Humboldt SINQ Midterm

last modified:2/7/13

NAME: ______________________________

Estimated time: 2 hours of writing. If you get much beyond that, it's time to quit, because you've probably done most of what you can, no matter how much longer you take or how many words you write.

The exam has three parts (1, 2, 3 below). In part 1 you have a choice among 1a, 1b, and 1c. In part 2 you will choose an article to read. But be sure to do all three parts: 1, 2, 3.

This exam is closed-book (and closed-other resources, other than what's in your own mind). By continuing with the exam you are declaring that you are complying with this policy.

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1) Revisit your first writing activity, where you described the famous Humboldt portrait (below, left, by Weitsch). Look also at the portrait (below, middle) that was featured during week 3 of the course (two men at a table with all those scientific instruments), and the modified version (below, right) of the Weitsch portrait that appears on the cover of Helferich's biography of Humboldt. Click on the images below to view the images enlarged (or just look at your book's [closed!] cover).

Now write about YOUR CHOICE of topics 1a, 1b, OR 1c:

a) Comment about your understanding, 'way back in week 1, of the Weitsch portrait, compared with what you understand about the portrait now. It's OK to mention what you got right from the very start. If somehow you didn't do that initial assignment, do for the present either 1b or 1c, and then soon do the first "portrait" assignment (it's timed at just 20 minutes).

b) Identify the people and the place in the second portrait. Compare it to the Weitsch portrait, both as a work of art (color, organization, poses, etc.) and as an attempt to convey meaning about people, things, and ideas. What scientific instruments are those in the picture? What did those men observe or measure with them? How much of that science (quantity, variety) did they do? Where did they travel to do their work? How did they get their results back to "civilization"? Liven up your comments with some exciting or at least interesting stories of their experiences doing "extreme" science and exploration, just in case Hollywood wants us to consult on their film, *Alex of the Jungle* (sequels: *Crocodile Humboldt, Humboldt in the Land of Smoking Volcanoes, Humboldt and the Man-Eating Piranhas of the Amazon, Humboldt at the Top of the World, Dances with Jaguars,* and on and on). Don't underestimate the power of the "yuk" factor, but go easy on the "ewww".

c) Compare the Weitsch portrait (above left) to the cover of the Helferich biography (above right). What was the cover designer's aim in changing and augmenting the portrait, and how well does that cover "work"?

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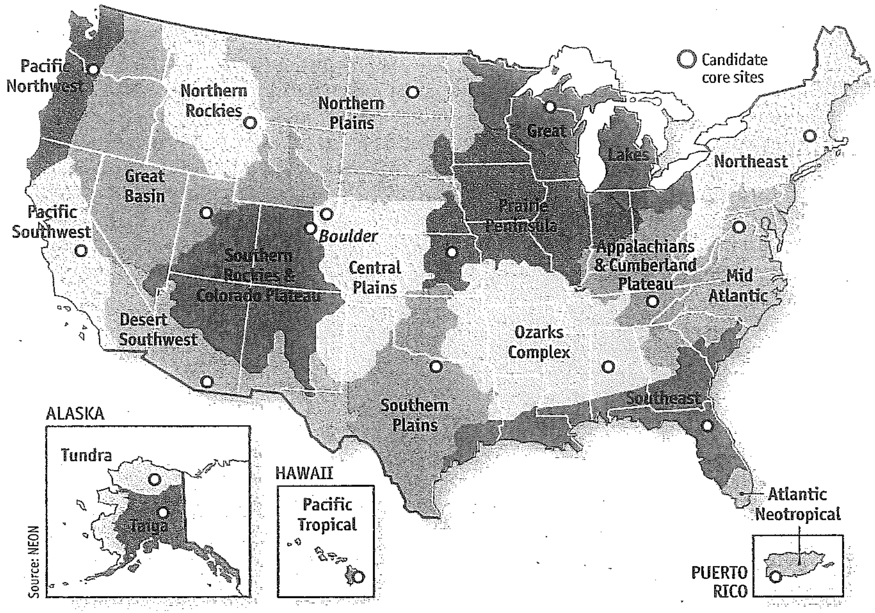
2) Choose ONE of the attached or provided short news articles (if there is more than one), read it, and relate it to Humboldt and (NOT "or") sustainable environmentalism. Humboldt would doubtless jump right into the activities and discussions those articles present and, in his charmingly accented English (French accent? German accent?) argue the ideas or help with the research. What could he offer? Along the way you should state your concept of sustainable environmentalism.

3) Tell how a skill, interest, or academic capability of yours relates to what you're learning about Humboldt and how it could be used, in combination with your knowledge of Humboldt's life and work, to help others learn something. That "something" can be about sustainable environmentalism, but does not have to be, and it does not have to be learning something specifically about Humboldt. Those "others" could be schoolchildren, professors in your other classes, politicians, or your fellow citizens around the country or around the globe.

Just as science needs not only ideas but data, your writing needs not only ideas but facts and examples.

Also in this section

63 Self-assembling computer viruses
64 Genetic damage and paternal age
64 Repairing vocal cords



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Economist.com/science

Terrestrial ecology

NEON light

BOULDER, COLORADO

A 30-year plan to study America's ecology is about to begin

THE phrase "Big Science" brings to mind rockets, telescopes and particle accelerators. When it comes to grand scientific gestures—and the cash that goes therewith—those who wield field glasses and butterfly nets in the name of terrestrial ecology seldom get a look in. Which is surprising, as the habitat they study, namely dry land, is the one actually occupied by humanity. But a group of American ecologists, led by David Schimel, intend to correct this state of affairs. They plan to shake up terrestrial ecology, and introduce it to the scale and sweep of Big Science, by establishing NEON, the National Ecological Observatory Network.

Finding the money for this project, which will be based in Boulder, Colorado, has not been easy, but after a decade of discussion and planning, America's National Science Foundation managed to persuade Congress to earmark $434m, the price of a modest space probe, to set it up. The operating budget will be around $80m a year.

Dr Schimel's team is thus now starting to wire up the landscape. Ground has already been broken at three sites—in Colorado, Florida and Massachusetts. Eventually, 60 places across the country will be covered simultaneously. Once this network is completed, in 2016 if all goes well, 15,000 sensors will be collecting more than 500 types of data, including temperature, precipitation, air pressure, wind speed and direction, humidity, sunshine, levels of air pollutants such as ozone, the amount of various nutrients in soils and streams, and the state of an area's vegetation and microbes.

Crucially, these instruments will take the same measurements in the same way in every place. By gathering data in this standardised way, and doing so in many places and over long periods of time, Dr Schimel hopes to achieve the statistical power needed to turn ecology from a craft into an industrial-scale enterprise. The idea is to see how ecosystems respond to changes in climate and land use, and to the arrival of new species. That will let the team develop models which can forecast the future of an ecosystem and allow policymakers to assess the likely consequences of various courses of action.

Tower records

NEON's researchers have divided America into 20 domains (see above), each of which is dominated by a particular type of ecosystem. Each domain will have three sets of sensors within it. One set will be based in a core site—a place where conditions are undisturbed and likely to remain so—that will be monitored for at least 30 years. The other two sets will move around, staying in one place for three to five years before being transplanted elsewhere. These "relocatable" sites will allow comparisons to be made within a domain.

Every site, whether core or relocatable, will have a sensor-laden tower that reaches ten metres above the existing vegetation. In an area of a few tens of square kilometres around this tower, the researchers will place further sensors in the soil and in local streams, to measure temperature, carbon-dioxide and nutrient levels, along with rates of root growth and the activities of microbes. These sensors will indicate how efficiently different ecosystems use nutrients and water, how vegetation responds to the climate, and how carbon dioxide moves between living things and the atmosphere. That will help those who seek to understand the carbon cycle—and with it, the consequences of greenhouse-gas-induced climate change.

To complement these ground-based measurements, which can focus on only a limited area, the team will conduct aerial surveys once a year at each core site, looking at things like leaf chemistry and the health of forest canopies, and will also look down on them with satellites. In addition, NEON's researchers can deploy a specially equipped aeroplane, fitted with lidar (an optical version of radar), a spectrometer (to measure chemical compositions) and a high-resolution camera, to assess the impact of natural disasters such as floods, wildfires and outbreaks of pests.

This aerial-surveillance system will be put to the test in a project that started on August 21st, when a team led by Tom Kampe and Michael Lefsky began studying the causes and impact of what has come to be known as the High Park fire. Between June 9th and early July this fire burned across 36,000 hectares (90,000 acres) of Colorado. Dr Kampe and Dr Lefsky will fly NEON's aeroplane over both the burned area and some adjacent un- ▸▸

burned stands of forest. They will record plant species, forest structure, ash cover, soil properties, river sediment and the overall topography of the burned area.

One particular question they plan to address is whether the behaviour and severity of the High Park fire was affected by the spread of mountain pine beetle, a pest that is rapidly overrunning Colorado because its breeding season has been extended by the warming climate. Repeated aerial surveys over the coming years will also give the researchers insight into how vegetation recovers from fires, how the beetles affect this process, how erosion and sedimentation affect the region's water resources, and whether fire creates opportunities for new species to invade.

So many data, of course, require a lot of number crunching. Indeed, it might be argued that what truly distinguishes Big Science from the small stuff—as astronomers and physicists have known for decades and biologists discovered in the aftermath of the Human Genome Project—is not the amount of money involved but the volume of data that needs to be processed. When fully operational NEON is expected to generate 200 terabytes a year. That is four times as much as the *Hubble* space telescope, a reasonably big piece of science, churned out in its first two decades.

NEON, then, truly does represent a shift by ecologists towards bigness. No doubt that will change the practice of the subject, just as astronomy, physics and genetics changed when they became big. The days of field glasses and butterfly nets may thus be numbered. But no one doubts that in those other cases, the change was for the better. The chances are, that will be true for ecology as well. ■

OR-7

Computer viruses

A thing of threads and patches

Soon, computer viruses may assemble themselves from other bits of code

LIKE their biological counterparts, computer viruses are locked in an evolutionary arms race. These programs, whose crucial characteristic is that they reproduce by copying themselves onto new machines, began as a curiosity in the early 1980s. Now, however, they—and other, similar, types of malicious software—support a multibillion-dollar industry in which those who use them to steal information and subvert computers struggle with those who devise and sell digital protection. With so much at stake, malware, as it is known, gets ever sneakier, while the programs designed to detect it must get clev-

There is, in other words, more than one way to write a program. Since Frankenstein is designed to generate its algorithms from a different set of gadgets each time it infects a new machine, the resulting program will look different from any other version that has gone before it. Each variant of the program will, however, behave in precisely the same way.

Protean programs like this are not, in themselves a new idea. Virus writers have

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Butterfly effect from city heat?

Urban warming sways air currents, alters weather far off, a study suggests

By SETH BORENSTEIN
THE ASSOCIATED PRESS

WASHINGTON — Heat rising up from cities such as New York, Paris and Tokyo might be remotely warming up winters far away in some rural parts of Alaska, Canada and Siberia, a study theorizes.

In an unusual twist, that same urban heat from buildings and cars may be slightly cooling the autumns in much of the Western United States, Eastern Europe and the Mediterranean, according to the study published Sunday in the scientific journal Nature Climate Change.

Meteorologists long have known that cities are warmer than rural areas, with the heat of buildings and cars, along with asphalt and roofs that absorb heat. That's called the urban heat island effect and it's been thought that the heat stayed close to the cities.

But the study, based on a computer model for the Northern Hemisphere, suggests that the heat does something else, albeit indirectly. It travels about half a mile up into the air and then its energy changes the high-altitude currents in the atmosphere that dictate prevailing weather.

"Basically, it changes the flow," said Guang Zhang of the Scripps Institution of Oceanography in La Jolla, Calif. He wrote the paper with Aixue Hu at the National Center for Atmospheric Research in Boulder, Colo.

This doesn't change overall global temperature averages significantly, unlike man-made greenhouse gases that cause global warming. Instead, it redistributes some of the heat, the scientists said.

The changes seem to vary with the seasons and by region because of the way air currents flow at different times of the year. During the winter, the jet stream is altered and weakened, keeping cold air closer to the Arctic Circle and from dipping down as sharply, Hu explained.

The computer model showed that parts of Siberia and northwestern Canada may warm up, on average, by an extra 1.4 degrees to 1.8 degrees Fahrenheit during the winter, which "may not be a bad thing," Zhang said. The effect isn't quite as much in northern North Dakota and Minnesota, where temperatures might be about half a degree warmer, and even less along the East Coast.

In contrast, Europe and the Pacific Northwest are cooled slightly in the winter from this effect. The jet stream changes prevent weather systems from bringing warmer air from the Atlantic to Europe and from the Pacific to the Northwest, thus cooling those areas a bit, Zhang said.

Several outside scientists said they were surprised by the study results, calling the work "intriguing" and "clever." But they said it would have to be shown in repeated experiments.

"It's an interesting and rationally carried out study," said David Parker, climate-monitoring chief of the British meteorology office. "We must be cautious until other models are used to test their hypothesis."

but the sorts of things that a virus author might find useful—using only gadgets harvested from Explorer, the file browser included with Windows.

Besides being technically neat, this gadget-based approach has advantages for malware writers. As with natural language, it is possible to write "sentences" in computer code that, although different in composition, convey the same meaning.

cisely aimed, short-lived attacks. In this context it is, perhaps, no surprise that the work was paid for in part by America's air force and that the authors note delicately that their program might come in useful for "active defence"—or, as one of Britain's rugby coaches once put it, "getting your retaliations in first". The world of cyber-warfare, always a murky place, may thus be about to get murkier still. ■