

Centers for Regenerative Studies: Graduate Studio Experiences in Education for Sustainable Design

Robert J. Koester

Ball State University, Muncie, IN, USA

ABSTRACT: This paper reviews a six-year history of offering graduate studio education focused on design-for-sustainability. Students have been exposed to methodologies of design appropriate to servicing the interest of sustainability while maintaining a clear sense of connection to experiences of prior studio education – at both undergraduate and graduate levels.

A ten-step pattern of assignments is discussed and illustration is provided of the culminating product of these assignments: the design of a *Center for Regenerative Studies*, as a nodal site within an international network of similar facilities. Students have been encouraged to use as a benchmark of inspiration the John T. Lyle Center at California Polytechnic State University in Pomona. Since many of the students participating in the course have been international, an exploration has been made of the design of such centers for the climates and contexts of many of their respective homelands.

Reflections are provided on the changes made from one semester to the next as this assignment set has been refined to serve better the intent of the educational mission and to accommodate the circumstances of each successive offering. Supplemental enrichment activities are noted as well.

Keywords: sustainability, design process, studio pedagogy, graduate education, international students

1. INTRODUCTION

The challenge of offering an architectural education which engages design-for-sustainability is to find the means to embrace this (new) content arena in all its measures, but in a way which honors the best of design studio teaching. The sections which follow describe that very delineation in a case study of studio *structure*, studio *content* and resulting student *work*. At one level the presentation is a generic discussion of the studio pedagogy and at another level is quite specific in reporting the findings from a cumulative six-year offering of a Graduate Design Studio — framed under the rubric of *DISCOVERING APPLICATIONS OF THE PRINCIPLES OF SUSTAINABILITY IN THE MAKING OF ARCHITECTURE*.

2. CONCOMITANT STUDIO EDUCATION

The active-learning of the studio format in an architectural curriculum is an inspired, inventive, immersive experience and always is embraced passionately by students — in large part because it cultivates such a personally-rooted investment in the design studio work. Students imbue each project with a sense of their individual identity; and this builds a habit of nearly always seeking a one-of-a-kind (obvious) form-based expression. This is reflected, and, in fact, reinforced, in the considerable references to so-called *signature architecture*; a term adopted in the academic and professional literature and by the trade magazines and popular press, as well.

This emphasis on pursuing unique (iconographic) expression can be found even in the assignments given by the studio faculty who themselves came

through this personally-rooted active-learning of the studio culture. In this context, faculty often function primarily as critics in a reactive mode, responding to student design work as it unfolds in the stages of what becomes, unfortunately, a substitution of unscripted *willful expression* for *design process*.

This culture of the individual (the different) plagues the active-learning even more in the occasional team-based project. In fact, it saddles graduates of professional design curricula with significant personally-rooted difficulties as they move into real-world office practice in which a very high order interdependence of participant roles and responsibilities is consistently at play.

This professional practice complexity, of course, is a topic of significant pedagogical interest; however, the challenge addressed herein is the positioning of sustainability content within this studio culture.

The approach described is pro-active and intentionally drives the stages of the learning process with highly structured subsets of scripted assignments and conceptual frameworks by which the students can begin to discover how to design-for-sustainability.

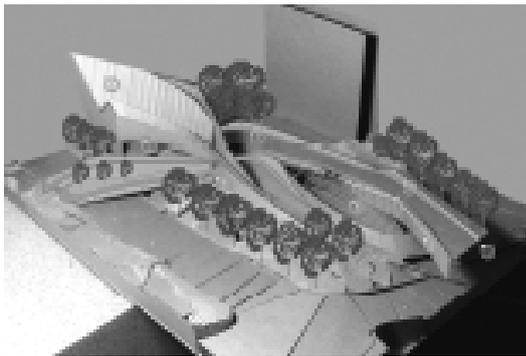


Figure 1: An Iconographic Form

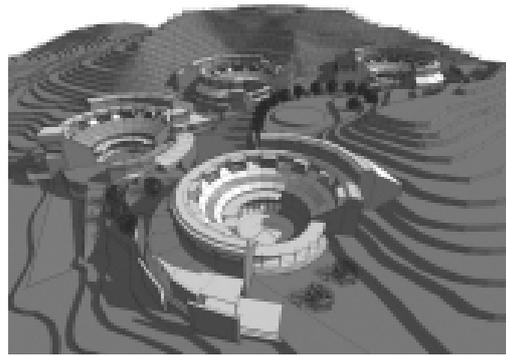


Figure 2: An Architectural Fabric

3. POSITIONING SUSTAINABILITY

Sustainability as a content arena can be ill-defined and rather broad. The challenge for studio teaching is to frame its introduction in a way that enables students to self-actualize and discover further an understanding of the intellectual discipline of design studio education through the very codifications of the sustainability concern, itself.

The profound opportunity is to set in place a clearer understanding of the importance of systems thinking and the time-dependent process of design decision-making. Students are meant to see how the *elements, relationships* and *ordering ideas* used in the design process align with those found in nature.

The very acts and products of design, in fact, are considered equivalent to the evolutionary phenomena of nature in which "species" evolve over time under multiple forces of influence, and emerge as a result of a cyclical trial-and-error development, more particularly comprising an iterative balance-seeking transformation toward environmental fit.

4. EMBEDDED IDEAS

The specific assignments given in the graduate studio described herein have sought operational purpose on many levels. One goal has been to inspire the students to discover the wholeness of the sustainability concerns in a design exercise; ergo, the overarching idea that a Board of Directors for a *College of the Seven Spheres* would commission the design of mirrored placements around the globe of a *Center for Regenerative Studies* — suited to many respective cultural, economic and climatic contexts.

In this spirit, students are introduced to two flagship examples of architectural response — the John T. Lyle Center for Regenerative Studies at California Polytechnic State University in Pomona and the Adam Joseph Lewis Center at Oberlin College, Ohio. Many other instructional touchstones are used as well; these include, but are not limited to, the writings of D'Arcy Thompson, the nature of musical structure as revealed in the stories of Mozart and Salieri, and the evolution of architectural form found in the life work of Frank Lloyd Wright. In addition, a connection is made to the historical Academic Village of the University of Virginia — an exemplar of pedagogical intent embedded in an architectural work.

A longer-term purpose has been to grow a sense of connectivity among the graduate studio participants that will last beyond the semester-long course in the hope that they will become part of a global network of professionals committed to the teaching, research and demonstration of sustainability; and over time that they each might take the initiative to establish a *Center for Regenerative Studies* in their respective home countries.

5. NEW OPPORTUNITY

Sustainability content offers the opportunity to open questions about the suitability of "foreground" vs. "background" design. In a "foreground" building (Fig. 1) the designer seeks inspiration from the complexities of sustainability for the making of an iconographic form. In a "background" building the sustainability factors are addressed in the knitting together of an architectural fabric (Fig. 2).

This dialogue within the foreground/background challenge leads to a new alignment of design understandings with the tenets embedded in the teachings of nature. The opportunity is to discover an architecture whose expressiveness locally and more generally "invites" the resolution of social, economic and ecologic (read climate) context. In this view, architecture can be rediscovered as a kind of language comprising a cell/tissue structure, with a DNA-like coding that can become emergent as a site-specific, localized expression — the product of, and a tool for, a virtual evolutionary transformation.

More specifically, the design ideas that are compiled as a particular construct for a particular site, in a given cultural and technological context, in response to some specific climate, can come to function as seed models whose transformation over time can be constrained/ expressed on many sites.

This, of course, is the lesson embedded in the life work of any of the celebrated master architects, though the principles and codifications with which they worked did not necessarily confront directly the concerns of social/economic/ecologic sustainability.

This realization brings to light the importance of adopting a highly structured pedagogical framework for leading the instruction of the design studio — thus enabling a discovery of, and thereby presenting a salvation for, the best of studio teaching.

6. THE ASSIGNMENTS

In keeping with criteria of the NAAB (National Architectural Accrediting Board) in the U.S., the course has sought to build in the students, both individually and as a group, an *awareness*, *understanding* and *ability* in the areas of design-decision process and sustainability knowledge.

Since the first of this studio offering, specific assignments have been used to draw reflection upon the nature of studio education in prior years, and to platform a longer term evolution of applying the skills of design thinking to the complexities of both the *problem-solving* and the *value-making* opportunities that lie within in the sustainability arena.

Assignments have ranged from carefully sequenced, rather abstract invitations for design response, to directed literature reviews (Table 1). The intent has been to leverage the individual work of studio members to the benefit of all. To the extent that each student has generated a response to a design request, all have examined the alternative constructs used to frame design thinking. To the extent that each student has illustrated and shared design process, all have come to understand that complexity more fully. To the extent that each student has prepared an assessment of a cutting-edge publication, all have become more informed about sustainability issues in the literature.

For each class this has made very effective use of the otherwise limited studio time in which to choreograph the active-learning.

7. THE PRODUCTS

The final design project has continued to be based on an imaginary program for a *College of the Seven Spheres* and has meant to incorporate as its first site-specific facility, the John T. Lyle Center for Regenerative Studies in Pomona, California. In the first class offering, this charge was mounted in two stages; an initial task to design a facility situated on a domestic U.S. site and a second task to “reseed” the design in a new physical site/venue — with emphasis on use of the original architecture as a DNA-like template, by which to embrace a differing climatic, cultural, and economic context.

Although students in the very first class went into considerable depth in the early assignments of the semester and became knowledgeable and more skilled in the conceptualization and technological implementation of the components of architecture-for-sustainability, they had difficulty “bringing forward” those ideas as a “reseed” project. As a result, not all students in the initial class elected to move the project to another climate/culture/site; choosing instead to develop their scheme further at its original location. Thus the two-stage requirement was eliminated in subsequent class offerings and only a single siting of the facility design has been required.

The following sections discuss the chronology of the course offering and the transforming nature of the project assignments.

Note: At the time of presentation of this paper, extensive illustrations will be provided.

Table 1 Initial Sequence of Incremented Assignments

1. Nine Stones	Students were asked to gather nine stones and explore “A Society of Rooms” --developing interpretative patterns to illustrate how the assignment was approached, the study was structured, the iterations were manifest, and conclusions were drawn.
2. Reflections and Writings	Students were asked to “develop a brief presentation on how you design”. The presentation included written and diagrammatic illustration.
3. Annotated Bibliographic Read	Students were asked to “develop an annotated summary of salient points and informational structure contained in one of the bibliographic reference books assigned”.
4. Deductive and Inductive Constructs	Students were asked to “pick one of the examples presented in response to the Nine Stones assignment and develop a series of analyses of the stone groupings as ‘built volumes’ -- to develop deductive and inductive constructs.
5. Themes and Details	Students were asked to reflect on the previous assignment and carry one item of detail through an iterative study.
6. Additional Measures	Students were asked to use the reference text to develop an assessment of the electrical production potential of the skin surfaces of the Nine Stones grouping
7. Annotated Bibliographic Read #2	Students again developed an annotated summary of the key points and the informational structure contained in another bibliographic reference book.
8. Patterns and Proportioning	Students were asked to re-visit the assessments of Assignment #4, and to represent these in terms of “the system of proportionalities inherent in the force flows and/or issues studied”.
9. Reflective Summary on Assignments 1-8	Students were asked to prepare a summary which “completely captures and explains the sequence of assignments you have had so far this semester”.
10. A Center for Regenerative Studies	Students were invited to engage a full studio design project—a <i>Center for Regenerative Studies</i> , “one of many such facilities to be sited around the world as part of a network of climate-specific residential facilities operated by the College of the Seven Spheres, an academic entity supported by numerous foundations and granting agencies”.

7.1 Spring 2001

Interesting revelations occurred for each student regarding the impact of concomitant (pre-ordained) design methodologies used (implicitly and explicitly) to frame and embrace the sustainability issues.

Some students became lost in detail and/or technical pursuit, exploding the project into multiple tributaries of investigation; finding it quite difficult to bring to resolution a synthetic integration of the expansive issues uncovered. Other students were uncomfortable opening the project to development — going beyond a particular point of “problem solution”.

The drawing habits (and abilities) led some to think only in terms of the two-dimensional graphics of plan/section patterns rather than the spatiality of three-dimensional built form.

By contrast, some were quite fluid in exploring the three-dimensional (experiential) relationships — so much so that, in one case, the student had difficulty with making decisions, i.e., selecting from the options.

Another student used the selection of project materiality to make emotive and/or expressive *gestures toward* nature — yielding a project design as much about a sympathetic (read *symbolic*) connection to nature as it was about sustainability in a *working sense*. The semester yielded substantial work; enthusiasm and openness to discussion and critique from each student remained high to the end.

7.2 Spring 2002

This class was larger, the program of spaces for the final project was increased in size by a factor of 10x and the site was shifted from rural to urban context — with placement in Chicago. In addition, this semester was supplemented by enrichment activities; as were others that followed (Table 2).

Though students struggled with the size of the project, they managed to exercise design responses at a high level of sophistication.

A device for course facilitation was the use of a “*studio mantra*”, to give the students a sense of freedom and confidence in taking risks; it was stated “*there is no right or wrong answer; do not think in terms of pure black and white choices*”. The intent was to achieve levels of development and refinement by accepting a certain level of *indeterminacy* in the range of complexities engaged. As a complementary move, a grading technique was used to correlate the breadth of issues addressed to the degree of development achieved — recognizing that the more one would broaden the range of issues, the less one could expect to develop that work to a full extent.

It was clear that scaling the complexity of this studio structure to the available time continued to be difficult. The decision was made to truncate slightly the first assignments to provide more time for the final design project work.

Student projects included considerations of the sustainability issues relative to the more traditional architectural content. In reflection, there was need to spend a bit more time on the ordering content of the traditional design decision-making techniques. The students, for example, treated the project still as a chance for expressive *form-making* more than an urban context *fabric-making* opportunity. This was dramatized by the uniqueness of the lake-front site — the Chicago River to the south, the Ogden Slip to the north, and the dividing effect of the overhead two-level Lake Shore Drive passing over the middle of the site. Nonetheless, requiring that more time be devoted to analysis of the existing urban context would have been appropriate.

The evaluations for the course revealed that the students found the educational approach meaningful; their dedication and excitement was reflected in the high level of development and quality of the final design work. In fact, the students made a special request for an Independent Study in Architectural Tectonics to be offered that following summer. That subsequent course work demonstrated a level of development that should be achievable within a normal studio semester.

7.3 Spring 2003

This third opportunity to refine the pedagogy involved (up to this time) the largest number of students taking the course and resulted in a broader array of explorations. As a means of enriching the studio opportunity, the decision was made to site the *Center for Regenerative Studies* on the University of Cincinnati campus in Ohio. The rationale included the facts that the campus was being outfitted with numerous projects by signature architects and was using a master plan which dictated that all new

2001	1) Distribution of pre-packaged site analysis;
2002	1) Travel to Chicago to examine the selected design project site; 2) Meeting with Joe Valerio to review the work of his firm, focused on material tectonics and expression in architectural form; 3) Participation by visiting scholar Walter Grondzik from Florida A & M University who offered insightful observations on the architect's role, architecture as a knowledge-based profession, and building commissioning in design-for-sustainability; 4) Participation by visiting scholars Annette Le Cuyer and Brian Carter, from the University of Michigan, who presented paired contrasts and comparisons of the tectonics of signature works in architecture and/or cutting-edge examples in <u>Radical Tectonics</u> ; 5) Participation in the SBIC <i>High Performance School Buildings Workshop</i> which was web cast from Indianapolis to the College of Architecture and Planning building, enabling the students to make use of interactive participation with the workshop.
2003	1) Interview with the former Dean Jay Chatterjee who reviewed the programmatic decision to select signature architects for major work; 2) Interviews with Joel Stout to explore the mandates by the institution to assure LEED certification of its building stock; 3) Interactions with the professionals within the greater Cincinnati area who comprised a “sustainability group”. 4) Visits by University of Cincinnati faculty members to the Ball State Campus to serve on juries; 5) Final public presentation of the student work at the Design, Art and Architecture building at UC; 6) Energy-10 Workshop with Kristine Chalifoux.
2004	1) Tour of John Todd Living Machine installation at PAWS, Inc.; 2) CERES Heliodon Gallery Tools and Equipment Briefing; 3) Reviews of Sustainability Video Modules; 3) Energy-10 Workshop with Kristine Chalifoux.
2005	1) On-campus interactive participation by faculty of Ecosa; 2) web-based teleconferencing with Tony Brown, Executive Director of Ecosa Institute; 3) Reviews of Sustainability Video Modules; 4) Participation in the College-wide <i>Health by Design Symposium</i> .
2006	1) Campus visit by Martin Leifhegger; 2) Campus visit by John Todd; 3) Energy-10 Workshop with Kristine Chalifoux.

Table 2 Supplemental Enrichment Activities

buildings meet the LEED guidelines promulgated by the US Green Building Council.

The urban context of the campus plan, and the significant differentiation afforded by the topographic variety of its location in the hills of Cincinnati, made it possible to establish alternative on-campus sites; three locations were selected by the students. They were chosen as contrasts of opportunity within the physical fabric of the campus: one site was along a ridge adjacent to a major transportation corridor at the *edge* of campus, another was located *within* the campus in a less dense urban context, and the third was located at a *junction* between the main campus plat and the acreage of a Medical Science complex developing to the northeast.

Some students again embodied sustainability as *iconographic form* as opposed to translating the principles of sustainability into an *architectural fabric* — integrating across the scales of components, skins, modules, and/or whole building assemblies.

Others, however, did use the modular nature of built fabric to address the environmental force flows. In some of these cases, the students elected to use *iconographic form as metaphor*, e.g., a ‘*string of pearls*’, a ‘*spiders web*’, or a ‘*bird and nest*’.

The students developed substantial content in their projects with a high level of graphic illustration.

7.4 Spring 2004

This Studio involved a smaller group of students. The structure of assignments mimicked the previous years' approach with small modifications to provide more time for development of the final design project. Students were asked to use a site of their choosing in their homeland. And in most cases, students were able to pull from the web the site plans, topographic data, photo images, and related descriptions of social, economic and cultural context.

Students were encouraged to borrow from the traditions of architectural response to these latter factors as evident in the vernacular architecture. In some instances, this served a liberating function; in other cases, it severely constrained the ability of the students to work with the fundamental principles of environmental force-flow management in making *strategy*, choosing *tactics*, and accounting *metrics*.

Nonetheless, the products of the studio were significant, achieving a high level of technical precision and high quality graphic presentations.

7.5 Spring 2005

This studio was teamed with the Ecosa Institute to examine the siting of a *Center for Regenerative Studies* in Prescott, Arizona.

One goal was to establish a long-term academic program link with Ecosa; the other was to borrow from the architectural inspiration of Frank Lloyd Wright's house in the desert — a model of locally harvested material sourcing and use of geometric inferences from the surrounding mountains in response to the extremes of the desert climate. That very climate and our distance from a real time experience of it, in fact, proved to be the hardest piece for the students to engage with their *strategies*, *tactics*, and/or *metrics*.

The products of the studio were shared in a mid-term on-campus review and in a final web-cast jury with Antony Brown from the Ecosa Institute; students benefited tremendously from his first-hand knowledge of the influence of the climatic factors on the making of indigenous architecture. Several of the students drew upon the *metaphors* and *analog*s of the climate response embodied in the material differentiation and physical form of the plant life in the desert.

7.6 Spring 2006

This most recent studio comprised the largest enrollment of international students to date; the breadth of context responses to climate, culture, and economy has been the richest yet explored.

Reflections on the results of this semester of work and the history of the course offering more generally, comprise the section that follows.

8. PEDAGOGICAL IMPACT

Reflections transcend the years of course offering. This includes observations about the students in the course and the course within the graduate program.

With regard to the students specifically, they: have relied on pre-existing tendencies to work in a primarily plan/section versus more three-dimensional

illustration mode; have exhibited difficulty in shaking the need to "perfect" a design rather than being comfortable with switching gears and reiterating their design ideas as new insights about context, climate, and culture; have occasionally succumbed to the 'temptation of information' endemic to sustainability.

Nonetheless, they have successfully addressed sustainability with a range of interpretations, while continuing to build design skill. Most importantly they have discovered a sense of belonging to a community of scholars in this content arena [1-15].

8.1 Icons or Fabrics

The challenge of embracing design-for-sustainability is to be wary of the inherent value systems that come with traditional studio education, wherein as designers we seek to identify value in our projects by making them different from others — seeking a form as a "solution to the problem".

Sustainability as a value-set, which integrates concerns for ecology, economics and social equity calls for a more generalized application of principles in a DNA-like "*seeding*" of design response as a built fabric within an environmental and/or urban context.

8.2 Criticality of Form

The 'criticality' of form is revealed in the making of icons or fabrics. This is amplified in the exemplary contrast of the engineered form of the fixed wing high speed modern jet as compared to the more elemental form construct of the first bi-wing plane, wherein the integration of the pilot's body with the control systems mimicked more the behavior of a bird in flight — built to adjust wing placement, feather angulations and bodily center of gravity to turn, dive, land, etc. This latter example, in fact, is suggested as an analog for the sustainable building—one that can continually flex in its response to environmental forces and can accommodate changes in those forces over time.

8.3 Lessons Drawn

A special distinction has emerged between "green", "sustainable", and "regenerative" design as a continuum of design sophistication; green as a categorization for the embodiment of sustainability in the material stocks of the building — its use of locally available resources for its construction, and its role in closing the technical nutrient cycles of our solid waste streams; sustainable as a categorization for the balance of flows in the building — its use of passive/active environmental intervention to service the needs of occupants; and finally, regenerative as a categorization for the yields of a building — its production of electrical power, supply of water, capture and redistribution of solar energy, and offering back, by way of a green roof and land development, the harvestable material stocks of the biological nutrient cycles.

8.4 Design Process

There is distinction between deductive and inductive reasoning and the need to draw on both of these spirited methods to give structure to the choices made during the design process. Sometimes we can deduce directly the felt need of a project; in other

cases we must *induce* an anticipatory need by which we frame the creation of new value sets. We are not only engaged in problem solving; we must embrace the distinction of problems and values as different frames of reference from which to operate.

We need to accept the importance of any starting point in the design process, recognizing that design process thrives on choices and the *implicit* as well as *explicit* constraints that come with those; once a choice is made, every project becomes a kind of “rehab” in which by living with decisions, the work evolves. We are thus ultimately empowered to reframe and thereby integrate the complexities of a project at ever-higher levels of sophistication. Fixing and varying, using metrics as feedback, even making decisions in the absence of information all reflect an active, healthy approach to addressing the challenges of design-for- sustainability.

Critiques in studio, the one-on-one feedback and careful guidance provided by faculty and/or peers, as well as public discussion of strengths, weaknesses, inclusions and omissions of a given project in a jury review will continue to be of enormous value.

However, it has been very important to remain clear-minded about the fact that critiques, in-and-of-themselves, do not reflect pedagogy. Simply tossing out an assignment in the studio setting, expecting students to begin to work and serving as a reactive critic will not service the powerfully demanding need of using design studio education to embrace the tremendous challenges of sustainability.

Studio teaching must address the complexities and legacies of the studio culture and the means by which students work independently and collectively to achieve a better understanding of their process — as applied to this content arena. This activity must be structured to spirit discovery. In the end each student should come to realize that his/her favorite project is, and always should be, “the next one”

9. CONCLUSION

The opportunity to teach design-for-sustainability at the graduate level over a period of years using an anchoring project differentiated by the selection of sites around the globe has been a rich and rewarding experience for students and faculty alike.

Sustainability as a content arena offers a kind of salvation for the best of studio pedagogy. The need to give structure to this otherwise amorphous topic demands a rigor to the sequence of assignments and a dialogue about the history of concomitant studio education — especially its explicit emphasis on seeking to achieve *signature architecture* in contrast to the needs of design process now emerging in the practice field as we embrace this new content arena.

The opportunities of design-for-sustainability reflect very pressing public concerns and dramatize the premise of this design studio—the creation of real time and virtual opportunities for participation in *Centers for Regenerative Studies* populating climates/cultures/economies worldwide.

Final Note: *This graduate studio was featured in 2005 for Special Recognition by the AIA/COTE Eco-Literacy in Architecture Project and is also referenced in the related 2006 AIA/COTE Tides Report.*

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- 2001 E. Kobets-Singh, A. Ceylan Oner, P. Liu, P. Howey
- 2002 M. Anderson, B. Berry, G. Carrio, D. Dettbarn, O. Guz, Z. Ji, J. Li, B. McKinney, J. Mracevic, C. Tirapas;
- 2003 A. Brakke, T. Guenes, N. Jaeger, S. Krenzke, R. Macias, K. Nunthavisith, C. Reiter, J. Richter, N. Somaiya, E. Tandogan, F. Thode, A. Ugursal, J. Vermillion;
- 2004 R. Adhikari, A. Cavender, N. Desai, M. Hart, Z. Hong, B. Mokha;
- 2005 Z. Benedict, N. Piriyaokob, S. Shrestha, S. Sinha, J. Vannice;
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