

What is Research?

A Reconstruction from 15 Snapshots

Charlie Van Loan

Warm-Up Question

How do you evaluate the quality of a PhD Dissertation?

The Skyline Factor...



It depends on the eye of the beholder.

The Appearance Factor...



Outwardly similar, inwardly different. An elevator to a view.

The Tilt Factor...



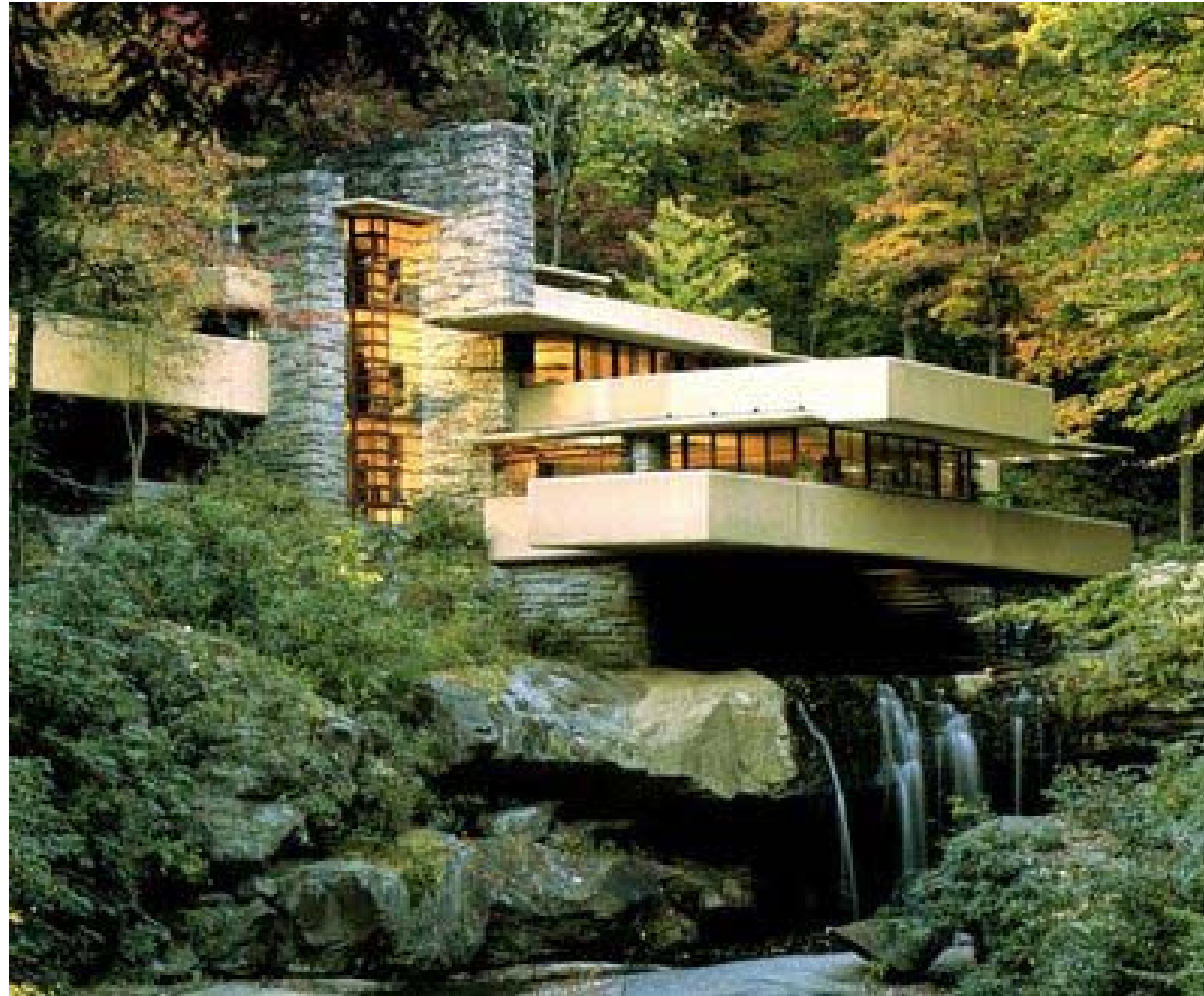
Object or camera?

The Reflection Factor...



Sometimes the Mirror Dominates

The Integrative Factor...



Beauty in the Niche and Nearby
Connections

The Proximity Factor...



up close, everything is by steps

The Repackaging Factor...



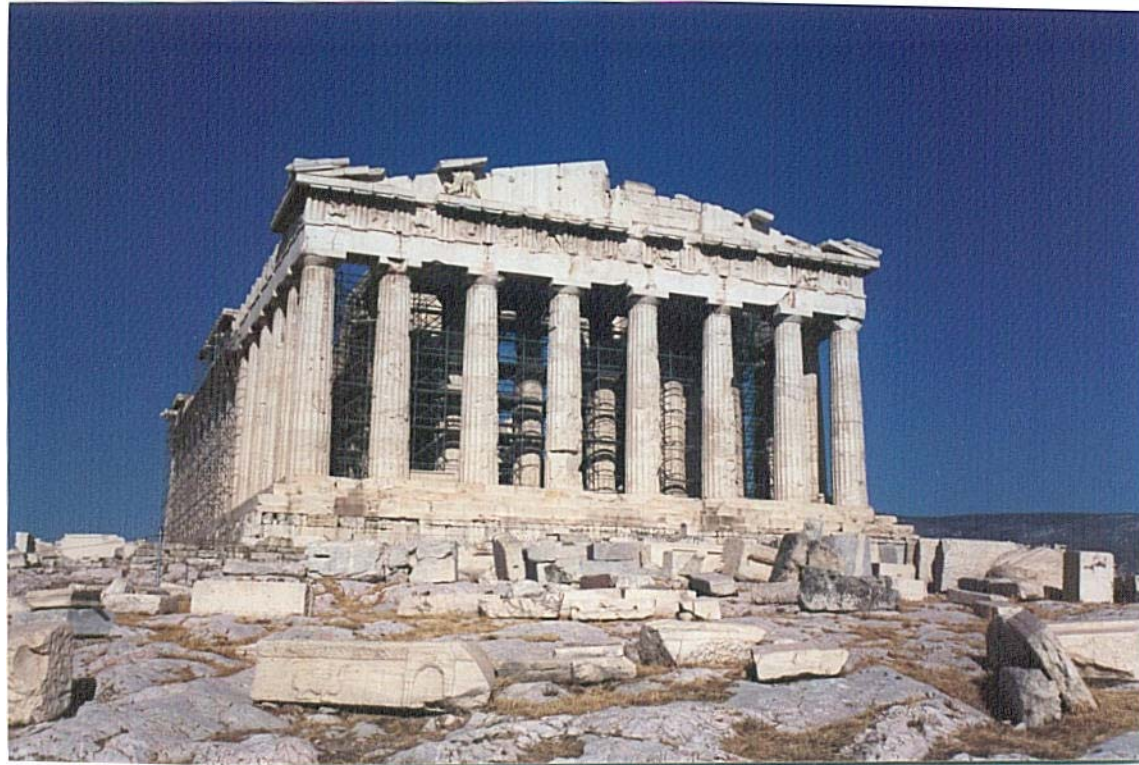
Great Ideas Deserve a Rethink

The Transparency Factor...



The Thrill of Seeing Inside What was Once
Opaque

The Impact Factor...



Every so Often, something will come along
That changes everything. Keep an eye out.

Now the 15 Snapshots...

Preamble

Let's say you are thinking about a career that has a research component.

The ratio of that component to the "rest of the job" is vitally important and should prompt a certain amount of reflection before you go on the market.

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"If I go work for a company or a lab, then will I be happy with my job's quotient of research and development?"

Just how you compute these ratios will depend upon your own research experience and how you think about research in general.

So let's ask a basic question...

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- Writing?
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- an Empire?
- a River?
- **the Wild West?**

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- an Empire?
- a River?
- the Wild West?
- a Journey?

Premises

In a research environment, just being smart is not enough.

Success is a product of intellectual ability and effective social skills.

While not necessarily teachable, these skills should at least be openly discussed.

Now on with the talk...

The Alignments...

Teaching
and
Research
Align

Teaching and research complement each other:

- Expository skills are refined by teaching and this multiplies one's effectiveness as a researcher.
- Research with enthusiasm inspires teaching with enthusiasm.

Development Work
and
Research
Align

A given project usually involves a mix of research and development.

“Working out the details” of an analysis or implementation or experiment may sound like low-level non-research, but with the right frame of mind it can prompt high-level creativity.

Coursework
and
Research
Align

It is a mistake to regard the “front end” of a PhD program as sequential:

Take courses → Find a thesis topic

These activities blend together. Early coursework can coincide with the act of finding a thesis topic if the student exercises grad-level curiosity and the instructors communicate a researcher's perspective.

Writing
and
Research
Align

Likewise, it is a mistake to regard the "back end" of a PhD program as sequential :

Do the research → Write it up

These activities should blur together.

Writing, like teaching, is a great clarifier. Committing to paper that which is fuzzy in your mind focuses attention on detail.

Organizing paragraphs into sections and sections into chapters forces you to identify hierarchies of ideas.

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Writing is research.

The Creative Process
and
Research
Align

Research does have a serendipitous aspect...

"I am not looking for anything that
I find."

- Picasso

But your ability to spot patterns in a random event is an acquired trait...

"In the field of observation, chance favors only the prepared mind."

- Pasteur

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And that trait is manifested by rigorous coursework and practical experience.

Ugrad Independent Study
and
Research
Align

The co-authored system or paper is not the essential outcome of undergraduate research.

More important is for the student to witness (up close) something that is the opposite of standard coursework:

- A setting where the questions are usually more important than the answers.
- A setting where the faculty mentor is more of a colleague than a pontificator.

University Mission
and
Research
(Should)
Align

The mission of a research university has several components.

Here are two:

- Deliver a great curriculum
- Deliver the next generation of scholars

On delivering a great curriculum...

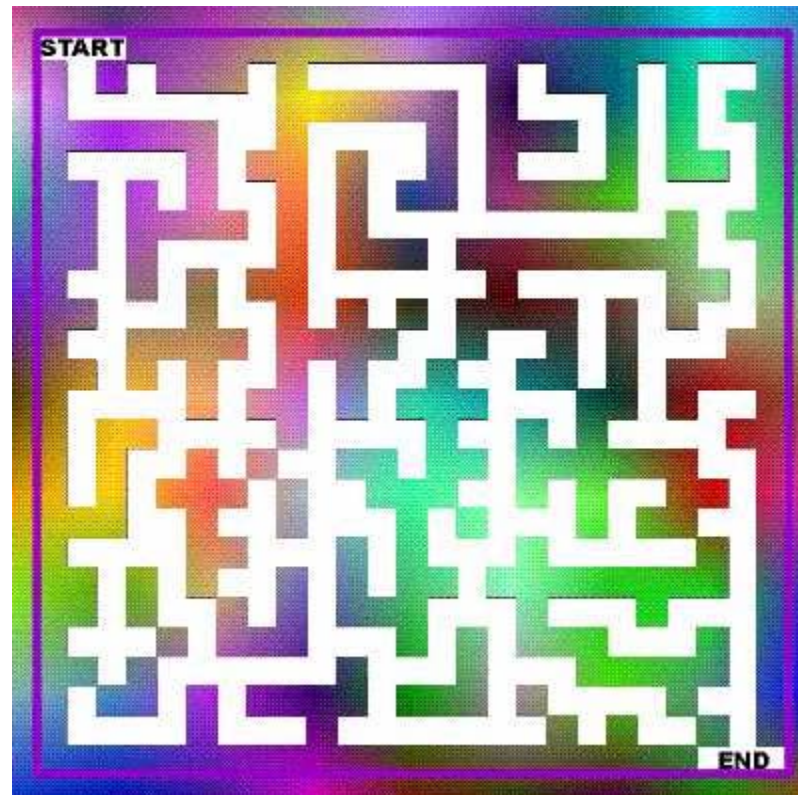
The faculty have the responsibility of bringing new research ideas into the *undergraduate* classroom in a timely fashion.

On delivering the next generation of scholars...

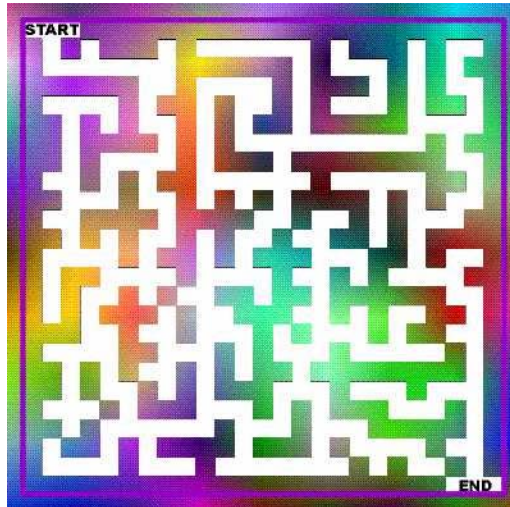
The continuation of life as we know it in the research university depends upon unfettered assistant professorships, where young people are free enough to be creative.

Now the Metaphors...

Research is a Maze

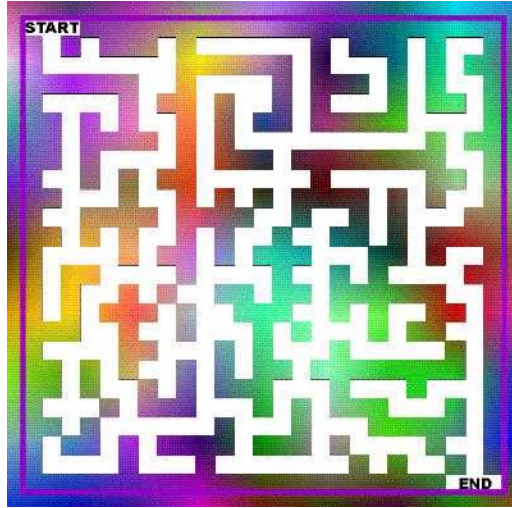


False starts and dead ends.



The "exit strategy" from start to finish sounds easy-- just keep your right hand on the wall and walk. (Try it!)

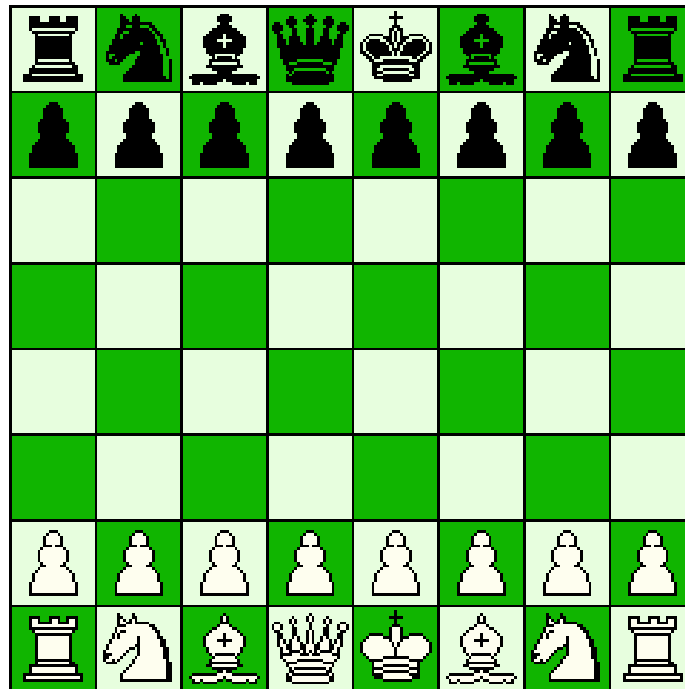
However, being strong enough to keep your hand on the wall is very hard.



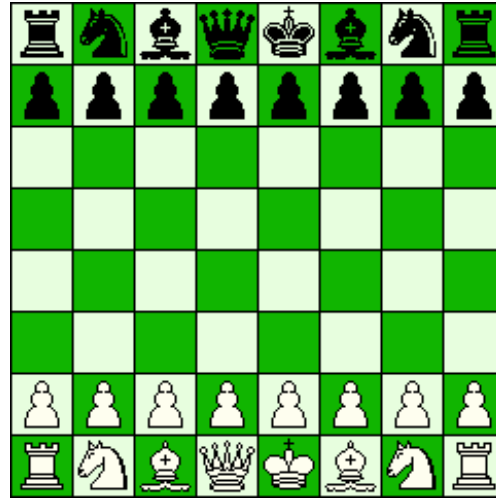
The only way to proceed when working on a research problem is to keep your mind on the scientific method at all times. This requires persistence and stamina.

Test positive for these steroids!

Research is a Game

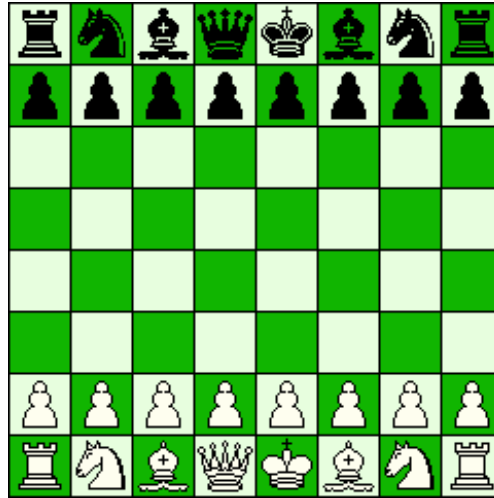


Rules, Etiquette, and Thinking Ahead



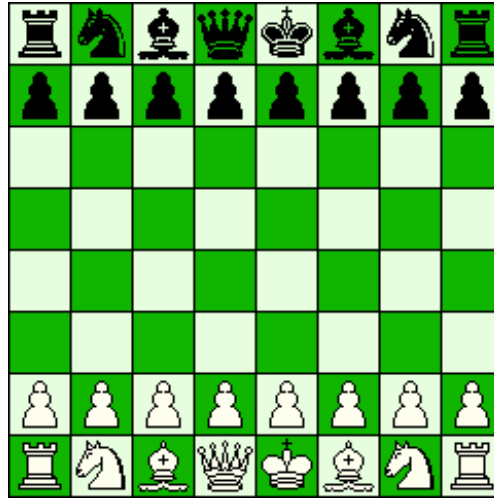
Colleagues move in different ways.

Learn how to analyze a board situation and how to formulate a realistic research agenda.



There are rules of engagement.

Learn how to respect related work and alternative styles of research.

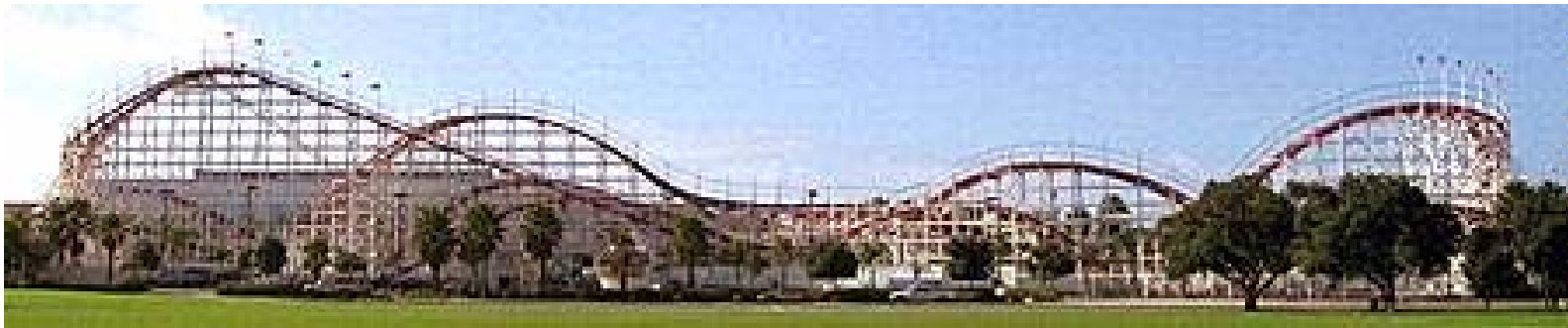


When you come to the table there is an appropriate dress code.

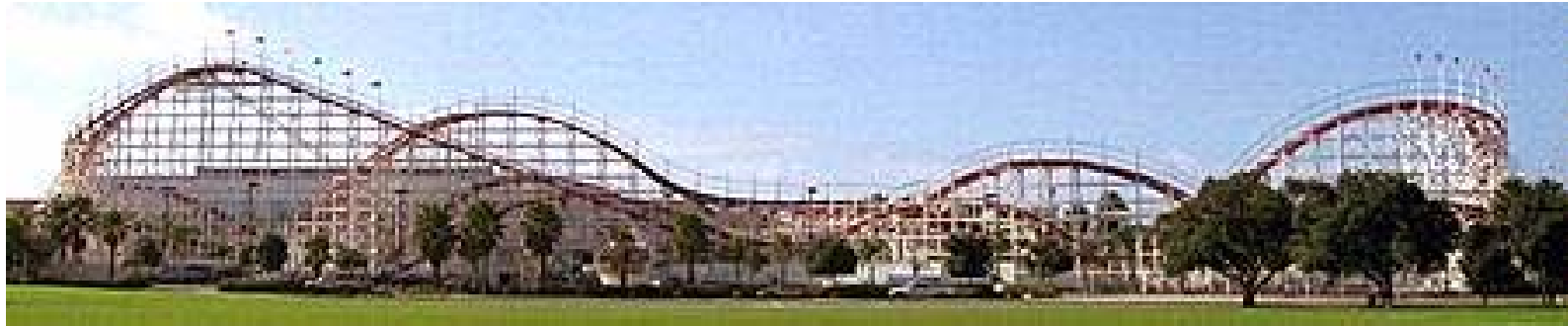
It is open and friendly.

It is called research casual!

Research is a Roller Coaster



Max's, Min's, and g-forces



Research has its ups and downs. Emotional ups and downs are bound to correlate.

Ride first with a mentor and become convinced that local minimums are (usually!) followed by local maximums.



Acquire confidence and learn that it is possible to work through a 5g deceleration.

Just skip lunch!

Research is a Pyramid



Base, Height, and Volume



Great researchers reach great heights.

From a distance they define a smooth,
glistening skyline.



In contrast, the up-close, street-level view of research is gritty and rough.

But it reminds you that accomplishments are just one stone on top of another.

Regardless, we are looking at a pyramid.

Its key attribute is volume.

Volume is proportional to base times height.

Research is an Empire



Course of Empire (Thomas Cole, 1834)



Research paradigms come and go.

Hot areas rise and fall.

Infrastructure expands and contracts.



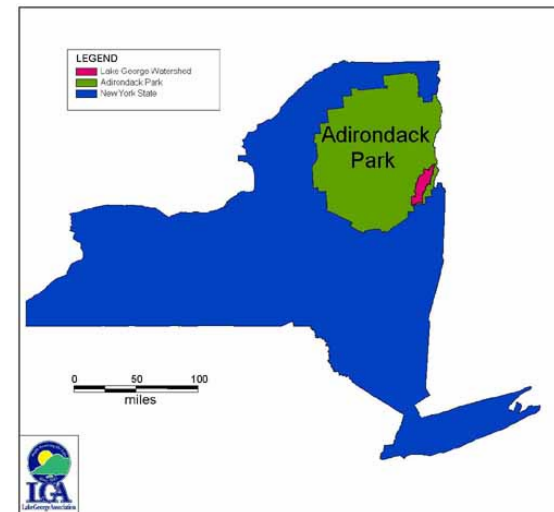
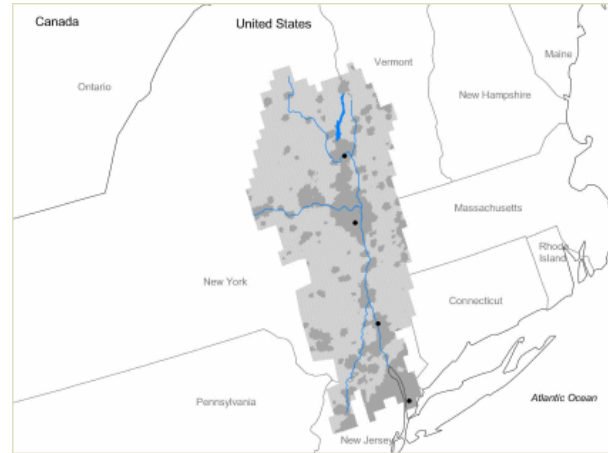
Appreciating this ebb and flow creates a healthy, realistic perspective of one's own work.



Funding agencies and universities must see their way clear from landscape to civilization and beyond.

Realization of the "next big thing" requires a warm Mediterranean climate.

Research is a River

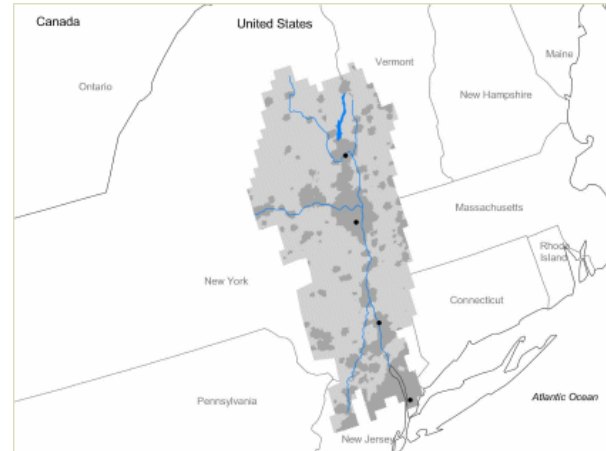


Origin and Watershed



The bog and the brook precede the river.

Before a research idea can flow with direction it must meander and join up with other research ideas. This is called "basic research."



Although all of the action is upstream, all of the impact is downstream.

A map of the catch basin connects it all.

Research is the Wild West



Horizons and Fences



On the open, interdisciplinary prairie it is impossible to tell where one field ends and the next begins. It's big Sky country with distant horizons.

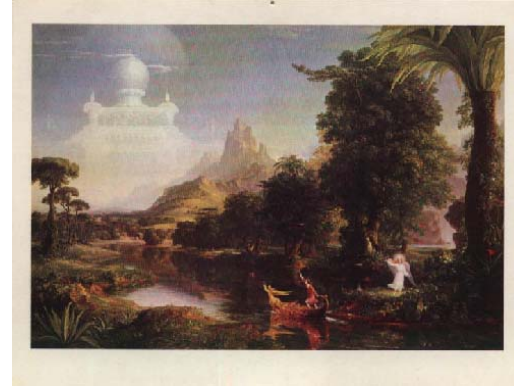


It is both wild and civilized. Barbed wire, rustlers and branding irons are part of the scene.

But so also are the "core research" homesteads that dot the plain and give it stability.

Life in the city is peaceful compared to this!

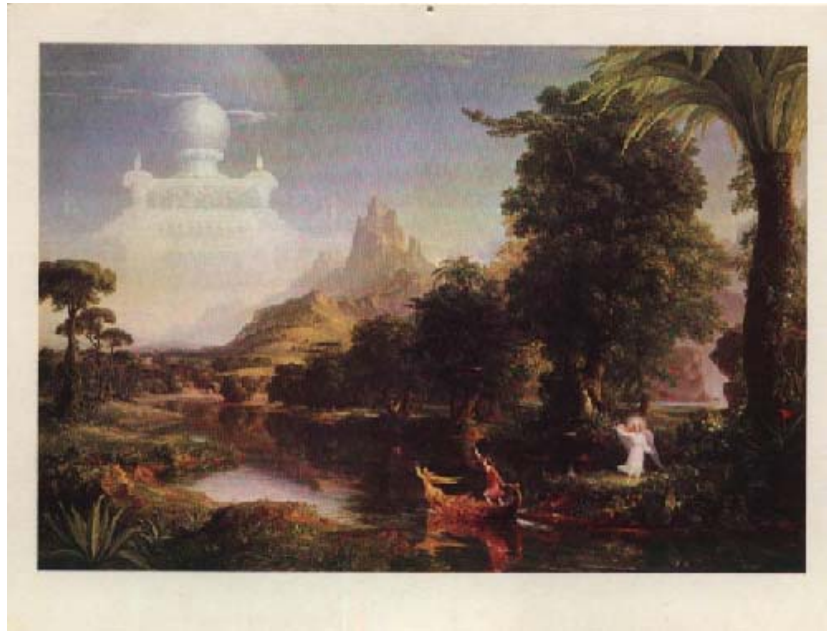
Research is a Journey



Voyage of Life (Thomas Cole, 1842)



If it can happen in life it can happen in research.



You can become independent and leave behind the safety of home.

You can reach for great things and remain youthful in outlook.



You can lose your rudder and be at the whim of the current.



And you can disappear into the Bermuda triangle.

Advice: Never get into a gondola with a strange person!

Summary

To paraphrase from the introduction, how you think about research will largely be determined by your own, individual research experiences.

But how you interpret those experiences will be a function of how well you are able to step back and put things into context.

This talk was about that context.