entries for *Cecropia* give a sense of the collecting region and flora seen while collecting. They cross-confirm of each other's accounts while also providing supplemental details, whether route of field travel or a specific medicinal use for the species of plant. Likewise, the *Cecropia* field slide provides a visual account of the sapling growing above the valley, giving both a micro and macro view of the location. With the palmettos, through her narrative relay of having seen palmettos in the region, Mathias both references as well as reiterates what is visible in the slide. In this way, the information is provided in two forms, visual and written, which are additive to each other in how they are each distinct means of information transmission, where each form is in constant interplay with the information, though differently.

Field Notebook Entries for July 2, 1959 and *Passiflora* and *Paullinia* slides 118 and 75:

Narrative and Specimen Field Notebook Entries, July 2, 1959:

The narrative field notebook entry for July 2, 1959 begins with the following locality description: "Collecting across river and northeast of Aguaytia- woods ..." The entry mentions that *Passiflora* was collected along the road. The specimen field notebook lists two *Passiflora*

specimens in the entry for July 2nd with the collection numbers as 3512 and 3530. Within the specimen notes of the second of the two *Passiflora* specimens (3530) the descriptive phrase “flowers red” is written. Next to where the date is initially listed for the July 2nd entry in the specimen field notebook is written “... to north of road east of Aquaytia.” The *Passiflora* specimens are also listed in the Peru Identification Index.

The narrative notebook entry gives a general idea of the habitats (river, woods, road) and area where the collecting occurred that day (northeast of Aguaytia). It also includes a specific reference to the specimens of the *Passifloraceae* family, also known as the passion flower family, that were collected. The multiple specimen notebook entries for *Passiflora* indicate that more than one specimen was collected while also providing specifics related to flowers’ color.

The specimen field notebook also lists *Paullinia josecuatri Mack* with the specimen collection number 3518, as well as two specimens *Paullinia* 3519 and 3532 in the entry for July 2. It provides the following description for specimen 3518: “Flowers white, calyx red; seed black w. white aril (photograph).” The *Paullinia* specimen is also listed in the Peru Identification Index.

Paullinia josecuatri is a plant from the *Sapadaceae* family, which is also known as the soapberry family. The specimen notebook provides details concerning the precise characteristics of the plant, specifically regarding aspects of the flowers and seeds. By including the word photograph in parenthesis, the notes also indicate that a photograph was taken of the specimen. Whether present in the narrative notebook or the specimen notebook, this is the primary method that Mathias used to indicate that a photograph had been taken of a specimen. This method was more

commonly used throughout the narrative notebook and much less common throughout the specimen notebook.

Passiflora and Paullinia Field Photograph Slides 118 and 75:

The Passiflora field photograph slide was located by cross referencing the slide index.

“Passiflora” is written next to the line for slide 118. On the border of the slide is written the region abbreviation of “AMZ” as well as the year “59” and the locality “Aguaytia.” In providing the region, year, locality, and plant genus on the slide frame, it situates the slide, linking it to time, place, and particular plant specimen of a specific collection event.

Within a thicket full of oblong leaves and stems, a saucer sized crimson flower with a fountain of filaments grows at a slant toward an overcast sky. In the foreground the Passiflora appears with anthers like tiny pearls. Indistinguishable vegetation in the background blurs into a variegated green. The camera is approximately a foot away with the specimen among partially damp plants. The proximity of the lens allows for seeing the specific plant anatomy for this species and particular to this specimen. The angle of view centers the passion flower in the photograph and places it parallel with the viewer. By placing the camera several inches from the specimen, the focus becomes predominately on the passion flower and its characteristics. Simultaneously, the rest of the image, bestrewn with darkness, becomes both less distinct while also serving to frame the flower through the contrast between the shadowy vegetation and the crimson corolla. In this way, as a visual record this field slide provides a sense of the how this species of Passiflora succeeded within its environment as well as what that environment looked like within the Aguaytia area of Peru during July of 1959.

An additional field photograph slide of *Passiflora* was located, likely taken either a few weeks prior or the following month when Mathias was in Tingo Maria. It is slide 75 with “passiflora” written on the line beside the slide number. It has the abbreviations “AMZ” and “59” written on the frame as well as “Tingo Maria.” The photograph shows the same variety of *Passiflora* as the previous slide, though the image is taken at a further distance from the plant. Among the understory of the overlapping forest leaves and branches are several coral colored passion flowers, upright and bright among the shaded forest light. Within close proximity there are a few unopened passion flower buds. A partially clouded sky is visible in the distance through the varying vegetative levels of the forest. With the passion flowers several feet away, the habitat is more visible, allowing for all elements of it to be in focus. The shaded emerald vegetation accentuates the vibrancy of the flowers by way of contrast between the two. The angle of view situates the flowers well above the viewer in such a way that elevates how they are seen. While being tangled among overgrown verdure, their height becomes synonymous with the height of trees. The light sky in the background further frames the forest habitat in the foreground through its subtle suggestion of a silhouette. In this way, this field slide compliments the previous slide of *Passiflora* in how it provides additional information concerning those habitats that this species of passion flower was common to within central Peru during the summer months of 1959.

The precise slide for the *Paullinia* specimen could not be located. Although another slide of a *Paullinia* specimen was found, it had the locality “Tingo Maria” written on it, which is approximately two hours, sixty miles, southwest of Aguaytia by car. This slide is 27 with “fruits” written next to it in the slide index. Since Tingo Maria is not mentioned in either field notebook

entries for the July 2, it is likely not the same specimen. Additionally, no year is written on the slide, though the abbreviation of “AMZ” is.

While this slide is not the exact slide of the specimen mentioned in the notes, it still serves a valuable function. Part of what is interesting about this slide is that the precise fruits that are described in detail in the notes for the *Paullinia* specimen are the primary focus of this photograph. In this way, the photograph functions as a type analogous representation of the original specimen, which provides a visual impression of the written description. Full of pink fruits, a branch of *Paullinia* appears among other varieties of plants crowded with leaves and stems intersecting at various angles. In clusters, the seeds alternate along the stems under the open forested daylight. The photograph is taken approximately a foot away and with a view that is parallel to the plant. This creates a certain position equivalence between the viewer and the specimen. It allows the viewer to look closely at the characteristics of the *Paullinia* species: its fruits, seeds, flowers, leaves, and branches. In occupying most of the image as well as being located in the foreground with the background consisting of shadowy colors that blur and recede, the specimen becomes framed by the contrast in light and color. In this way, this field slide provides a sense of the degree to which this species of Sapadaceae succeeded within this area of central Peru during the summer of 1959. It also serves to function as analogous representation of the *Paullinia* specimen described in the field notes.

Taken together, the narrative and specimen field notebooks as well as the field slides provide collection event information that is congruous and furthers understanding of Mathias’ field research in Peru. More precisely, the narrative and specimen field notebook entries for *Passiflora*

provide both directional details of the field collecting and area as well as descriptive details of the specimen collected. The field slides, while from different localities, give a sense of the range of the species of passion flower. Both the notebook entries and slides are reiterative while also being distinct versions of the collection event. In this way, they provide varying accounts and thus become variable versions of each other, which complimentary. Likewise, with the notebook entry for Paullinia, the characteristic details given regarding its particular plant anatomy are correlative with the field slide of a specimen of the same species. In this way, the field slide becomes a representational surrogate for the specimen described in the notebook entry and while it may function as a type of visual equivalence, the precise slippage between the field notebook entry and field slide gives rise to an expanded translation of the collection event as an occurrence in multiples.

Field Notebook Entries for July 13, 1959 and Mallow Field Photograph Slide 10:

Narrative and Specimen Field Notebook Entries, July 13, 1959:

The narrative field notebook entry for July 13 mentions plant presses and pictures taken of various flora. The specimen field notebook entry for July 13 has the location of Tingo Maria next to the date. The first specimen listed for the entry is Mallow, which is from the Malvaceae family, the same family as Hibiscus. The specimen collection number is 3658 and the description provided is as follows: “Seeds of yellow mallow. Shrub to 10 ft. Picture.” Within the Peru Identification Index notebook, beside the 3658 specimen collection number is “seeds (picture)” is written as well.

The narration gives a general sense of collecting activity for the day, which included pressing and drying specimens as well as photographing flora as well as the habitat area more broadly. The specimen notebook entry indicates the locality, a small city in central Peru, as well as the specimens collected that day, one of which was Mallow, which is the common name for specimens of the Malvaceae family. The specimen description provided for the Mallow specimen gives the type of vegetation (shrub), approximate height (10ft), and characteristics of the plant (yellow flowers with seeds).

Mallow Field Photograph Slide 10:

The field photograph was located by cross referencing the slide index. In the index “Malvaceae” is listed on the line for slide 10. On the frame of the slide the region abbreviation “AMZ” and the year “59” are written as well as the locality of “Tingo Maria” and the family Malvaceae. In providing the region, year, locality, and plant family on the slide frame, it situates the slide, linking it to time, place, and particular plant specimen of a specific collection event.

The Malvaceae slide shows a flowering section of Mallow stalk at a diagonal in the sunlight amongst other vegetation, which is blurred in the background of the photograph. There are clustering leaves growing around pale yellow petaled flowers with tiny globes of pollen at the very tips of the stamens. Additional flowers are present, though less visible further down the stalk as well as on the opposite side. The flowers appear to exhibit a circular growing pattern around the stalk, opening at all angles, which maximizes synthesis of sunlight for the plant’s success. The close proximity of the lens allows for seeing the verdant foliage and the general absence of plant discoloration, which indicates a certain level of thriving of the plant.

The mallow flowers are centered within the photograph. One flower, stained with pollen, faces the summer sun and the other two are oriented downward toward the ground and slightly shaded by their petals. The plant's leafy stem continues in either direction through image's corners. This diagonal compositional bisecting in conjunction with the intensity of light creates a certain division between the foreground and the background. The blurred vegetation of the background and the radiance of flower characteristics in the foreground brings the viewer's attention to see the particular properties of the plant in all their angles in such a way that accentuates their attributes. The camera is parallel to the flowers, which places the viewer and the plant on the same plain, lateralizing how the specimen is seen in relation to the viewer. The photograph at once shows how the mallow was seen by Mathias as she collected near Tingo Maria while at the same time it also shows how this species of plant was growing during the summertime of 1959 among other tropical vegetation of central Peru.

Taken together, the narrative and specimen field notebooks as well as the field slides provide collection event information that compliments each other and further extends understanding of Mathias' field research in Peru. The field notebook and index entries together descriptively confirm the collecting activities as well as the accounts of the mallow specimen collection. Each account references the slide by stating that a picture was taken. In this way, they become collection accounts that account for each other; thus transforming the specimen collection event into a self-referential collection of collecting accounts.

Further Discussion:

The field notebooks, indexes, and field slides allow for linking the various elements of the field research into a composite of Mathias' observations and syntheses, and therefore method and understanding, of the specimens, habitats, and regions. In this way, considering these collection materials in conjunction with each other gives rise to a certain stitching together of records of registration grounded in empiricism.

With the field photographs more specifically, the particular properties of the field slides are precisely where their value lies and distinguishes them as visual records. It is these attributes that are not entirely reducible, which illustrate an event that cannot be replicated, though can be reconstructed in varying ways through these materials.

Broader Thesis Discussion:

Taken together, these three case studies consider the value of field photographs by looking at how field collecting, field photographs, and field collection material are a co-constitutive type of knowledge production in plant science research.

The three case studies include three different types of photograph media and lens-based visual records. The first case study focuses on 2in x 3in Kodachromes, a type of print generated from 35mm film using a film camera. The Kodachrome prints are practically pocket size, they can fit in one's hand, making them both portable and an ideal economical size for inclusion on a plant specimen sheet. The Kodachromes are also single and original prints, meaning that based on the research thus far, duplicates have yet to be located.

The second case study involves an online database comprised of digital surrogates of both analog and born digital photographs. The database of digital surrogates provides a certain flexibility with viewing through online access, which allows for remote viewing, as opposed to being in the physical presence of the visual record. It also allows for viewing varying sizes of the images. The digital surrogate image files are duplicates of original images, either film or born digital.

The third case study focuses on 35mm film slides, which were produced through using a film camera. The 1 in x 1 in 35mm reversal film slides, which presents a positive image, are meant to be backlit when viewed. Their small size often necessitates a certain close proximity to the eye for seeing details of the image. The slides are also intended and designed for light to be projected through them, thus creating a larger projection, on a wall or screen, for viewing from a greater distance.

Each of these media have certain limitations as well as affordances, which influence how they are handled and viewed both by the original photographer and producer of the visual record as well as the user of the record for research purposes. The field photograph is held or viewed on a specimen sheet. The digital surrogate file is produced and viewed on a backlit computer screen and through the use of a computer and the internet. The slide is held in one's hand, placed on a lightbox, held between one's fingers while being backlit, or viewed while being through lit. In this way, the nature of these three types of visual records: print, digital surrogate file, and slide, in conjunction with the specific purpose of their use, each give rise to different ways in which

their metadata is inscribed in them as well as different types of metadata. The three different types of metadata inscription are each part of a different form of record keeping.

With the Kodachrome prints, Liogier wrote the collection number on the very edge of the field photograph print once the film was developed and he was no longer in the field. By writing the collection number along the border of the print, it provided a means for keeping track of or linking the visual record with its complimentary collection material like the plant specimen, collection label, and map, which facilitated record keeping of his research/materials. Likewise, it also allowed for correlating this material at a later time by his affiliate institution where it was sent and mounted on a specimen sheet. For the user and researcher of the specimen record, it allows for quick reference between the field photograph and the collection label, both of which have the collection number on them. Part of the function of the scrawled collection number on the very edge of the field photograph is that through its presence it becomes a numerical declarative that functions semantically, which reaffirms that the plant specimen in the photograph is the same plant specimen referred to in the collection label and present in dried form on the specimen sheet.

With the Hengduan Mountain database of digital surrogates, metadata was inscribed into the digital files when copies of the analog or born digital images were originally made for the database. Likewise, additional metadata was added prior to as well as once ingested into the database. This metadata facilitates organization of the digital files, individually and as collections, for the botanist as well as for the database managers through names, dates, and key words included in the metadata. Additionally, it allows for linking the digital surrogates with the

related collection material within the database. Likewise, it also allows for searching for the field photographs by researchers using the database as well as downloading the images as needed for research. In this way, the metadata, while not always visible to the user, becomes a means for using the field photographs individually and in conjunction with the related collection material.

With the Mathias slides, the metadata was written on the border of the slide once the film was developed and the transparencies were made. This metadata was written in abbreviated text on the one inch cardboard or plastic frame as a way for Mathias to index her slides, if somewhat inconsistently, within her extensive slide collection. It also allowed correlating the slides with other relevant collection material like field notebooks and indexed plant lists. The metadata primarily consists of the year, location, and plant name (either common name or by genera). In this way, the metadata becomes a type of abbreviated declarative that both states that Mathias was at a certain location, during a certain time, observing a certain species of plant as well as confirms this through correlation of other associated collection material.

Taken together, these three case studies show the particularities of three types of media and visual records (digital file, print, slide) with varied metadata, which can provide the date/time, location/GPS, and photographer/botanist. Each of these uses of metadata function as types of record keeping across the different media formats. The associative field collecting material like field notebooks, field notes, and specimen collection information, can also provide correlative dates, locations, and specific information concerning the botanist's field research.

An additional aspect of plant science field photographs that is central to their value is that field photographs are visual records. They provide a visual trace of an event, which is evident in the image. While field photographs are valuable as single records, part of their value is in relation to each other and the collection material associated with them, whether a Kodachrome print, a digital surrogate, or a 35mm slide. And although the entire breadth and complexity of information accessible through looking at field photographs as visual records is irreducible into metadata that can be entered into fields within records, categories can however be generated from the visual properties of the images, which are unique to each individual field photograph. The set of categories that emerge from each of the images specifically pertain to the aesthetic attributes of the images from which visual descriptions can be generated and entered or ingested into a record as an abstract. More precisely, this relates to the formal compositional elements like framing, point of view, depth of field, light, focus, color, etc. as well as those components that comprise the image that are informative with regard to its content.

Within each of the three case studies, discussion of the visual properties of the field photographs includes attention to the aesthetic attributes that are unique to the field photograph. Each field photograph, whether taken by Alain H. Liogier in the Dominican Republic in 1968, David E. Bouffard in the Hengduan Mountain Region in 1984, or Mildred E. Mathias in Peru in 1959 gives rise to a welter of categories that are reflective of the formal compositional components that comprise the image. These very categories in turn become inextricably enmeshed with understanding of the collection events as do the imprints of these images. Meaning that, through engagement with them, the images produce, permeate, and preserve understanding of the field research.

Given the complexity of field photographs as visual records of knowledge production, it is important that the categories pertaining to their visual properties be properly represented in fields within records generated for accessing them so that they can be available to research outside of plant science and the sciences more broadly, like the humanities and the arts. Part of the difficulty lies in translating these visual properties into quality metadata with simple semantic values that lend themselves to easy and intuitive searching.⁷⁰ This notion is a common challenge for cultural heritage institutions, which has been discussed widely by cultural heritage scholars. In particular, Wanda Klenczon and Pawel Rygiel emphasize the importance of appropriately assigning metadata that reflects the image attributes of “the non-textual materials... it involves transforming visual code into written code.”⁷¹ It is these visual codes, like transparent threading through images, that are integral to knowledge production and understanding the plant specimens within the field photographs and the field collecting more broadly. It would be worthwhile for plant science to integrate the cataloguing model that Klenczen and Rygiel propose, which facilitates access and interoperability of cultural heritage records within and between institutions.⁷²

The field photograph is a record in multiples, which approximates and reflects: the botanist’s perception, the landscape and of a specific locality within a given region, and the camera technology at the time. In this way, the field photograph traces three types of history: knowledge, geography, and technology, which triangulate dialectically through time in the form of a record.

⁷⁰ Wanda Klenczon and Pawel Rygiel. “Librarian Cornered by Images, or How to Index Visual Resources.” *Cataloguing and Classification Quarterly*. Taylor and Francis. (2014) 52: 42-44.

⁷¹ Wanda Klenczon and Pawel Rygiel. “Librarian Cornered by Images, or How to Index Visual Resources.” 43-44.

⁷² Wanda Klenczon and Pawel Rygiel. “Librarian Cornered by Images, or How to Index Visual Resources.” 42-61.

Plant science field photographs allow us to see our varying views of nature, as they are constructed, practiced, and understood, and thus constitute an unmatched knowledge resource.

Collectively, field photographs construct an evolving view, a visual chronology, of the transformation of the geography, ecology, climate, land use, and human development in specific regions around the world. They are a progressive view that shows a range of environments that are thriving at different levels over time. In this way, they are an invaluable resource for numerous research fields because they represent a century and a half land survey on a global scale.

Again Verran: "...collective picturing and storytelling about the land with its possibilities for emotional ladenness and material embeddedness is an inherent part of knowing ...we must...include our use of imaginaries in our accounts of our knowledge."⁷³ The field photographs that botanists take while out in the field contribute to and are part of constructing our imaginaries. Taken together, they knit an uneven, inconsistent, and heterogeneous view of nature that collides with science. They are not objective nor absolute. They are not fixed nor refined. They are irregular records of knowledge production. Though ubiquitous within plant science research, in some ways they are outliers of research. Knowledge occurs in tandem and is tangential as does movement through space, like field collecting.⁷⁴

⁷³ Helen Verran. "Re-Imagining Land Ownership in Australia." 249.

⁷⁴ David Turnbull. "Messy Assemblages." 13-14.

The bibliography and literature review provided below give an overview of the sources consulted for this thesis research. These sources have provided theoretical and analytical grounding for analyzing and arguing for the value of plant science field photographs, which has been invaluable conducting the three case studies.

Appendix I: The Plant Specimen Sheets with Field Photographs of Alain H. Liogier





THE NEW YORK BOTANICAL GARDEN



Salvia selliana Urb.

Det. Alain H. Liogier *22/10*
Bot. Garden, Univ. P. Rico

THE NEW YORK BOTANICAL GARDEN
Flora of Hispaniola
Dominican Republic

No. 12732

Salvia selliana Urb.
Det. Dr. Alain H. Liogier Aug. 1969

Shrubby, up to 2 m high; flowers: calyx pale purple, corolla-pyriform; waxes in pine forest, Sierra - Los Viratos, W of Ametillo, Sierra de Baoruco, alt. 1600 m. on limestone mixed w/ to basaltic.

Dr. Alain H. Liogier 9 Feb. 1969
Supported in part from the National Science Foundation.





THE NEW YORK BOTANICAL GARDEN
 Plants of Hispaniola
 Dominican Republic

No. 13525

Agave intermixta Erel.
 Det. Alain H. Liogier, 1970.

Urbably, 4-5 m high, flowers orange-colored,
 on slopes, from Santiago to La Moca. Alt.
 400 m.

Det. Alain H. Liogier 26 Jan 1969

5

Supported by funds from the National Science Foundation.





THE NEW YORK BOTANICAL GARDEN



LAMIACEAE
Scutellaria havanensis Jacq. n. l.
Det. A. Pool, 2004
Missouri Botanical Garden Herbarium (MO)

THE NEW YORK BOTANICAL GARDEN
Plants of Hispaniola
Dominican Republic

No. 15195

Scutellaria havanensis Jacq.
Det. Alain H. Lagler, Aug 1969

Herbaceous, erect, about 10 cm high, flowers deep blue. On rocks, in exposed places, common, limestone hills, Jaigüí Pardo, about 20 miles N of Santiago. Alt. 900-1000 m.




Dr. Alain H. Lagler 14 Aug 1969 5
Sponsored by funds from the National Science Foundation.

Appendix II: Field Photographs of the Biodiversity of the Hengduan Mountains Online Database

Locality 74 (Sichuan)


Locality 74
Sichuan: Daocheng Xian. Bowa pass on road from Daocheng to Gongling. Dwarf Rhododendron scrub, alpine meadows and gravelly slide areas. 28°53'57"N, 100°17'8"E; 4460-4650 m.




Copyright 1998 David E. Boufford [\[Edit image\]](#) [\[View original in new window\]](#) [\[X\]](#)

▼ Hide images (11)

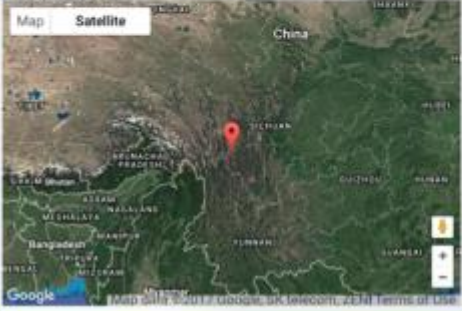
Habitat:



Specimens:



- ▶ Show angiosperms (26)
- ▶ Show pteridophytes and lycophytes (1)
- ▶ Show bryophytes (14)
- ▶ Show fungi (1)



Map Satellite

China

Google



Copyright 1998 David E. Boufford [\[Edit image\]](#) [\[View original in new window\]](#) [\[X\]](#)

▼ Hide images (11)

Habitat:



Specimens:



Liliaceae

Lilium lophophorum (Bureau & Franchet) Franchet var. *lophophorum*

📍 Sichuan: Daocheng Xian. Bowa pass on road from Daocheng to Gongling. Dwarf Rhododendron scrub, alpine meadows and gravelly slide areas. 28°53'57"N, 100°17'8"E; 4460–4650 m.

Around shrubs of dwarf Rhododendron on slope. Tepals yellow with dark spots on inside, ovary green.

D. E. Boufford, B. Bartholomew, W. Y. Chen, M. J. Donoghue, R. H. Ree, H. Sun & S. K. Wu
28298

5 July 1998



Copyright 1998 David E. Boufford. [Edit image] [View original in new window]



Locality 459 (Yunnan)

Locality 459

Yunnan:Dali Xian. E side of Diancang Shan mountain range. Vicinity of Yinglofeng. Disturbed shrub covered slopes and Pinus plantation. 25°42'0"N, 100°7'0"E; 2900-3050 m.



Upper slopes of Cang Shan near Yinglofeng; habitat of *Vaccinium delavayi*

Copyright 1984 David E. Boufford [\[Edit image\]](#) [\[View original in new window\]](#) [X]

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Habitat:



Specimens:



► Show angiosperms (24)

► Show pteridophytes and lycophytes (1)





Upper slopes of Cang Shan near Yinglofeng; habitat of *Vaccinium delavayi*

Copyright 1984 David E. Boufford [\[Edit image\]](#) [\[View original in new window\]](#) [X]

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Habitat:



Specimens:



Ranunculaceae

Thalictrum delavayi Franchet



Yunnan: Dali Xian. E side of Diancang Shan mountain range. Vicinity of Yinglofeng. Disturbed shrub covered slopes and Pinus plantation. 25°42'0"N, 100°7'0"E; 2900–3050 m.

Plants 0.5 to over 1 m tall. Flowers purple, stamens yellow.

1984 Sino-Amer. Bot. Exped. (B. Bartholomew, D. E. Boufford, H. W. Li, C. G. Ma, D. H. Nicolson, T. S. Ying & S. W. Yu)
958 10 July 1984



Copyright 1984 David E. Boufford [\[Edit image\]](#) [\[View original in new window\]](#)
[\[center\]](#)



Locality 2794 (Xizang)

Locality 2794

Xizang (Tibet):Jiangda (Gyamda) Xian. Ca. 21 km W of the city of Jiangda on highway 314 (to Changdu), then N on road to Yushu, Qinghai Province. Gravelly slopes along stream, flat Kobresia-Bistorta meadows, 31°34'29"N, 98°3'19"E; 4000–4100 m.



Copyright 2009 Rick Ree [\[Edit image\]](#) [\[View original in new window\]](#) [\[X\]](#)

▼ Hide images (14)

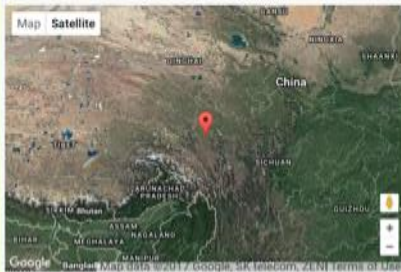
Habitat:



Specimens:



► Show angiosperms (37)





Copyright 2009 Rick Ree [\[Edit image\]](#) [\[View original in new window\]](#) [X]

▼ Hide images (14)

Habitat:



Specimens:



Asteraceae

Anaphalis xylorhiza Schultes-Bipontinus ex J. D. Hooker

Determined by: Yousheng Chen, October 2014

Xizang (Tibet): Jiangda (Gyamda) Xian. Ca. 21 km W of the city of Jiangda on highway 314 (to Changdu), then N on road to Yushu, Qinghai Province. Gravelly slopes along stream, flat Kobresia-Bistorta meadows, and slopes with dwarf Rhododendron (< 0.5 m tall) and Sibiraea. 31°34'29"N, 98°3'19"E; 4000-4100 m.

Flat meadow. Stems in clumps from common base; florets white.

D. E. Boufford, B. Bartholomew, D. A. Eaton, X. H. Li, R. H. Ree, B. Xu, J. P. Yue, J. W. Zhang & X. X. Zhu
41728

3 August 2009



Appendix III: The Field Photographs of Mildred E. Mathias

Cecropia Field Photograph Slide 66



Palmetto Field Photograph Slide 117



Passiflora Field Photograph Slides 118 and 75



MADE IN U.S.A.

AUG 59

AMZ

59-

138



Tiyo Maria

Paullinia Field Photograph Slide

15

AMZ 18248



Tingo Maria

Mallow Field Photograph Slide 10



Literature Review

Armstrong, Carol M. *Scenes In A Library: Reading the Photograph in the Book*. 1843-1875. MIT Press: 1998. Print. YRL. UCLA. Print.

This book discusses the relationship between the photograph and text with regarding to understanding the image. This discussion may be worthwhile to the case studies. In particular, the two case studies that examine field photographs that are attached to specimen sheets as well as field photographs considered in relation to the associative field note books.

Atkins, Anna. *Sun Gardens: Victorian Photograms*. NY: Aperture (1985). Arts Library. UCLA. Print.

This book presents the cyanotype photograms of botanists Anna Atkins from the mid 19th century. Particular focus is given to algae and ferns specimens. This source may provide insight into early uses of the photographic technology in relation to botany.

Baca, Murtha, ed. *Introduction to Art Image Access; Issues, Tools, Standards, Strategies*. Getty Research Institute. Getty Publications. 2002.

Barthes, Roland. "The Rhetoric of the Image." *Image/Music/Text*. NY: Hill and Wang. (1977) pp.32-51. CCLE

This text gives particular attention to the image and how it functions with regard to meaning. This source may prove valuable to further discussion of the field photograph as a visual record.

Benjamin, Walter. "Unpacking My Library." *Illuminations*. New York: Schocken Books. (2007). Print.

This piece discusses collecting and provenance with regard to books. This source may be worthwhile to the discussion of the botanist's role within field collecting and in relation to field photographs.

Bowker et Al. "Toward information Infrastructure Studies: Ways of Knowing in a Networked Environment." *International Handbook of Internet Research*, 2010. CCLE.

This text focuses on knowledge production in networked environments using a socio-technical framing. This source will be valuable to discussion of knowledge production involving plant science field collecting in conjunction with field photographs and associative collecting material.

Bruns, Gerald L. *Hermeneutics Ancient and Modern*. New Haven: Yale University Press. (1995) Print.

This text is about understanding understanding. This may be valuable to the discussion of field collecting and field photographs as a particular type of knowledge production.

Flusser, Vilém. *Towards a Philosophy of Photography*. London: Reaktion Books. (2000). Print.

This book gives particular attention to the range of ways that photographs function culturally (aesthetics, politics, science). This source may be worthwhile to the discussion of the value field photographs within research fields outside of plant science.

Fox Talbot, Henry William. *The Pencil of Nature*. 1844-1846. YRL Special Collections. UCLA. Print.

As the first text with photographic illustrations, this source provides insight into early understanding and uses of the photographic technology. This source may be valuable concerning discussion of plant science field photographs as visual records that provide traces of nature.

Goldberg, Vicki. *Photography In Print*. University of New Mexico Print. (1988). Print.

This book is a collection of texts on photography which span the history of the technology. The texts vary to include critical analysis, philosophy, as well as more personal and narrative views on photography. This source may prove worthwhile with regard to discussion of the value and function of field photographs.

Kittler, Friedrich. *Optical Media*. Malden: Polity Press. (2010). Print.

This book gives an historical overview of optical/lens-based media- mechanical up through digital technology. Particular attention is given to all aspects of the image and its evolution and progression through history. This work may be worthwhile with regard to discussion of how the field photograph as a visual record functions and is of value within and outside of plant science.

Mathias, Mildred. "Field Notebooks." The UCLA Herbarium. UCLA. Print.

There is a total of fifteen field notebooks of Mildred Mathias, which include details of her plant science field collecting research. These are located in her office in the herbarium, which contains all of her research materials (literature and media). Both field photographs and the field notebooks have been briefly reviewed. These will be the focus of one of the case studies.

Meyer, Robinson. "What Good Is A Library Full of Dead Plants?" *The Atlantic*. 18 Mar 2016.

Accessed. 18 Mar 2016. <http://www.theatlantic.com/science/archive/2016/03/the-peculiar-importance-of-a-dead-plant-library/474438/>

This piece gives particular attention to the value of herbaria across fields and the degree to which specimen record metadata can provide unbiased data to show movement patterns of plants as well as of botanists. This source presents a framework for considering field photograph metadata as potentially valuable to both the sciences and the humanities.

Owens, Trevor. "Defining Data for the Humanities: Text, Artifact, Information or Evidence." *Journal of Digital Humanities*. 1:1 (2011) Accessed 15 Oct 2015.

<http://journalofdigitalhumanities.org/1-1/defining-data-for-humanists-by-trevor-owens/>

This text provides a humanist framework for considering data. This may be worthwhile to the discussion of field photograph metadata and the value of field photographs.

Philip et. Al. "Postcolonial Computing: A Tactical Survey." *Science, Technology and Human Values*. 2010. CCLE.

This text uses an STS (Science Technology Studies) framework (socio-technical) to discuss postcolonial theory in relation to computing. This thesis will present discussion of the value of plant science field photographs within an STS framework. In this way, this text is valuable to this thesis because it provides a framework for considering STS.

Sandweiss, Martha A. *Photography And the America West*. New Haven: Yale University Press (2004). Print.

This book gives particular attention to early photography in conjunction with westward exploration. A certain focus is given to the degree to which these two types of discovery influenced each other. This source may be worthwhile to the discussion of field collecting and the role of field photographs within this specific type of knowledge production.

Smithsonian Institution. "Smithsonian Field Book Project; Plant Science Field Photographs And Associative Material." *Smithsonian Field Book Project*. Accessed 15 Oct 2016.

http://collections.si.edu/search/results.htm?q=field%20notes&fq=data_source:%22Smithsonian%20Field%20Book%20Project%22&fq=object_type:%22Photographs%22&fq=topic:%22Plants%22

There is a total of 286 items related to plant science field photographs within the Smithsonian Institute Field Book Project. Further review of these items will be valuable and integral to the second as well as possibly the third case studies.

Sontag, Susan. *On Photography*. New York: Picador. 2009. Print.

This book consists of Sontag's insights regarding the role, function, and value of photographs. This source may be worthwhile concerning the case studies.

Trachtenberg, Alan. *Classic Essays on Photography*. New Haven: Leete's Island Books (1980). Print.

This collection of texts includes a range of writings from the earliest photographers to modern photographers as well as writings of photographers and philosophers from the second half of the 20th century. These texts may be worthwhile with regard to discussion of the value and function of the field photographs throughout the case studies.

Turnbull, David. *Maps and Territories: Science Is An Atlas*. Deakon University: Deakon University Press. (1989). Print. Also available: <http://territories.indigenouknowledge.org>

This book focuses on maps in conjunction with knowledge production and representation. This source is part of the theoretical framework of the thesis specifically with regard to discussion of field collecting as a particular type of knowledge production.

Turnbull, David. "Messy Assemblages, Emergent Protocols, and Emergent Knowledges." *4S Conference*. Pasadena. (2005). 1-27. CCLE.

This text focuses on emergent mapping as it relates to complexity theory. This source is central to the theoretical framework of this thesis. More precisely, it is part of the discussion of field collecting as a particular type of knowledge production in motion.

Verran, Helen. "A Postcolonial Moment in Science Studies: Alternative Firing Regimes of Environmental Scientists and Aboriginal Landowners." *Social Studies of Science*. SAGE. (2002) 32; 729-761. CCLE.

This text compares the firing practices of Aborigines and environmental scientists. This text is valuable to the theoretical framework of this thesis in its analysis of the environmental scientists' research practices in relation to the Aboriginal firing regime and understanding of agency and land as inseparable (people-place).

Verran, Helen. "Re-Imagining Land Ownership in Australia." *Postcolonial Studies*. The Institute of Postcolonial Studies. (1998) v.1, n. 2. 237-254. Accessed 1 May 2016.

<http://www.douri.sh/classes/readings/Verran-ReimaginingLandOwnershipAustralia-PostcolStudies.pdf>

This text compares the Aborigine understanding of land and the Western notion of land ownership. This text is central to the theoretical framework of this thesis. In particular, the attention that is given to imaginaries as they relate to knowledge systems is worthwhile to discussion of the value of field photographs as visual records.

Wittgenstein, Ludwig. *Remarks On Color*. Oxford: Blackwell. (2007). Print.

This text primarily focuses on Wittgenstein's thoughts on color. It may be worthwhile to the discussion concerning the value of field photographs as visual records. "Is there such a thing as 'a natural history of colors and to what extent is it analogous to the natural history of plants? Isn't the latter temporal and the former non temporal?"

Wolf, Adam, Naupaka B. Zimmerman, William Anderegg, Posy E. Busby, and Jon Christensen. "Altitudinal Shifts of the Native and Introduced Flora of California in the Context of 20th-Century Warming." *Global Ecology and Biogeography*. (2016)

This piece primarily focuses on the outcomes of research considering the degree to which specimen record metadata can provide unbiased data to show movement patterns of plants as well as of botanists. This source presents a framework for considering field photograph metadata as potentially valuable to both the sciences and the humanities.

Wolf, Adam, William R.L. Anderegg, Sadie J. Ryan, and Jon Christensen. "Robust Detection of Plant Species Distribution Shifts Under Biased Sampling Regimes." *Ecosphere*. (October 2011) Volume 2(10) Article 115.

This piece primarily focuses on the methods used within research considering the degree to which specimen record metadata can provide unbiased data to show movement patterns of plants as well as of botanists. This source presents a framework for considering field photograph metadata as potentially valuable to both the sciences and the humanities.

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Gibson, Arthur C. "Mildred Esther Mathias Hassler (1906-1995)." *Neotropical Biodiversity and Conservation*. Occasional Publication of the Mildred E. Mathias Botanical Garden. University of California Los Angeles. (1996) Print. ix-xi

Klenczon, Wanda and Pawel Rygiel. "Librarian Cornered by Images, or How to Index Visual Resources." *Cataloguing and Classification Quarterly*. Taylor and Francis. (2014) 52: 42-61.

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Nazaire, Mare. Research at RSA." *Interview with the Manager of the Rancho Santa Ana Herbarium*. Unpublished Interview. Rancho Santa Ana Herbarium, Rancho Santa Ana Botanic Garden, Claremont, California. 15 Jul 2016.

Thiers, Barbara. "Field Photographs in Plant Science Research." *Interview with the Director of the New York Botanical Garden Herbarium*. Unpublished Interview. The William and Lynda Steere Herbarium at the New York Botanical Garden. Sep. 2013.

Turnbull, David. *Maps Are Territories: Science Is An Atlas*. Deakon University: Deakon University Press. (1989). Print.

Turnbull, David. "Messy Assemblages, Emergent Protocols, and Emergent Knowledges." *4S Conference*. Pasadena. (2005). 1-27. CCLE.

Verran, Helen. "A Postcolonial Moment in Science Studies: Alternative Firing Regimes of Environmental Scientists and Aboriginal Landowners." *Social Studies of Science*. SAGE. (2002) 32; 729-761. CCLE.

Verran, Helen. "Re-Imagining Land Ownership in Australia." *Postcolonial Studies*. The Institute of Postcolonial Studies. (1998) v.1, n. 2. 237-254. Accessed 1 May 2016. <http://www.douri.sh/classes/readings/Verran-ReimaginingLandOwnershipAustralia-PostcolStudies.pdf>

Watts, Brandy. "Historical Assessment of the LuEsther T. Mertz Library Photo Vault."
Unpublished Data. LuEsther T. Mertz Library at the New York Botanical Garden. (Jun 2013-Jun
2014).