

A catalogue of
50 of the most
influential
scribbles and
sketches that have
emerged in the last
half century...

...since the discovery of the double helix, to shape our language, our economy, our culture, and our sense of self. From “conflict resolution,” to “the new soul,” “in vogue,” to “the death of death row”—a survey of the trivial, the provocative and the

outright
revolutionary

5 NOT THAT THERE'S ANYTHING WRONG WITH THAT

When news of a possible gay gene made it to the mainstream media in 1993, our society's image of homosexuality was redrawn. Dean Hamer's seminal paper published in *Science*, "A Linkage Between DNA Markers on the X Chromosome and Male Sexual Orientation," took homosexuality out of the realm of choice and into that of biological determinism alongside red hair and left-handedness.

Hamer's paper attracted enormous international attention and has spawned different camps of opinion. Some support research in this direction, and believe it's important to establish whether or not homosexuality is genetically determined. Others believe that such research might follow a dangerous course, and worry it could be wielded by those with anti-gay sentiments. Others maintain that it shouldn't matter, that everyone, regardless of their sexual preference, should be treated equally.

A second paper was published in *Science* three years ago that didn't support Hamer's findings. The debate continues.—*Laura McNeil*

6 DEATH OF DEATH ROW

Governor George Ryan made news across the country this January when he commuted the sentences of all 156 inmates on Illinois' death row, just two days before leaving office. Three years ago, courts discovered that 13 of the state's death row inmates had been wrongly convicted since 1977. "Our capital system is haunted by the demon of error—error in determining guilt, and error in determining who among the guilty deserves to die," Ryan said. Nothing has cast a darker shadow of doubt over that system than the use of DNA evidence, which has exonerated 12 of the 50 death row inmates freed in the US since 1993.

These exonerations, and the role DNA evidence has played in them, have prompted nationwide soul-searching on the death penalty. Last year, North Carolina's Chief Justice set up the Actual Innocence Commission to study the justice system and recommend reforms. A similar commission in Illinois just published 85 recommendations, which California plans to review.

Not to be outdone, federal legislators are getting into the fray. Last year, 25 senators and 249 House members signed the Innocence Protection Act, which provides access to DNA testing for federal inmates with credible claims of innocence. The Federal Moratorium Bill calls for a temporary freeze in executions while systematic flaws are reviewed. DNA testing may prove to be the deciding factor in the debate over capital punishment, a debate which moral arguments alone have been unable to settle.—*Jennie Rose*

7 POPULAR SCIENCE

The fastest growing destination for undergraduate students is the biology lab, and according to the 2002 *Jobs Rated Almanac*, "biologist" ranked as the nation's number one job—in terms of "low stress, high compensation, lots of autonomy, tremendous hiring demand, and several other criteria."—*Heather Sparks*

8 SURVIVAL OF EVERYTHING

In 1953 nobody could have imagined it would one day be possible to reduce a species of living creature to a number. That is now fact. The genome of a person, frog, or weed, is just a quaternary code for how to build that body, a numeric definition of the species. In theory, we may one day save species from extinction by reading genomes and reprogramming cells.

Until that day, zoologists are limited to establishing cell culture collections from endangered species known as frozen zoos. It's a race against time, one that zoologists are losing as species endangered one day become extinct the next. In 1914, when Martha, the last passenger pigeon, was dying in the Cincinnati Zoo, if somebody had had the foresight to freeze a piece of her tissue, we might have been able to resurrect her species.

But what about the species left undescribed, some endangered? Imagine that ten years from now researchers could send a device into the rain forest to sequence the entire genome of every species it encountered. From the seeds, hairs, insect wings, and fungal spores it collected, it would read whole genomes into its library. This Twenty-first century Noah's Ark would guarantee longevity for millions of species on our planet, endangered, extinct or otherwise.—*Matt Ridley, author of Genome*

9 FLIP OF A COIN

Francis Crick and James Watson tossed a coin to determine whose name would appear first on their epoch-opening, "Letter to Nature". Watson won, and from then on the double helix has been linked to "Watson and Crick."

Watson-n-Crick. The two names have become inseparable, locked together in modern lore and language, rolling off the tongue in four syllables.

It is intriguing that the high profile of Watson's lead-authorship echoes in the prominent role he has continued to take within the burgeoning world of DNA. In contrast, Crick has pursued a more reclusive career.

It's an odd quirk of fate that contradicts alphabetism, the little known discrimination that links our success to the first letter of our family's name. Being in the first half of the alphabet increases the likelihood of success above those in the range of N to Z.

Take the world's five richest people: Gates, Buffet, Allen, Ellison and Allbrecht. Pure chance? Not according to the stats, which time and again show that coming first in the alphabet puts a student at the top of the class.

In academic circles the propagation of this name discrimination had an obvious root. Until recently many journals insisted on alphabetical order of authors, with the aim of destroying any sense of cult status. Instead, it gave alphabetically enhanced members of a team heightened prominence, particularly as the popular convention is to write "Bloggs et al., 2000." W&C—alphabetism with a right-handed twist.—*Pete Moore*

OUR CAPITAL PUNISHMENT SYSTEM IS HAUNTED BY THE DEMON OF ERROR—ERROR IN DETERMINING GUILT, AND IN DETERMINING WHO AMONG THE GUILTY DESERVES TO DIE.

used to study DNA and its structure. The rest is history.

—Angelina Sciolla

33 THE NEW PATRIOTISM

No place in the world is both as modern and genetically homogeneous as Iceland, and its citizens are lining up in what may be the newest incarnation of national pride. deCODE Genetics, an Icelandic biotech firm, is studying the genetic profiles of the island-nation's people, and combining it with extensive medical records and genealogical data to spot disease-causing genes and develop new treatments. A vast majority of the island nation's 280,000 residents have agreed to participate.

Such unbridled enthusiasm for a project that, effectively, turns Icelanders into one biomedical commodity, would be unimaginable in the United States and many other countries. But, deCODE has tapped into much more than a crystal-clear gene pool in the North Atlantic; it has appealed to a particularly Icelandic virtue.

Icelanders view their DNA, like their fishing stocks, as communal property. "Icelanders have a stronger sense of community than people in the US," says Gísli Pálsson, an anthropologist at the University of Iceland who is studying the deCODE project. They

No. 34 "RACE IS A SOCIAL CONCEPT, NOT A SCIENTIFIC ONE." —CRAIG VENTER, HUMAN GENOME PIONEER

may strive to express their individuality through music and fashion, says Pálsson, "but there is not this sense that every man is an island."

Iceland's Prime Minister, David Oddsson, considers the project, "extremely important," ostensibly for economic reasons. But as hundreds of thousands of islanders literally give of themselves for the greater good of the nation, sacrificing their medical records, their privacy and their blood, it seems we're witnessing a new kind of sacrifice for God and country: Twenty-first century patriotism.—Mark Beard

35 TRANSHUMANISM

Transhumanism takes a pro-science stance to the development of humanity and the human form, and opens a discussion for the use of bio, nano, cognitive and information sciences to enhance our bodies, minds and lives. And the conversation isn't confined to Alcor's cryonauts and Raelian-styled futurists: the US Department of Commerce and the National Science Foundation recently published a report entitled, "Converging Technologies for Improving Human Performance." The 450-page document suggests opportunities for the improvement of human abilities, social outcomes, the nation's productivity, and its quality of life.

"We are only half-baked," says Nick Bostrom, founder of the over 2,000-member World Transhumanist Association. The 29-year-old Bostrom, who has a PhD in Philosophy, a Master's in Physics, and is working on a research fellowship at Oxford University, suggests that if we say yes to therapeutic cloning and cryonics research today, tomorrow we will say yes to ageing reversal and intelligence enhancement. "Modern humanity is a blip. It is naive to think it stops here. Ordinary evolution will not take us to the next level; deliberate self-modification will. After that, the fun can begin."

Transhumanists are optimistic futurists, but they also consider the negative impacts of the scientific advancements they support. In fact, they think it's an obligation, given present leaps in regenerative medicine, designer babies, cloning and pharmacolo-

gy. The World Transhumanist Association supports therapeutic cloning, for instance, but does not advocate for reproductive cloning, given current unknowns.

"Things are moving quite fast," says Bostrom. "It is high time to do some serious thinking about achieving this unprecedented level of human flourishing in a responsible and ethical way."—Danielle Egot

36 JEFF GOLDBLUM'S CAREER

It seems as though without Watson and Crick's discovery, we may not have heard of Jeff Goldblum. The actor spent years building up to the hipster genius he displayed as Ian Malcolm, the leather-clad chaos theorist of *Jurassic Park*. In the mid-80s, he redirected his thespian—and relatively obscure—career with back to back roles as DNA-dabbling researchers. In *Race for the Double Helix*, Goldblum portrayed a temperamental James Watson on the verge of discovery. (Critics loved it. Watson did not. The film is shown often in college biology classrooms.) A year later Goldblum starred in David Cronenberg's remake of *The Fly*. As Seth Brundle, the scientist-turned-*Musca domestica*, Goldblum seduced us into the genetic unknown, hoarding

decayed relics of his humanity in the medicine cabinet. He later played scientists in *Independence Day* and *The Lost World*.

Goldblum doesn't seem to mind repeatedly portraying scientists on the silver screen. "It's a living," he quips. Though he's played plenty of unscientific men, he is famous for his interpretation of geneticists and mathematicians. Goldblum fuels these characters with an ecstatic urgency, his sharp mind working ebulliently ahead of his mouth as he arrives at a thought. "A lot of it has to do with saving the world, so it's a vital thing," he suggests.—Angelina Sciolla

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38 DEAD PRESIDENTS

Political leaders are at the mercy of 24-hour news services. People know more about the private lives of their elected officials than ever before. No missteps or medical problems pass under the media's radar for long. DNA is now starting to play a part in these dramas, both present and past.

Long-held secrets of America's great and private heroes are waiting to be exposed. Did Thomas Jefferson father the children of one of his slaves? DNA testing of living relatives has confirmed that this is a possibility. Did Abraham Lincoln suffer quietly from Marfan syndrome? Some day scientists may probe his DNA for the answer.

Historians are enthusiastic about their new molecular tool, which promises to revive—and revise—rumors and oral traditions once relegated to endless speculation.—Tracy Smith Schmidt

39 BIOLOGICAL MCCARTHYISM

The year was 1987. Advanced Genetic Sciences, in conjunction with researchers at the University of California at Berkeley, were holding the first open-air trials for an

altered form of *Pseudomonas syringae* bacteria dubbed ice minus and designed to prevent frost from forming on crops.

As technicians clad in biohazard suits sprayed strawberry and potato patches with the recombinant bacteria, protestors stormed the fields, attempting to thwart the experiment by uprooting the test plants. This incident was the culmination of a five-year legal battle waged by author and activist Jeremy Rifkin against the federal government, attempting to prevent the release of the bioengineered ice minus microbes into the atmosphere.

"The position I took at the time was that we hadn't really examined any of the potential environmental consequences of introducing genetically modified organisms," said Rifkin, now the president of the Foundation on Economic Trends, during an interview with PBS in August of 2000.

Such dramatic controversy surrounding produce was unheard of before this time, but a year later, at a biotechnology symposium held at the University of California, scientists vented mounting frustrations at regularly finding their experiments stalled or sabotaged by what they called, "biological McCarthyism," or "the-tomato-that-ate-Hollywood syndrome."

Although the field of bioengineering has made impressive strides in the past 15 years, it continues to face skepticism from many sides. Greenpeace drives one campaign against GMOs, claiming that "these genetically engineered organisms can reproduce and interbreed with natural organisms, thereby spreading to new environments and future generations in an unforeseeable and uncontrollable way." It seems that genetic engineering may never be able to escape public fear of the "Teenage Mutant Ninja Tomato." —*Jennie Rose*

40 SITTING FOR YOUR PORTRAIT

Ever vigilant in his quest to shock the art world with avant-garde rebuffs to the question "what is art?" British artist Marc Quinn paints with the code for life itself in his conceptual portrait of geneticist Sir John Sulston.

The biological photograph, as it were, is about the size of a standard sheet of paper, and framed by a shimmering silver surface which reflects the face of the viewer. The pristine, sterile surface of the work is a nod to the lab conditions under which work. Sulston is captured in hundreds of colonies of bacteria, each generated from a single cell containing a fragment of his DNA, a fitting portrait for the man who spear-headed the Human Genome Project in Britain.

According to Quinn, the portrait is the most singular likeness of Sulston that can be achieved. While it is completely abstract in one sense, "it is, in fact, as accurate as one can get, giving you instructions on how to remake the sitter," he says.

Now that life itself has become an artistic medium, have the boundaries of artistic freedom finally been reached? —*Tatiana Helmus*

41 THE POST POST INDUSTRIAL AGE

The dominant alphabet is changing from 1s and 0s to As, Ts, Cs, and Gs. Increasingly, genetics is becoming the dominant language and economic driver of this century.

Fifty years ago, a similar change occurred as languages and grammars like Linux, ASCII, and C++ came to replace English, Russian, and Chinese. The global economy evolved into a knowledge economy, one based on brains and binary code. Some countries changed and some didn't, which is why Singapore and South Korea emerged as economic powerhouses, while Argentina and North Korea faded into economic oblivion.

Now, as the genetic age is usurping the computer age, the currency of the knowledge economy is changing. Even the smartest people are at risk of rapidly becoming illiterate.

We are reading the source code of life, and beginning to reprogram some of it. As we start to deliberately control the evolution of life forms on the planet, a lot of things will change, including politics, business, war, and our children. We are also witnessing the emergence of bioinformatics, one of many ways our present and future alphabets are already overlapping.

Those who remain genomically illiterate will lose their competitive edge. Those who get literate fast will leave their mark on this new age. —*Juan Enriquez, author of As the Future Catches You*

42 GOLD BUG VARIATIONS

Richard Powers illustrated the intellectual fervor set off by the discovery of the double helix by creating the character of Stuart Ressler, the protagonist of his acclaimed



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