Meeting 06 • 15 April 2010 • Thursday

Version: **4/15/10**

People: Fischer; Ireton; Konrad; Moore

Today

(X') = anticipated time in minutes
(0001) etc.=item in document collection on CD-ROM
Key to notes added AFTER the class meets:
√ = topic / activity that was adequately dealt with during the class
+ = topic needs more attention & will be resumed at next / subsequent meeting(s)
- = a topic / activity that was proposed but not carried out - will be taken up later
~~Struckthrough text like this~~ = a topic / activity that was proposed but ~~not included is not going to be taken up after all~~
Italic green text like this = comments after the meeting

Week 3: Thinking through the first CBI project; more possibilities; where to get help (standards, lesson plans); the "Humboldt Project"	
	materials: Subject-area standards for exiting high-schoolers in the state of Oregon (0691 Second Languages; 0693 Visual & Performing Arts; 0694 English; 0695 Mathematics; 0696 Science; 0697 Social Science) example of the kind of math activity we do NOT want to produce
	(50') SpeakEasy Maintenance: see below
	(5') A bit more about the "Humboldt Project" and its possible role in this course; possibilities beyond this course
	(45') Project 1 as group effort. We'll go with the "Smart Pizza Buyer" project. Initial reminder about "Why don't they just do the math?" What will be in the "box" (for teacher, for students?) Initial walk-through to survey the activities and the language they might employ. Mapping the project onto the language (at which level?) Timing the activity. Advanced question: How could the project include resources to adjust it to learners with higher-level language skills, or allow the learner identity to be something other than an individual pizza purchaser?
	(10') initial discussion of Projects 2 & 3, maybe with reference to the article about engineering and German (0712)
	First hour: SpeakEasy maintenance: 1) confirmation of the plan to divide tasks (se my email of 14 April) - Maggie and I maintain card production and sales, you others (and I) develop the Marching Orders and try out shorter modules, with pedagogical discussion. Do we want to sell on Earth Day next week? 2) A shorter module: Our manufacturing policies, processes and equipment - top management and key department people critique describe them, critique them, and explain, step-by-step, the printing and cutting operations. Another such: the sales operation to handle individual inquiries: the kit, steps, monitoring, money-management (modals? prepositions? conditional / temporal clauses?) 3) Pedagogical issues: a) supporting vocabulary building (Condron email; idea: unsere Fachleute sprechen!); b) value of realia; c) how much to assign in advance

Upcoming class meeting(s): #7 & #8 (20 & 22 April)

1) finish Project 1

2) Continue Stryker /Leaver (or Kasper)
3) Starting to think about projects 2 & 3
4) More on-line lesson plan resources (see "Schedule", week 2)
5) Calendar-appropriate "mini-ideas": income tax, Holocaust, literature. Since next Tuesday's meeting is on Hitler's birthday, we may spend 20 minutes relating that to CBI. Link to WBF presentation.
6) Close look at an entire CBI course: 300-level German & hydraulic engineering (0712)

Upcoming assignment(s)

This section offers a PREVIEW, not activated assignments. Assignments are made, with announcement of their deadlines, both in class and on the "schedule" page.
CBI Project 1: An instructional module for a single classroom meeting (but WAIT until the assignment is officially activated).

Announcements

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Business Field Studies: SBA Graduate Program: Micro-Enterprise in Nicaragua

Nicaragua has a significant number of micro-enterprises (1 to 2 person operations) in need of assistance. Green Empowerment works directly with Managua-based NGOs to provide students with a thorough overview of the range of projects that they have collaborated on with AsoFenix to date (and plan to in the future). Green Empowerment will review how a project is developed and managed. Green Empowerment will prepare the students for travel in Nicaragua, interaction with rural farming families, and investigations into micro-renewable energy. Green Empowerment will discuss ways in which finance and entrepreneurship may be utilized to alleviate poverty and improve the environment and help facilitate post-travel course "deliverables." Green Empowerment will facilitate all communications with AsoFenix (pre- and post travel) and ensure adequate arrangements are made for the group prior to their arrival in Nicaragua. AsoFenix, Green Empowerment's central Nicaraguan NGO partner, will organize community leaders and committees at several sites so village representatives are prepared to describe their experiences, with renewable energy and the growing/sale of their crops, to students once the group is in Nicaragua. AsoFenix will also provide all in-country communication/translation services, coordinate meals and lodging, and facilitate safe ground transportation. AsoFenix will provide an overview of their community organizing to date and the corresponding micro-renewable energy projects (existing and planned).

Students will study the principles of micro-enterprise with specific foci on developing country contexts and the implementation of micro-renewable projects. Students will be led to Managua, Nicaragua and surrounding areas to study local micro-enterprises and how micro-renewable technologies can impact economic and social development and environmental stewardship.

Service Learning

Students will work with the field study faculty to define the service learning activities to occur in conjunction with the coursework of the field study. It is likely that the students will engage directly with Green Empowerment's NGO partners in Nicaragua to study and/or implement a micro-renewable project focused on one or more micro-enterprises in the surrounding area of Managua.

Post-travel meeting

Program Links
PSU

SBA Micro-Enterprise Summer 10 Application (PDF)

Deadlines
Friday, April 16, 2010

Program Contact

Knott, Blythe
Education Abroad Advisor

blythe@pdx.edu
503-725-4030
East Hall - 210

To make an appointment with an advisor call 503-725-4094

▲ News & Events

Participants can present their experiences in a Net Impact (PSU Chapter) meeting. They can incorporate their learning into their own micro-enterprise concept and initiate the concept in the Social Innovation Incubator (Center for Global Leadership in Sustainability, School of Business). Participants can utilize this knowledge in concentration in Managing Sustainable Enterprise or Innovation Management and Entrepreneurship.

Program Focus

Course information:

MGMT 510: Micro-Enterprise in a Developing Country, context: Nicaragua 4 cr.
MGMT 510: Micro-Renewable Technologies in a Developing Country, context: Nicaragua 4 cr.

- Both four credit courses can be applied to the Managing Sustainable Enterprise concentration in the MBA+ program.
- The four credit Micro-Enterprise course can be applied to the Innovation Management and Entrepreneurship concentration in the MBA+ program.
- One or both of the four credit courses might be applied to the Global Business and Sustainability concentration in the Master of International Management program. This is yet to be determined.

Draft itinerary:

Day 1 6/18/10 (4:00-7:00 pm) (At PSU) Review of Micro-Enterprise, Micro-Renewable, Green Empowerment initiatives in Nicaragua, Trip Details
Day 2 6/19/10 (9:00 am-3:00 pm) (At PSU) Review of Micro-Enterprise, Micro-Renewable, Green Empowerment initiatives in Nicaragua, Trip Details
Day 3 6/23/10 Depart Portland/ Arrive Managua, Nicaragua
Day 4 6/24/10 Welcome and tours/logistics review
Day 5 6/25/10 Morning meeting with partner organizations (Aso Fenix). Afternoon lecture on Micro-Enterprise
Day 6 6/26/10 Morning lecture on Micro-Enterprise. Afternoon lecture on Micro-Renewables
Day 7 6/27/10 Morning lecture on Micro-Renewables. Afternoon conversation with partner organizations. Evening faculty-led student group discussion
Day 8 6/28/10 Travel to local micro-enterprises, field study interviews with villagers and micro-entrepreneurs, initial training and site assessment for technology applications
Day 9 6/29/10 Morning faculty-led student group discussion and planning. Afternoon initiation of training and technology applications
Day 10-12 6/30-7/2/10 All day training and technology applications.
Day 13 7/3/10 Morning faculty-led reflection. Afternoon departure preparation
Day 14 7/4/10 Depart Managua/ Arrive Portland
Day 15 7/9/10 (4:00 – 7:00 pm) (At PSU) Lecture and discussion – reintegration of service learning to theory and framework of Micro-Enterprise
Day 16 7/10/10 (9:00 am– 3:00 pm) (At PSU) Lecture and discussion – reintegration of service learning to theory and framework of Micro-Enterprise

Program Duration

Short-Term, Summer

Language(s) of Instruction

English

Relevant Academic Disciplines

Business, Management, Service Learning, Social Work

Pre-Requisites

SBA Graduate students only
GPA: 3.0

Language Skill: None

Housing Options

Dormitory

Portland State UNIVERSITY

PSU EcoWiki

your local sustainability action hub

Main Menu

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- What is Sustainability?
- Sustainability at PSU
- The Miller Grant
- Our University EcoDistrict
- Student Groups
- Green Teams
- Sustainability Class Offerings
- Scholarships, Jobs, Internships, and Volunteer Opportunities
  - Green Jobs
  - Scholarships, Grants and Fellowships
  - Volunteer and Intern
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- Campus Infrastructure, Grounds & Planning
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Student Leaders for Service Offers Earth Day Volunteer Opportunities (Throughout April)

Written by Emily Hoffer

The following is a list of events hosted by EDG:E and Student Leaders for Service focused on creating Earth Day service projects at local schools.

Earth Day/Global Youth FService Day service project at Ockley Green School

Come join the EDG:E after school club and Ockley Green SUN to help us celebrate Earth Day/Global Youth Service Day! We will be celebrating the 40th anniversary of Earth Day by focusing on four different themes throughout the week: the growing cycle; water day; Reduce, Reuse and Recycle; and Earth Day. Volunteers will work with Ockley Green students to make seed starts, recyclable journals, chalk murals and much more!

When: Friday, April 23 from 3-5.
Where: Ockley Green School 6031 N. Montana Ave. Portland, OR

Earth Day/Global Youth Service Day project at Marysville Elementary School

Join the EDG:E after school leadership club and Marysville SUN School to help us celebrate Earth Day! We need volunteers to work with Marysville students to tend to the courtyard garden, decorate recycle bins and promote recycling around the school!

When: Tuesday, April 20 from 3:30-5
Where: Marysville School at Rose City Park 2334 NE 57th Portland, OR

Earth Day/Global Youth Service Day project at Vernon School!

Come join EDG:E, Vernon School, and Hands on Greater Portland to beautify Vernon School in NE Portland! Volunteers are needed to replant the native plant garden, paint the school doors and portables, maintain the community garden, and assist with making garden art with youth!

When: Saturday, April 24 from 9-3 (Service component from 9-12 and garden art/ scavenger hunt activity from 12:30-3)
Where: Vernon School 2044 NE Killingsworth Ave. Portland, OR

Earth Day/Global Youth Service Day at Whitman Elementary School.

Join Whitman SUN School and EDG:E after school leadership club as a volunteer to beautify Whitman Elementary and unveil the new school mural! Volunteers are needed to clean up the school grounds, paint wooden placards and much more!

When: Saturday, April 24 from 11-3.
Where: Whitman Elementary 7326 SE Flavel St. Portland, OR

Earth Day/ Global Youth Service Day at Woodmere Elementary School.

Come join EDG:E and Woodmere SUN School for their Earth Day circus! Volunteers are needed to assist with Earth Day games led by EDG:E elementary students, staffing Earth Day booths, and celebrate the 40th Anniversary of Earth Day!

When: Wednesday, April 21 from 4-6.

Where: Woodmere School 7900 SE Duke St. Portland, OR

Earth Day/Global Youth Service Day at Kelly Elementary School.

Join EDG:E, Kelly SUN School and SOLV in planting a native Oregon garden! Volunteers are needed to assist with the garden, planting flowers along the school walkway, and creating recycled art projects with Kelly students.

When: Friday, April 23 from 3-5:30
Where: Kelly Elementary School 9030 SE Cooper Portland, OR

Earth Day/Global Youth Service Day at Woodlawn School.

Come join EDG:E and Woodlawn SUN School in celebrating the 40th anniversary of Earth Day! Volunteers are needed to paint a courtyard mural, beautify the school campus, and help youth make seed starts.

When: Friday, April 23 from 3-5
Where: Woodlawn School 7200 NE 11th Ave. Portland, OR

Earth Day/Global Youth Service Day at King School.

Join EDG:E and King SUN School as a volunteer for their Earth Day celebration! Volunteers are needed to assist youth with creating seed starts, beautifying the courtyard and playing Earth Day jeopardy!

When: Friday, April 23 from 3-5
Where: King School 4906 NE 6th Ave. Portland, OR

Group: EDG:E/ Student Leaders for Service
Contact: studlead@pdx.edu **or (503) 725-8311**

To register and learn more about the projects visit www.pdx.edu/cae/slsevents.html

Portland State UNIVERSITY
Sustainability

Template design

2) Continue Stryker /Leaver (or Kasper)
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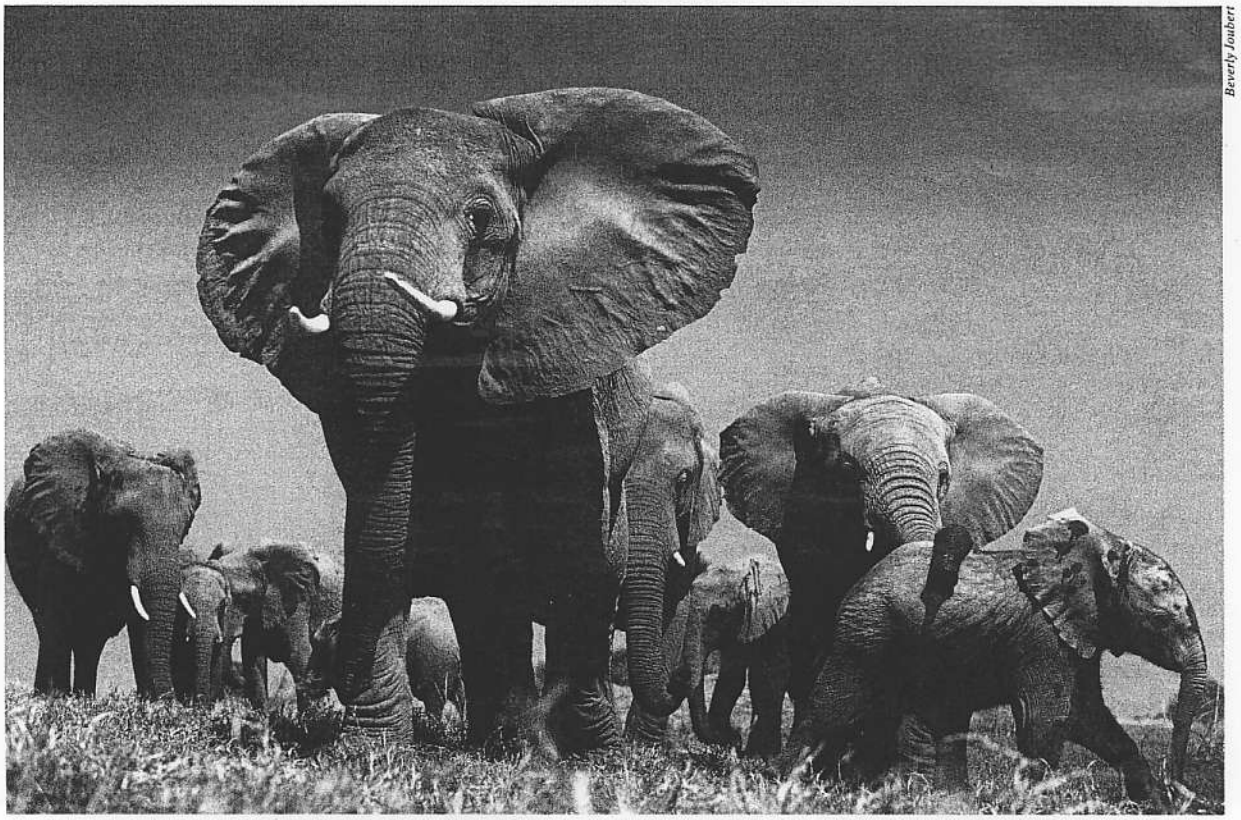
Getting to Know Them

Tim Flannery



Beverly Joubert

The matriarch of an elephant family stepping forward to protect her relatives from threat in the Okavango Delta, Botswana, one of the few places on earth where they are still safe and in abundance; photograph by Beverly Joubert from Eye of the Leopard, *written with Dereck Joubert and published by Rizzoli*

The Social Behavior of Older Animals
by Anne Innis Dagg.
Johns Hopkins University Press,
225 pp., $35.00

Elephants on the Edge: What Animals Teach Us about Humanity
by G. A. Bradshaw.
Yale University Press, 310 pp., $28.00

Animals Make Us Human: Creating the Best Life for Animals
by Temple Grandin
and Catherine Johnson.
Mariner, 340 pp., $15.95 (paper)

The Hidden Life of Deer: Lessons from the Natural World
by Elizabeth Marshall Thomas.
Harper, 239 pp., $24.99

Not so very long ago we humans thought of ourselves as a separate creation—the pinnacle of God's work—that had been granted dominion over nature. But then along came Darwin, and we discovered that we are related, through descent, to other animals. Despite this blow to our dignity we long maintained a polite fiction that we're special enough to merit classification in our own scientific family—the Hominidae. In our minds at least, we thus maintained a comfortable distance from the apes. But the analysis of DNA put an end to that, with the demonstration that only 2 percent of our genetic code differs from that of the chimpanzees. Now we and chimps must share a twig in the family tree, and the Hominidae has been expanded to encompass the other "great apes"—chimps, gorillas, and orangutans.

That being said, we clearly differ from the other great apes in many ways, a fact elucidated in Anne Innis Dagg's *The Social Behavior of Older Animals*. It's a highly unusual work in that it treats an age group of organisms that has received little previous attention. It is also a commendably broad study—covering a diversity of species from parrots to primates. Humans and chimps, it turns out, value age in sexual partners very differently. In our species youth is prized, but among chimps the reverse is the case. Importantly, female chimpanzees (unlike female humans) do not experience menopause, and thus can remain fertile into old age.

Flo was one of the most sexually attractive female chimps in a troop studied by Jane Goodall. By the time Flo was forty, her teeth were worn down to the gums and her time as the dominant female in the troop was over, but she still managed to drive the boys crazy, attracting a string of suitors and mating fifty times in a single day. Researchers, wondering whether Flo was an anomaly, carried out an eight-year study of chimpanzee sex. In what seems to be something of an understatement of their results, they concluded that

> chimpanzee males may not find the wrinkled skin, ragged ears, irregular bald patches, and elongated nipples of their aged females as alluring as human men find the full lips and smooth complexions of young women, but clearly they are not reacting negatively....

There is great variety in the ways older animals differ from younger ones—in both physical and behavioral manner. Older chimps may go bald, and leopards suffer faded spots, but not all creatures bear such badges of seniority. The plumage of geriatric swallows, for example, is indistinguishable from birds in their prime. But old creatures, regardless of species, tend to be less agile than young ones, and more likely to suffer from arthritis, diabetes, cancer, heart disease, and mental confusion. All of this means that they're unlikely to be top of the pack, and the way they cope with this is intriguing.

Sherlock was a male baboon who, at the age of twenty-four, was about ninety in human terms. While still keen on sex, elders like Sherlock often don't have the status required to assert themselves against other males. So they often befriend individual females instead. Remarkably, such friendships are not about sex alone. They often involve nursing females, who, though rightly nervous of most males (who occasionally kill infant baboons), in a remarkable sign of trust will even leave their babies in the care of their older male friends while they forage.

When the end comes for older animals, they do not always go unmourned. Some species, such as elephants and chimpanzees, show unmistakable signs of grief and mourning at the death of a member of their group, and even gray whales have been observed behaving as if paying their last respects to the dead. Astonishingly, careful disposal of the body is not beyond some, for gorillas have been observed to bury their dead, while elephants have been known to raid a shed filled with the body parts of slaughtered elephants, removing the feet and ears (which were destined to be turned into umbrella stands) and burying them.

In many ways, elephants represent the great "other"—enormous, highly social, and intelligent creatures whose ways on occasion eerily echo our own. G. A. Bradshaw's *Elephants on the Edge* is a remarkable study of elephant–human interactions, whose opening premise is that "it is not so much that

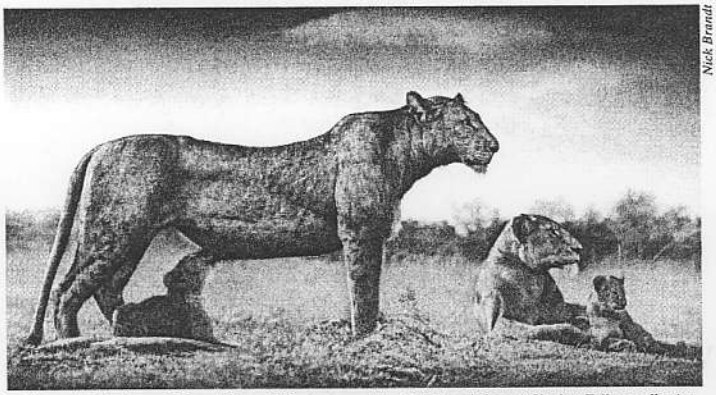
elephants are *like* us. They *are* us, and we them." This, I fear, the author means literally rather than metaphorically, for she seems to see no difference between the elephant and the human mind. That allows her to attempt psychoanalysis of elephants using methods developed for humans, and to diagnose their "condition" using human criteria. It flows from her premise that elephants should be endowed with all the basic human rights, and that we can expect them to respect our rights in turn. Unfortunately, the implications of Bradshaw's extraordinary opening premise are not fully explored in her book. Instead, it's essentially a catalog of human abuse of pachyderms, which jumps in an instant from the treatment of elephants in circuses to the experiences of Holocaust survivors.

Very few people would accept Bradshaw's premise uncritically, so it's important that we explore the nature of the relationship between humans and elephants. Taking an evolutionary perspective reveals many similarities, but differences as well. Every now and again evolution throws up a new kind of creature that goes on to colonize most of the world. The landmass of Eurasia, being the largest of the continents, has produced the largest number of these species, including the family that includes sheep, goats, and cattle. But North America too has given the world its champions, including the dog, camel, and horse families—arguably man's best friends. Africa, while larger than North America, has paradoxically few such champions. Only two are of any note—the families Hominidae and Elephantidae—yet between them elephants and humans have colonized the habitable surface of the earth. Indeed they are arguably the most successful mammal families ever to have evolved.

In times past the elephants were more successful than people. Dozens of species—from the pony-sized dwarfs that once grazed on the island of Crete to the woolly mammoth and the mastodons of North and South America—colonized the whole habitable world (with the exception of Australia). But then humans spread and climates changed, so today there remain just two species—the African and Asian (though some argue that the pink-tusked, pygmy elephant of the Congo is a third type)—and today all are under siege from a growing human population. Elephants are more truly African than we are, being members of an ancient group known as the Afrotheria, whose ancestors lived in Africa at the time of the dinosaurs. The hominids, in contrast, are only newly African, our ancestors having arrived on the continent from Eurasia a mere ten million years ago.

These disparate histories mean that the last common ancestor of the elephants and ourselves was a rat-sized creature that lived over 100 million years ago. Yet undeniably we share much in common, perhaps because some of our ancestors were shaped at the same evolutionary forge—the productive, crowded, and intensely competitive world of the African savannah. It's this world, in part, that endowed both elephants and humans with exceptional intelligence, and a dependence on complex societies for their well-being. But for all their sagacity, elephants have been losing the battle for survival for the last 50,000 years—since humans started leaving Africa. As humans have encroached upon their world, one after another species has gone extinct, and Bradshaw argues that, as we endanger the last living species, they have become prey to psychological stresses that they are manifesting in startling ways.

About two hours' drive outside Johannesburg lies the small nature reserve of Pilanesberg National Park, which is plagued by strange goings-on among its elephants. Rangers working there have observed young males harassing older females for sex, and tourists filmed the astonishing spectacle of an elephant copulating with a rhinoceros. Then dead rhinos started to turn up, all gored to death by elephant tusks. Bradshaw thinks that these phenomena have their roots in a "complex post-traumatic stress disorder" suffered by the elephants. The stress, she believes, was inflicted by human interactions with elephants—and she thinks that the aberrant elephant psychology at Pilanesberg is only an indication of something much larger.



Nick Brandt

A lioness feeding her cub, Masai Mara, 2007; photograph by Nick Brandt from A Shadow Falls, *a collection of his images of wildlife in East Africa, with forewords by Vicki Goldberg and Peter Singer and published by Abrams. For a slide show of Brandt's photographs, see the NYR blog, blogs.nybooks.com.*

These are important claims, and in order to assess them properly we need to know more about Pilanesberg's elephant population. Prior to its proclamation as a national park, elephants had been long extinct in the Pilanesberg area, and in an attempt to build up the region's biodiversity, park managers accepted two former circus elephants (both female) and a number of juvenile males that were orphaned during elephant culling operations elsewhere in South Africa. The rhino-raping and killing males, it turns out, originated in Kruger National Park. At the time they were captured, only small elephants could be transported, so no adult male was present at Pilanesberg when they arrived. Among elephants, males and females lead largely separate lives, the females belonging to herds led by a matriarch, and from which males are ejected at puberty. They then join all-male groups, and presumably learn from mature males the recipe for a successful life.

In her search to explain the bizarre behavior of the young males, Bradshaw focuses almost entirely on the trauma they suffered when their families were shot during culling. "Elephant attacks on rhinoceroses... reflect the violence that this otherwise peaceful species has experienced," she says. But surely the situation is far more complex than that. What about the circus-raised females? Did they have much experience of elephant sex, and know how to handle young males? Bradshaw tells us nothing of their reproductive histories, nor their interactions with the males other than that they rebuffed "behavior not only unbecoming of a young bull but highly irregular." Such modesty might be fitting in a Victorian novel, but as we seek to understand the Pilanesberg situation we need facts.

Then there's the matter of the rhinos. Frustratingly, Bradshaw tells us nothing of the histories of Pilanesberg's rhino population, and too little of their fate. It's reasonable to assume that the rhinos, like the elephants, came from elsewhere; but had they any prior experience of elephants? If they had never interacted with elephants before, may they not have been vulnerable to bullying by the larger creatures? And what of the sex? Was it only female rhinos that were sexually penetrated and then pierced with tusks, or was interspecies sodomy practiced as well? Pretty much all we know is that forty-nine white rhinos died at Pilanesberg between 1992 and 1996 from such attacks—and that is far too little, in my view, to accept uncritically Bradshaw's diagnosis of "complex post-traumatic stress disorder."

For all its faults, *Elephants on the Edge* deals with a fascinating and little-understood subject, which makes it doubly disappointing to find it so devoid of facts and overstuffed with opinion. Sadly, it seems to be as much about its author's view of human nature as it is about elephants; but even more disappointingly, it has almost nothing useful to say about how humans and elephants might continue to coexist. Bradshaw talks of creating enormous wild areas for the use of elephants—areas large enough for them to migrate in search of food and water. But in an Africa whose human population is growing exponentially, that is a fantasy. It's clear that the millennia-long contest between elephants and humans will only accelerate in the future, and that the elephants can survive only through our good graces, and on our terms. This means that elephant populations will need to be managed. As they overpopulate parks, we can either watch them precipitate collapse of the ecosystem, then starve to death, or we can cull them. In this context, it's hardly helpful to talk, as Bradshaw does, of a "humane self" and an "Auschwitz self" in conflict as we try to manage elephant populations.

If the largest of wild creatures present profound moral and physical challenges to us, so too do the domesticated species with which we share our lives. Temple Grandin is a professor at Colorado State University who has devoted much of her career to the humane treatment and slaughter of the cattle, sheep, and pigs that feed us. She is also autistic, a disability that she argues allows her a special empathy with nonhuman creatures. Her latest book, *Animals Make Us Human*, is an amazing tour de force of animal–human relationships, with chapters on our companion animals, as well as on livestock, wildlife, and zoos.

Most of us would prefer not to know where the meat on our plates comes from. And indeed when we consider slaughterhouses where animals mean only money, such knowledge is enough to turn one off meat for life. Grandin comes at the problem from a very different perspective from most, asking simply, "What does an animal need to be happy?" Even creatures raised for meat, she believes, have the right to a happy life—and they can have it if certain "freedoms" are granted them. Among these are freedom from hunger and thirst, discomfort, pain, injury, and disease; and freedom to express normal behavior and to live free from fear and distress. Yet as she points out, it's far from obvious how such freedoms might be granted, for each species has its own requirements, and conditions that are paradise for one may be purgatory for another.

If we are to grant these freedoms, Grandin argues that we need to understand how animals think, and most of the book is taken up with chapters on the inner lives of our companion animals—from dogs to cows to chickens to wildlife we interact with, and animals in zoos. In each instance Grandin displays an exceptional understanding of beings that, to most of us, remain enduring mysteries. It's hard to know which animals Grandin has the greatest fondness for, but cattle must be high on the list, for she has long experience of them, and has arguably done more than anyone to improve their lot.

Cattle, Grandin argues, aren't tame animals as are dogs or cats, and therefore freedom from fear is a big issue for them. As she puts it, "A central welfare issue for beef cattle is poor stockmanship. People screaming and yelling at cattle, hitting or punching them, shocking them with electric prods—all of these things terrify cattle." In arguing against such practices, she poses a series of immensely practical alternatives, such as positive reinforcement with food treats to move cattle into trucks or chutes. Well-cared-for cattle will "actually SEEK handling procedures," she asserts, and such cattle can remain relaxed, unstressed, and happy all of their lives—right up to the moment of slaughter.

Unfortunately this is not, for reasons both mundane and infuriating, how

He Conquered the Conjecture

John Allen Paulos

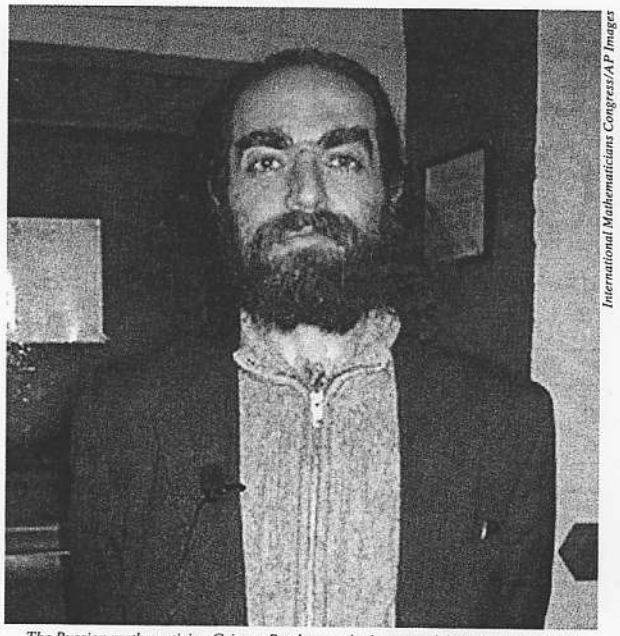
Perfect Rigor:
A Genius and the Mathematical Breakthrough of the Century
by Masha Gessen.
Houghton Mifflin Harcourt,
242 pp., $26.00

Masha Gessen's *Perfect Rigor* is a fascinating biography of Grigory (Grisha) Perelman, the fearsomely brilliant and notoriously antisocial Russian mathematician. Perelman proved the Poincaré Conjecture, one of mathematics' most important and intractable problems, in 2002—almost a century after it was first posed, and just two years after the Clay Mathematics Institute offered a one-million-dollar prize for its solution.

Gessen herself grew up in the former Soviet Union, is roughly Perelman's age, and has a mathematical background, which facilitated her interviews with many of his classmates, mentors, teachers, and colleagues. Not surprisingly, she did not interview the reclusive mathematician or his mother, with whom he currently lives. But the others give a convincing picture not only of him but also of the strange world of Soviet mathematics, which was divided between the official, rigid mathematical establishment and the informal mathematical counterculture. The former, because of its historical importance to engineering and military projects, was supported by the Party and the government; the latter consisted of scholars who loved mathematics for its own sake and used it as a way to escape the stultifying influence of officious apparatchiks.

Born in 1966 to Jewish parents, Perelman came of age when this distinction was breaking down during the era of glasnost and perestroika. By the time he was ten he began to show a talent for mathematics, and his mother, who had abandoned her own graduate work in the field in order to raise him, enrolled him in an after-school math club coached by Sergei Rukshin, a mathematics undergraduate at Leningrad University. Rukshin was a troubled youth who became obsessed with mathematics and gradually developed a rigorous, distinctive, and very effective method of teaching problem-solving. Over the last twenty years, approximately half of all Russian entrants to the International Mathematical Olympiad have studied with him.

Only nineteen himself when he met Perelman, Rukshin stayed in contact with him from his first after-school math club until, it seems, a relatively recent break. He found that the not yet adolescent Perelman, described by Gessen as "an ugly duckling among ugly ducklings... pudgy and awkward," was already unusually deliberate and precise in his thinking. Alexander Golovanov, who studied math alongside Perelman, said that Rukshin's growing commitment to and love for Perelman came to give meaning to his own life. Like many a competitive sports coach, Rukshin hated it when his charges engaged in anything other than his sport. This was an unnecessary restriction in Perelman's case since from the beginning he seemed uninterested in girls or anything other than mathematics.



International Mathematicians Congress/AP Images

The Russian mathematician Grigory Perelman, who has turned down both the Fields Medal and the Clay Millennium Prize, which were to be awarded to him for solving the Poincaré Conjecture

When Perelman was fourteen, Rukshin spent the summer tutoring him in English; he accomplished in a few months what generally took four years of study. Perelman had to fulfill the English requirement to get into Leningrad's Specialized Mathematics School Number 239. As Gessen writes, these mathematical high schools owe much to Andrei Kolmogorov, arguably the most important Soviet mathematician of the twentieth century and a figure who straddled the divide in Soviet mathematics mentioned above.

Kolmogorov, who did seminal work in probability, complexity theory, and other subjects, was something of an anomaly. A prolific mathematician, he was also passionately interested in education and devised an imaginative secondary school curriculum featuring mathematics first of all, but also classical music, sports, hiking, literature, poetry, and activities intended to foster male bonding. In the schools that he inspired, his disciples promoted Greek and Renaissance values and tried to protect their students from Marxist indoctrination. Eventually Kolmogorov was denounced as an agent of Western influence in the Soviet Union, but his ideas still permeated School 239 when Perelman studied there.

Valery Ryzhik, Perelman's teacher at School 239, remembered him as "such a little boy" who sat in the back of the class. Ryzhik and Rukshin employed Kolmogorovian methods of instruction and character-building and dragooned the students into long walks, which Perelman endured but didn't enjoy. A brilliant man himself, Ryzhik was denied entry to Leningrad University because he was Jewish, but Perelman, as he is described here, seemed oblivious not only to Ryzhik's past difficulties, but also to the pervasive Soviet anti-Semitism and, indeed, to any sort of political issues.

The school insulated Perelman and allowed him to think that the world, like the math classroom, was a place where logic mattered and rules were interpreted strictly. It also allowed him to grow his fingernails until they curved. And if he wanted to eat only a particular kind of raisin bread with peanuts on the surface (which he didn't like and scraped off), he could do so. Ensconced in his mathematical cocoon, he could tune out all the messy inconsistencies and contingencies of life in general and of Soviet life in particular.

As he approached the end of his days at School 239, Perelman had to think about the next stage of his education. Gessen writes that for a Jewish boy gifted in mathematics to be admitted to a university, there were three possibilities: hope you were one of the two Jews accepted at Leningrad University every year; go somewhere with less draconian admission policies; or make it onto the Soviet team for the International Mathematical Olympiad, which guaranteed admission to Leningrad University. Perelman decided to try out for the team.

Accompanied by his seemingly omnipresent mother, he embarked on a grueling training program held in a town near Moscow and run by Alexander Abramov, who later remarked that Perelman never encountered a problem in a competition that he couldn't solve. He won a gold medal in the 1982 Olympiad with a perfect score and gained admission to Leningrad University.

After Abramov, Perelman's mentors and teachers were world-class mathematicians in their own right, and Gessen provides brief sketches of all of them. In particular, there were Viktor Zalgaller, his undergraduate adviser at Leningrad University and an eminent geometer; Alexander Danilovich Alexandrov, his graduate adviser and a distinguished mathematician and philosopher; and Alexandrov's student Yuri Burago, another prominent differential geometer. The latter two were instrumental in getting Perelman a postdoctoral position at the Steklov Institute of Mathematics in Leningrad. Mikhail Gromov was yet another important mathematician who on several occasions helped ease Perelman's way into the larger mathematical world.

A big part of that larger world was the US, and in the late 1980s and early 1990s Perelman worked on theorems in Riemannian geometry as a postdoctoral fellow at a number of American universities, including NYU, SUNY Stony Brook, and UC Berkeley. After succinctly and elegantly proving a topological theorem called the Soul Conjecture—which dealt with the use of small parts ("souls") of certain geometrical figures to deduce the wholes—in 1994, Perelman was widely recognized as a star and offered positions at both Stanford and Princeton. He declined both offers, rejecting Princeton's because the math department had the temerity, in his view, to ask for a CV. Perelman thought the results he'd already proved and a lecture he'd given there should have been sufficient to warrant granting him immediate tenure. In 1995 he returned to the Steklov Institute.

The next year the European Mathematical Society planned to announce the award of a prize to Perelman, and he responded by saying he'd create an unpleasant scene if he was given it. According to Gromov, he believed that his work was not complete, that the judges were not qualified to assess it, and that he, not they, should decide when he should receive a prize.

Gessen, on the basis of many incidents of Perelman's prickliness, his long hair and fingernails and Rasputin-like appearance, and his often asocial behavior, suggests that he has Asperger's syndrome, sometimes referred to as autism-lite. Quoting the psychologist Simon Baron-Cohen, an expert in the field, she writes that people with Asperger's have limited social skills, have trouble communicating, often speak oddly (their speech is characterized sometimes by jarring transitions, literal interpretations, or obliviousness to nuance), and frequently need help with the minutiae of everyday living and so are dependent on others, such as their mothers, as was the case with Perelman.

Moreover, they are extraordinarily good at systematizing but extraordinarily poor at empathizing, and have what Baron-Cohen calls an "extreme male brain." They lack a built-in "theory of mind," the ability both to easily

imagine other people's points of view and to realize that others will evaluate situations differently. For them, truth is literal and uniform. For example, seeing that a ball has been moved from one cup to another while someone has left the room, many people with Asperger's expect that on the person's return he will know that the ball is now in the other cup.

In part because of their training, mathematicians deal with universal statements and often tend to interpret assertions literally. (For a personal example, whenever I see the bumper sticker "War is never the answer," I think that, to the contrary, war most certainly is the answer, if the question is "What is a three-letter word for organized armed conflict?") Baron-Cohen thinks there's more to the matter than this, however. He maintains that there is some neurological reason for the strong correlation between mathematical talent and Asperger's syndrome. Whether true or not, mathematicians do score consistently higher on what he calls his AQ (autism-spectrum quotient) test, and Gessen writes that she herself has a high AQ. Although there are many gregarious mathematicians, there may be some truth in the definition of an extroverted one: he's the one who looks at *your* feet while he's talking.

Still, Perelman's behavior, unusual as it sometimes has been, doesn't seem all that peculiar to me. I suspect that a small part of the appeal of his story depends on the satisfaction people derive from reading about unbalanced scientists and mathematicians. Witness the popularity of *A Beautiful Mind*, the biography of John Nash, or *The Strangest Man*, the recent biography of the physicist Paul Dirac.[1] The phenomenon is vaguely akin to the schadenfreude elicited by tabloids' tales of celebrities' faults and foibles.

Perelman seemed to fade from the mathematics scene after 1995, but then in 2002 and 2003 he posted on the Internet (rather than submit to a journal) three papers in which he sketched a proof of the Poincaré Conjecture, as well as some more general results. It is these three papers that Gessen calls "the mathematical breakthrough of the century" in the subtitle of her book. What is the Poincaré Conjecture? Useful in understanding it are a few ideas from topology, the branch of geometry concerned with the basic properties of geometric figures that remain unchanged when they are stretched and shrunk, deformed and distorted, or subjected to any "smooshing," as long as they're not ripped or punctured. Size and shape are not topological properties; figures shaped like melons, dice, and baseball bats are deemed topologically equivalent since they can be contracted, expanded, and transformed into one another without ripping or puncturing.

Whether a closed curve in space has a knot in it or not is, however, a topological property of the curve in space. That a closed non-self-intersecting curve on a flat plane, no matter how convoluted it is, divides the plane into two parts—the inside and the outside—is a topological property of the curve. How many dimensions a geometric figure possesses, whether or not it has a boundary, and if so of what sort—these too are topological properties.

Also a matter of topological significance is the genus of a figure—the number of holes it contains. A ball has genus 0 since it contains no holes; a torus (a doughnut, bagel, or inner tube–shaped figure) has genus 1; eyeglass frames without the lenses have genus 2; and so on. Genus 0 objects such as melons and baseball bats are topologically equivalent. Less obviously, a doughnut and a coffee cup with a handle are both figures of genus 1. To see this, imagine that the cup is made of clay. Flatten the body of the cup and expand the size of its handle by squeezing material from the body into the handle. The finger hole of the cup's handle is in this way transformed into the hole of the doughnut.

Henri Poincaré was a French mathematical polymath who laid the foundation for chaos theory and came close to discovering the theory of relativity, among other accomplishments. In a 1904 paper he famously wondered whether a certain topological property of a sphere holds for higher-dimensional analogues of a sphere.

To understand that property, imagine stretching a rubber band around the surface of a ball. We can contract this rubber band slowly, making sure it neither breaks nor loses contact with the ball, and in this way shrink the rubber band so that it becomes no more than a point. (See illustration on this page.) We can't shrink it to a point if the rubber band is stretched around a doughnut (either around the hole or around the body) or around a pretzel. We can do it, however, if the rubber band is stretched around any topological equivalent of a smooshed ball such as a deformed melon, a crooked die, or a baseball bat with protuberances sticking out of it.

The surface of the ball, but not that of the doughnut, is said to be "simply connected." Poincaré was aware of the fact that a two-dimensional sphere—the topological term for the two-dimensional surface of a three-dimensional ball—could be defined by this property of simple connectivity. That is, *any* simply connected two-dimensional closed surface, however distorted, is topologically equivalent to the surface of a ball. He wondered if simple connectedness might characterize three-dimensional spheres as well. The statement that it does so is the Poincaré Conjecture.

This may not sound that daunting until we understand what a three-dimensional sphere is. Topologically speaking, a one-dimensional sphere is the boundary of a circle, i.e., a one-dimensional *line* of constant curvature on a two-dimensional plane. And, as mentioned, a two-dimensional sphere is the two-dimensional *surface* of a ball in three-dimensional space. A three-dimensional sphere would be a formally analogous but much more abstract entity: the three-dimensional *boundary* of a ball in four-dimensional space.

This fourth dimension is easy to define formally but difficult to grasp, except by analogy. Two numerical coordinates are needed to locate a point on a two-dimensional plane, and three to locate it in a three-dimensional space; four-dimensional space is that hypothetical space in which four coordinates are needed. It contains four-dimensional equivalents to our familiar three-dimensional geometrical objects—a four-dimensional cube, for example, known as a tesseract, that has sixteen corners and thirty-two edges to a cube's eight and twelve. (See illustration on page 45.) A four-dimensional ball, then, would have the same relation to a normal three-dimensional ball that that three-dimensional ball has to the two-dimensional interior of a circle. Such a four-dimensional ball, and the three-dimensional sphere that bounds it, can't be visualized except in cross-sections—or, it is said, by a very few mathematicians like William Thurston of Cornell University—and can only be defined rigorously and elaborated upon by means of logical rules informed by a flickering intuition.

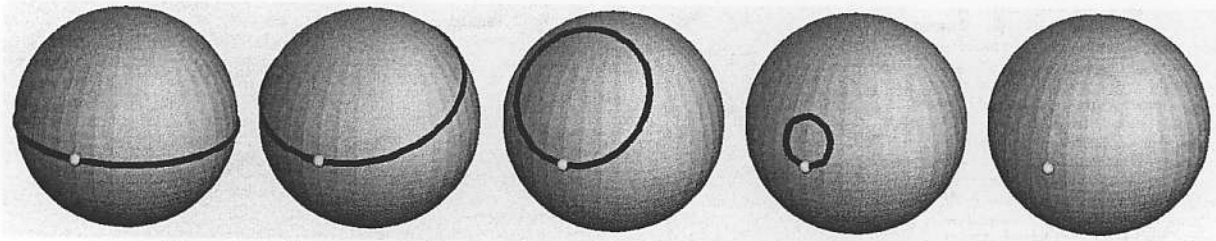
As with any important mathematical conjecture, there are partial results along the path to proving it on which later mathematicians must stand, as with Newton's statement "we stand on the shoulders of giants." In the case of the Poincaré Conjecture, partial results accumulated over time. In particular, these included proofs of the equivalent conjecture for spheres of dimensions greater than three, but not for three. Many brilliant mathematicians, among them Michael Freedman, Stephen Smale, John Stallings, and Christopher Zeeman, engaged in this work.

William Thurston and Richard Hamilton, a mathematician at Berkeley, made seminal contributions that pointed the way to Perelman's proving of the much more intractable three-dimensional Poincaré Conjecture. Thurston speculated that there were only a small number of different geometries possible for three-dimensional shapes, from which the Poincaré Conjecture would follow as a corollary, but he didn't prove it. Still, the suggestion and a partial proof of it stimulated more work on the Poincaré Conjecture by Hamilton and had a part in Perelman's work as well.

Hamilton's strategy, roughly described, made use of the fact that spheres of every dimension have a constant curvature. Therefore, if an undifferentiated blob in a higher-dimensional space could be kneaded and massaged and distorted, without puncturing or tearing, into something with constant curvature, then this would prove that the blob was, topologically, a three-dimensional sphere after all. To approach this constant curvature Hamilton used a mathematical tool called the Ricci flow. This is a mathematical method of transforming shapes that has somewhat the same effect as heat flowing through a space: as the heat flows it makes the temperature more uniform and in the process smooths out bumps and mountains, hollows and valleys, thereby revealing the underlying shape. Think of blowing hot air into a crinkled-up balloon.

Sometimes, however, it turns out that the Ricci flow must be interrupted at "singularities" (places where the process breaks down and part of the shape starts to stretch on and on, beyond bound—a little like dividing by zero) and a repair must be made using a controlled process of grafting on pieces of other shapes that topologists call "surgery." Before Perelman's work there was no guarantee that repairs could be made for every type of singularity and for every recurrence of the same type. Perelman dazzlingly showed that all possible singularities were reparable, and he demonstrated how to do the requisite surgeries and put all the stringy and lumpy pieces of the blob together. As Gessen writes:

> He succeeded because he used the unfathomable power of his mind to grasp the entire scope of possibilities: he was ultimately able to claim that he knew all that could happen... as the object reshaped itself.



Richard Morris/Wikipedia

Robert Webb/Great Stella/Wikimedia Commons

A diagram showing 'simple connectedness,' a topological property allowing for, in this example, a rubber band around the surface of a sphere to be shrunk to no more than a point. This property was long known to characterize two-dimensional spheres and has now been shown to characterize three-dimensional spheres as well by Perelman's proof of the Poincaré Conjecture.

[1]Sylvia Nasar, *A Beautiful Mind* (Simon and Schuster, 1998), reviewed in these pages by Joan Didion, April 23, 1998; Graham Farmelo, *The Strangest Man* (Basic Books, 2009), reviewed in these pages by Freeman Dyson, February 25, 2010.