Open up a rat, a dog, a pig, and a human, and you will find much the same terrain but with differences. These visible differences have an impact when it comes to assimilating drugs. Consider the most commonly used species in toxicology research, the rat. Rats have no gall bladder. They excrete bile very effectively. Many drugs are excreted via bile so this affects the half-life of the drug. Drugs bind to rat plasma much less efficiently. Rats always breathe through the nose. Because some chemicals are absorbed in the nose, some are filtered. So rats get a different mix of substances entering their systems. Also they are nocturnal. Their gut flora are in a different location. Their skin has different absorptive properties than that of humans. Any one of these discrepancies will alter drug metabolism. And these are only differences on a gross level.

Smaller differences, being largely chemical, are more difficult to observe. Therein lies a greater dilemma. Medications do not act on the macro-organism—the large, visible level of, say, keeping organs in the right arrangement or bones in the right place. Medications act on the microscopic level. They interrupt and/or initiate chemical reactions, altering molecular activities that are far too small for the human eye to observe. Indeed, medications’ actions are not apparent, even with high-tech instrumentation, until they occur.

The discrepancies between diverse mammals are largely microscopic. Imponderably intricate, they are born of millions of years of speciation, adaptation, and mutation. The more modern science reveals about genes, cell function, ion channels, proteins, and so on, the more apparent is the complex gulf between species. And the more ludicrous the existing requirement for animal testing becomes.

The other, even more obvious, problem with the animal model is that animals cannot communicate about their well-being. They cannot say, “I have a stomachache” or “my head hurts,” or even “I ache all over.” Hence, until animals manifest grand scale malaise in a lab, observations are all guesswork. Or as experts in toxicity write,

The only universal model for a human—that is, one which would best predict what would happen at a given endpoint across the full range of chemical structures, concentrations, etc.—is other humans.

Is it possible that we are not only receiving inaccurate data about the side effects of medications, but also not receiving access to certain drugs that do not produce those side effects that animal models claim? Are we missing good medications because of animal testing? Logic suggests that the answer to these questions is yes.
As it is now, animal testing for medications has created and continues to create catastrophe. Animal experiments fail to predict the lethal side effects of many drugs and also prevent good medications from reaching the marketplace. These two outcomes are called “false negatives” and “false positives,” as we will explain. The critical word here is false. Animal models for human medicine are false.

Different chemicals have diverse effects on different species. Therefore, the belief that “simply doing enough animal testing will predict all human toxicity” is, as Dr. Louis Lasagna of the University of Rochester so eloquently put it, a “pathetic illusion.”

When compounds demonstrate therapeutic effect on an animal, therapeutic effect without ill side effect, they proceed to human clinical trials. There, very often—our research shows anywhere from 52 to 100 percent of the time—they fail, frequently by wounding or killing people. Animal testing has made it look as if given compounds will not injure humans, but they do, as the many examples later in this chapter indicate. Test results such as these are called “false negatives,” an important term in the trial process. Thalidomide is a perfect example of a “false negative.”

The second catastrophic impact of animal testing is this compounds that show evidence of therapeutic effect in the human arena are tested on animals. When they bring on injurious side effects in animals, they are withheld from development for humans. More people stay ill. More people die. When it later turns out that humans do not experience the side effects as animals did and also that they actually benefit from the medication, then the animal modeled test results are called “false positives”—a second significant drawback to the animal testing protocol.

In this chapter we show many examples in both categories. These examples only begin to reflect the scope of the historic failure of testing potential human remedies on non-humans.
Delusions of Harm

“Normally, animal experiments not only fail to contribute to the safety of medications, but they even have the opposite effect.” So stated Dr. Kurt Fickentscher of the Pharmacological Institute of the University of Bonn, Germany, in *Diagnosen*, March 1980. Here is another scientist emphasizing that animal tests not only fail to predict the bad effects. When they falsely predict side effects, it keeps good medications off the market. Koppanyi and Avery stated of many medications that are used to save lives today, “Had these drugs first been tested in animal experiments for their safety, some of them might never have reached clinical trial.” The truth is that all medications in use today can be found to cause a serious side effect in some animal. Given that, if medications were withheld based on a negative side effect in animals, we would have no medications today.

Pharmaceutical companies are very wary of releasing drugs that have extremely negative effects on their test animals for legal reasons. Therefore, they keep some of these compounds off the market. Again, as explained earlier, when an animal experiment predicts side effects that do not occur in humans, it is called a “false positive.” It is the false positives that prevent potentially therapeutic medications from reaching afflicted humans who really need them.

For an idea of just how helpful these medications might be, we have only to weigh the personal benefit of several common painkillers—drugs that demonstrate false positives in animals but have outstanding therapeutic value in the human setting.

Look in your own medicine cabinet. When you get a headache, would you reach for a pain medication of which a single dose causes renal failure and death in cats? Perhaps. That medication is acetaminophen most commonly marketed as Tylenol. Leery now of Tylenol, you might prefer aspirin. Today, twenty-nine billion aspirin per year are sold in the United States and twice that number are sold worldwide. Aspirin is not only used for pain relief and fever reduction but for the prevention of strokes, heart attacks, and other illnesses. Aspirin causes birth defects in mice and rats and results in such extensive blood abnormalities in cats that they can only take twenty percent of the human dosage every third day.” How about ibuprofen, which most people know as Advil or Motrin? Ibuprofen causes kidney failure in dogs, even at very low doses.

When clinical success suggests itself for humans, researchers labor long and hard to find an animal whose response to the drug is favorable. Some animal, somewhere, will eventually produce the kind of results they are after. Some researchers even use fish! Once they know what kind of effect they are after, the cat (for example) is out of the bag.
Frequently, drugs used abroad have such overwhelming evidence of effectiveness and safety for human use that the FDA eventually approves them for use in this country. Sometimes the FDA requires abbreviated animal testing. Other times it demands the entire protocol, but releases the manufacturer from certain requirements. Prozac is a good example of this.

We found many other examples of valuable medications of which Americans were initially deprived because the mandate for animal testing prevents their development and distribution here.

- Depo-Provera, the contraceptive, was barred from release in the U.S. in 1973 because it caused cancer in dogs and baboons.\textsuperscript{79}

Elsewhere in the world, women used it and found it safe. Not until 1993 did the FDA release the drug to the American public.

- Digitalis, a plant used by herbalists for centuries to treat heart disorders, was discovered without animal use. It is described later in this chapter. However, clinical trials of the drug were delayed when it caused high blood pressure in animals. Digoxin, an analogue of digitalis, was much later released and has saved countless lives. How many more could it have saved had it been released sooner?\textsuperscript{76-79}

- Streptomycin, a popular antibiotic, is teratogenic in rats, causing limb malformations in offspring.

Just as corticosteroids have indications in humans that are not present in animals, the converse is also true. Animal experiments suggested that these drugs would help septic shock, a severe bacterial infection of the blood.\textsuperscript{92,93} Unfortunately, humans reacted differently, leading scientists to conclude that corticosteroids were “...ineffective for the prevention or treatment of shock associated with sepsis...[and] may make secondary infection worse.”\textsuperscript{94} Others agreed stating that “...extrapolation of data from experimental models to the clinical setting may be dangerous and misleading.”\textsuperscript{95}

The final analysis showed clearly that this treatment increased the death rate in cases of septic shock.\textsuperscript{96} This variation from animals to humans should not be particularly startling. It happens all the time. The dose required to achieve therapeutic effects from corticosteroids in the cat is double that of the dog. The type and incidence of side effects also differs dramatically between these two seemingly similar species. Chronic steroid use damages the canine liver and causes diabetes in cats. In humans it causes adrenal suppression and osteoporosis. Though dogs also suffer adrenal suppression and osteoporosis from steroid use, they are less susceptible.
SCIENCE/BIOLOGY TEXTS
EXTENDED WRITTEN TEXTS (NON-FICTION)

J.S. Greek, R.C. Greek, Sacred Cows and Golden Geese: The Human Cost of Experiments on Animals. (Continuum, 2000), pp. 59-76.
Extracts from Chapter Four: The “Pathetic Illusion” of Animal-Modelled Drugs.

- Penicillin was delayed by animal testing and almost derailed altogether. Alexander Fleming saw penicillin kill bacteria in petri dishes in 1929 and tested it on rabbits. It did not work. We now know that rabbits excrete penicillin in their urine; it is eliminated before it can be effective. Based on rabbit work, Fleming put the drug aside, believing it to be useless as a systemic medication. He later had a very sick patient and since he had nothing else to try, administered the penicillin. The rest is history. Interestingly H. W. Florey, co-winner of the Nobel Prize for penicillin administered penicillin to a sick cat at the same time Fleming was giving it to his sick human. Florey’s cat died. Fleming attributed the discovery to serendipity, saying, “Penicillin happened... It came out of the blue.”

Fleming might have thrown his penicillin away entirely if he had tried it first on guinea pigs or Syrian hamsters instead of rabbits. It kills them. In addition, penicillin is teratogenic in rats, causing limb malformations in offspring. Fleming stated, “How fortunate we didn’t have these animal tests in the 1940s, for penicillin would probably never been granted a license, and possibly the whole field of antibiotics might never have been realized.”

Macfarlane, another early penicillin researcher, also credited serendipity in penicillin’s discovery referring to “a series of chance events of almost unbelievable improbability.” And:

Mice were used in the initial toxicity tests because of their small size, but what a lucky chance it was, for in this respect man is like the mouse and not the guinea-pig. If we had used guinea-pigs exclusively we should have said that penicillin was toxic, and we probably should not have proceeded to try and overcome the difficulties of producing the substance for trial in man. (Emphasis added.)

What if mice had not worked either? It was Fleming’s application to a human patient that proved the drug’s effectiveness. Interestingly the other individuals awarded the Nobel Prize for penicillin, along with Florey and Fleming, Dr. E. B. Chain, stated this about testing medications on animals.

No animal experiment with a medicament, even if it is carried out on several animal species including primates under all conceivable conditions, can give any guarantee that the medication tested in this way will behave the same in humans.

- Prilosec (Omeprazole), a gastrointestinal medication, was almost canceled because of an effect in animals that did not occur in humans. The drug was delayed for years. Presently, millions now prefer it to the traditional H2 blockers like cimetidine.
Isoniazid is a commonly used medication for tuberculosis. It causes cancer in animals. Here is what one researcher said about isoniazid:

Presently, we recognize the ability of the effective antituberculosis drug, isoniazid, to induce lung adenocarcinomas [cancer] in a wide variety of mice that are susceptible to this tumor... Despite the fact that this drug has been effectively and extensively used since 1953, a period of 24 years, I know of no convincing evidence of its carcinogenic effect in man... Unfortunately, we know of no sure way to differentiate accurately between those drugs and other chemicals which induce cancer in both animals and man and those which although effective in animals, are ineffective in man.¹⁰⁷

Furosemide, commonly called Lasix, is another example of an important medication almost lost to the public due to animal studies. It is a diuretic, used to treat high blood pressure and heart disease. Mice, rats and hamsters suffer liver damage from this widely used drug, but people do not. The drug is metabolized differently in each species.¹⁰⁸,¹⁰⁹,¹¹⁰

Fluoride, which causes cancer in rats, was initially withheld from dental use. A dentist made the discovery that fluoride may decrease the risk of dental decay. Observing patients who had mottled teeth from living in areas with a large concentration of fluoride in the water, he noticed that they had fewer cavities.¹¹¹

For development and distribution of these drugs in the U.S., pharmaceutical companies overcame the animal model mandate only through perseverance. What of the potentially thousands of curative substances that do not overcome this hurdle? Is it possible that we are not only not getting accurate data from animals on the side effects of medications (false negatives) but also are not having access to certain drugs because of inaccurate predictions of side effects (false positives)? Are we missing good medications because of animal testing? Apparently so.

Dr. C. Dollery has this to say about missing good medications because of animal tests:

For the great majority of disease entities, the animal models either do not exist or are really very poor. The chance is of overlooking useful drugs because they do not give a response to the animal models commonly used.¹¹⁵
All medications in use today can cause a serious side effect in some animal. As we have already explained, if researchers persevere, inculcating enough species with high enough dosages, illness will eventually result in one or more species. Hence, if we truly withheld any medication from the public based on its negative impact on non-humans, we would have no medications today. This fact alone destroys all justification for continuing animal testing.

The more we learn in regard to the physiological differences between humans and other animals, the more strained support for animal experimentation becomes. What use are animal tests if scientists’ chances of predicting safety are no better than fifty percent? The troubled impact of the animal model on drugs covered in this chapter, albeit incomplete, is tragic enough to merit overhaul of drug development procedures.

The National Cancer Institute and other prestigious institutions have issued statements stating that they no longer rely on animal tests. They do not believe animal tests are protective, and they admit there are cases of safe medications being withheld because of animal-derived data.

However, despite these institutions and despite billions and billions of dollars in flawed, misleading, inconclusive science and who knows how many hundreds of thousands of human lives lost, the animal testing mandate persists. Intelligent scientists and reputable publications continue to support it. In the February 1997 issue of Scientific American, in their article defending animal experimentation, authors Jack H. Botting and Adrian Morrison nonsensically state, “In truth, there are no basic differences between the physiology of laboratory animals and humans.”

Current estimates place the cost of developing, testing, and marketing each new drug at between 150 and 349 million dollars, the latter figure according to a 1993 report by the Congressional Office of Technology Assessment. The drug companies pass the costs along to the patients and our insurance companies. Drugs are so outrageously expensive in the United States that the elderly and poor cannot afford them. In view of these staggering costs, measures should be taken to insure that only cost-effective and accurate tests are conducted. Not until the Congress and the FDA changes the way medications are evaluated prior to releasing the drug will tragedies stop and valuable therapies, previously withheld, reach the needy expeditiously.

More extensive preclinical testing on human tissue, more extensive clinical trials, and mandatory postmarketing drug surveillance would offer the general public much safer medications. These changes are long overdue and absolutely vital.

The only truly accurate knowledge about the positive and negative effects of medications on humans is acquired through in vitro testing, computer modeling, epidemiology, clinical observation, and autopsy of humans. Today’s technology makes observations of compounds on human systems more and more easy. Nonetheless, animal testing persists.
The future of biology is really going to be [human] systems analysis.

—Dr. Leroy Hood, University of Washington

Say we open the cages and let loose the lab animals. Then what? If we do not experiment on animals, on whom? How will we derive our discoveries, our cures?

Animal experimenters would have us believe that scientific innovation would come to a great, grinding halt if animals were let out of the lab, or as the Foundation for Biomedical Research publication Animal Research Fact vs. Myth puts it: “There are no alternatives to animal research [for human disease].”

As scientists, we find this insulting and ridiculous. Yes, if we abandoned the animal experimentation protocol, many researchers would have to scramble to learn other, more predictive methodologies; and certainly there would be major adjustments in publishing and drug approval. However, there are compelling reasons to believe that scientific innovation would get a big boost if medical research were devoid of animal models. Other, more rewarding techniques would gather strength under augmented effort, and maybe we would then find cures for today’s most challenging illnesses.

There is an even more ludicrous scare tactic perpetrated by animal experimenters and their lobbyists. That is the claim that if there were no animal experiments we would have to experiment on humans. Human experiments, yes, but not on caged humans, nor prisoners, nor the mentally disabled, nor lab humans, nor any unwilling experimental humans. We would conduct experiments on human cells and human tissues, examine and document humans at autopsy, tally and analyze the results of human epidemiology studies, more carefully observe humans in the clinical setting and spread the word among humans on preventative measures. It is human health that is at risk and human wellness that is our objective. Is it not reasonable to observe the species that needs curing directly?

Everyone agrees that epidemiology makes sense. Same with autopsy. Few intelligent people argue that a clinical condition documented in an actual human never happened. Genetic, in vitro, and high tech developments may be inscrutable to the average person. But few question whether it is prudent to study the composition of the very cells and genes that are inflicting or skirt human disease.
These modalities are the research techniques that we should be funding now. Ancient techniques—autopsy, clinical observation, and epidemiology—have worked well in the past; now they are far more sophisticated and accurate. Others are new and incredible, the more so when compared to the atavism of animal-modeled experiments. To date, these alternative methodologies are not anywhere near as well known as animal experimentation. Part of the reason people believe that stopping animal experimentation would put the brakes on medical development is because alternative protocols are not peddled by huge corporations, which have both the money and the incentive to sway public sentiment. Companies with science that works do not need to pay lobbyists and publicists to pave their futures. There is no need to be defensive about effective methodologies. Success speaks for itself.

But success does not yet speak loudly enough. Animal experimentation lobbyist and publicist efforts fall on susceptible ears. Everyone wants to be healthy, but few people can keep abreast of medicine’s growing reservoir of complexities. Even many physicians do not have the expertise in comparative biochemistry to make sense of extrapolations from animals to humans. And certainly, lay people are entirely in the dark: justifiably misinformed, since their information comes from slick advertising and reporting of press releases churned out by the animal experimentation industry itself. When they hear that furry little creatures are saving their own lives and those of their children, they do not dare risk disbelieving it.

The animal experimentation lobby is the largest medical research lobby there is. It bathes scientifically illiterate congresspeople and reporters with a steady flow of persuasive half-truths and poignant stories to buoy support for this duplicitous form of science. And while it bathes, taxpayers misspend, consumers misspend, and lives are jeopardized by falsely modeled therapies.

Human-modeled protocols decrease human suffering and increase our medical knowledge base. We define and exemplify each of these following. Subsequent chapters have many more examples. Any one of these modalities described does far more for humankind than animal experimentation, and together they can revolutionize medical research.

Clinical Studies of Patients

The most obvious bellwethers for information about human disease are diseased humans. Careful observations and analyses of patients have always been an important index of medical research. Countless discoveries have occurred at the bedside—the successful treatment of childhood leukemia and thyroid disease, our present level of HIV and AIDS therapy, and the discovery of a number of heart drugs among them.
Clinical observation could be encouraged. Without remuneration, physicians are disinclined to cooperate in studies that could have broad usefulness nationwide. If doctors were compensated, they would eagerly incorporate patients into studies. The information would be far more relevant and valuable than animal studies.

Researchers already rely on healthy human volunteers for studying new treatments and medicines, and strict guidelines control this type of research. Traditionally, volunteers receive tiny, harmless amounts of test drugs. Researchers carefully increase the dosage in the next person, while monitoring effects on breathing, heart rate, blood, urine, and various body functions. In addition to dosages, these tests also indicate how specific drugs are metabolized in the human body, information that cannot be reliably garnered from animal studies since animals metabolize differently than humans.

Called clinical pharmacology, this process is the only way to find out whether a drug will be safe and effective in people, and in what dosage. Studies like this repeat a lot of what drug companies do in animals. However, whereas the animal model tells only about the animal in question, clinical pharmacology produces data that is actually applicable to humans. More often than not, this data is entirely discrepant from that indicated in animal experiments.

**In Vitro Research**

As other chapters exemplify, *in vitro* research (*or test tube research* as it is also known) has revolutionized medical research, illuminating pathways to discoveries of great importance. Even the federal government acknowledges: “There is virtually no field of biomedical research that has not been affected by *in vitro* technology.”

*In vitro* means, literally, “in glass.” *In vitro* research occurs in a flask or another controlled environment, rather than within a living organism or in a natural setting, which would be *in vivo*. To understand illness and therapies better, scientists observe the given culture, and observe the effects of other chemicals on it. When a chemical causes cells to mutate *in vitro*, or if it kills rapidly dividing cells, then it may cause disease in humans. When it interrupts the action of a disease-causing agent, or the disease itself, it may be curative.

For over a hundred years, scientists have refined methods for sustaining somatic cells (cells that make up our bodies, not germ cells). As a result, human cells and tissues, removed during surgery, biopsies or post-mortems, can be grown outside the body in the “test tube.” The cells are carefully cultured inside special flasks or dishes, bathed in a nutrient fluid. The fluid is a complex mixture of all the substances essential for the cells’ continued survival and contains nutrients, enzymes, hormones and growth factors.
Cell and tissue preservation technology is now so advanced that many different types of cells can be kept alive almost indefinitely. Cell culture is an exciting and rapidly developing field of research that holds enormous potential for improving the quality of medical research. By culturing complex mixtures and layers of cells scientists can create more realistic models of parts of the body, such as skin and capillary vessels. This increases our insight into how they work.

Just as promising as it is controversial is stem-cell research. Stem cells are “master cells” that can grow into virtually any of the body’s cell types. Originally harvested from early stage human embryos, it may now be possible for stem cells to be lab-grown. Researchers anticipate that they will be able to grow new cells to replace diseased or damaged cells in patients suffering from Alzheimer’s, diabetes, Parkinson’s, and other illnesses.

In 1985, the National Academy of Science emphasized the advantages of human studies over animal studies, saying, “Major recent advances in our knowledge of the immune system made possible by cell culture techniques would have been virtually impossible to achieve in intact vertebrates.”

Research on human body matter is much more reliable than animal studies since the cells or tissue that are diseased are the same as that you are studying. For instance, let us say you are studying human metastatic cancer. There is no shortage of human cancer tissue. Human tissue, rather than being thrown away after surgery, is now harvested for just such a purpose. No one need observe an animal tumor since human tumor tissue is so abundant.

The leading animal experimentation handbook says that cytotoxicity studies such as the total cellular protein assay and the neutral red uptake assay, the Lowry method, evaluation of cell adhesion, cell proliferation, morphology, membrane damage uptake of radioactive precursors, microrcinematography analysis can all be performed in vitro. Why then use a rat?

Most illnesses do their work at a microscopic level. Hence, human proteins, ion channels, cells, and cell components such as genes obviously make ideal test beds for determining ways to interrupt the course of human diseases. Even in its early years, in vitro science allowed the discovery of antibiotics penicillin and streptomycin, and an understanding of blood types. Human cell and tissue culture observation, in the form of in vitro research, has refined the processes of vaccine production, toxicity testing, and selecting new drugs. It is leading to a better understanding of illnesses such as cancer, Parkinson’s disease, multiple sclerosis, diabetes, heart disease, viral infections like AIDS, and many more.

On a gross level, surgeons use the human placenta to train to repair tiny vessels and nerves, such as in re-implant procedures. The human placenta can also be used to study reactions to medications and metabolism. Scientists can watch the effects of antibiotics and other medications on cells from specific organs, or on the organs themselves.5,6,7
The human placenta has enormous potential for studying metabolic processes without recourse to animal experimentation. Its greatest advantage lies in eliminating the necessity for extrapolating results from animal experiments and trying to interpret them in terms of the human situation.¹

Scientists have pointed out,

Whenever human material becomes available for research in satisfactory condition and without danger to the patient, it should be preferred to any animal living material.²

State-of-the-art in vitro technology continues to streamline the medical research process. This demands precise tooling and miniaturization. Further advances in technology have led to the development of extremely sensitive and sophisticated equipment to monitor the cultures and detect minute cellular changes.

To contain human micro-matter, tiny screening plates, now not much bigger than a pager, hold several thousand miniature wells. Scientists can fill them with different cells, then subject these to potential therapies. Fluorescent assay technology then delivers accurate information about the compounds' efficacy fast, as many as 100,000 compounds per day, per screening plate. Moreover, conducting experiments the size of notes economizes what are frequently valuable and limited supplies of human organs, cells, and tissue.

Only the convention for animal testing prevents in vitro tests from being used more often. Toxicologist Bjorn Ekwall elucidated,

We should not imitate cell test systems [because] that is an old toxicology; in fact simple cell line tests are much more revealing than people think, but it's difficult to sell the idea because it could be a threat, and the animal testing monopoly would be destroyed.³

Drug companies are branching into designing drugs that act specifically along signal transduction pathways. Signal transduction pathways are the “highways” on which many different internal stimuli travel to the cells. Since almost all known diseases make these signals dysfunctional, drugs that controvert the dysfunction should inhibit disease. Scientists subject human cells to chosen chemicals in vitro and watch ensuing expression. They then record precise data that is far more likely to correlate to that of human clinical trials than data garnered from animals. (More about this in Chapter 7, Real Origins of Medications.)

Many scientists recognize and criticize the limited use of human tissue.⁴ Some now state, “Direct extrapolation from animals to humans is frequently invalid . . . recently much interest has focused on use of human autopsy or biopsy tissue as a means of overcoming these limitations.”⁵
Autopsies

Autopsies have led to many of the great medical breakthroughs described in this book. They are an essential source of knowledge. If you want to know what caused a failure, investigate the failed entity. Drs. R. B. Hill and R. E. Anderson wrote,

VIRTUALLY THE WHOLE FIELD OF MODERN MEDICAL KNOWLEDGE WAS CREATED THROUGH STUDY OF AUTOPSIES, AIDED AND SUPPORTED BY PHYSIOLOGY, PHYSICAL DIAGNOSIS, AND MICROBIOLOGY... IT WAS ABOVE ALL AUTOPSY STUDY THAT USTERED IN THE MODERN ERA.13

Research in diabetes, hepatitis, appendicitis, rheumatic fever, typhoid fever, ulcerative colitis, congenital heart disease, hyperparathyroidism, and many other illnesses has been enriched by autopsies.14 Autopsies elucidated the mechanisms of shaken baby syndrome, sudden infant death syndrome, and head injuries suffered during car accidents.15,16,17 Autopsies also indicate aspects of illness missed in diagnoses. Studies of patients who present for autopsy, performed since 1970, indicate that physicians misdiagnosed approximately ten percent.18 One study demonstrated that in 64 percent of 2,537 cases, findings at autopsy proved that an undiagnosed disease was present at death. Undiagnosed findings either caused the patients’ demise or were an important factor in the patients’ health.19

In former days, every patient was autopsied, and that is how discoveries were made. Unfortunately, autopsies are not now done with the frequency that they once were. The rate of autopsies has dropped to less than one-quarter of what it was in the 1950s, because no one will pay for them. Once a patient has died, only rarely is anyone on hand willing to go out of pocket to find out why. Pathologists do not routinely perform autopsies unless insurance companies reimburse them, which they usually do not. The NIH funds few research projects that utilize autopsies, therefore few universities perform them. Yet, if just one out of every five patients were autopsied, an immense amount of valuable information would be retrieved. And there were be more organs for research on specific parts of the body. Again, why not divert funds to autopsies from animal experiments?

The infrequency of human autopsy, as contrasted with the bottomless reservoir of experimental zoology, caused Dr. Robert Anderson, a pathologist at the University of New Mexico, to state, “We know more about the causes of death in old mice than we do about the causes of death in old people.”
We do not have to kill humans to generate bodies for autopsies. Humans die, and it is not unreasonable, as some European countries have now realized, to use their bodies in order to ease suffering in subsequent patients.

An expert in medication development stated,

No laboratory animals will ever be a completely satisfactory substitute for the human system and the time will come when we shall stop wasting the enormously valuable enzymes and organelles of the dead and instead put these to use to understand the living human being.²⁰

Epidemiology

Epidemiology is another highly rewarding area of medical research. Gathering and analyzing data regarding the incidence and prevalence of specific diseases among populations presents very valuable information about why and how the illness occurs. Scientists use this data as a point of departure for examining which genes confer either to disease or immunity. They can also draw conclusions about environmental or lifestyle factors that influence susceptible people positively or negatively. These insights suggest preventative measures that can mitigate the frequency of illness.

Epidemiology today is greatly facilitated by computer-accessible medical records that track thousands of patients at multiple institutions. Though now vastly more sophisticated, epidemiology is not a new field. Accumulated data about patients brought an end to the practice of blood-letting centuries ago.²¹ In 1747, James Lind noticed that sailors came down with scurvy during long voyages. This epidemiological observation resulted in preventative action. The Royal Navy began to take limes and other citrus fruits on voyages; thus sailors were referred to as “limeys.”²²

Epidemiology uncovered innumerable occupation-induced diseases. One of the first to discover the association between industrial chemicals and disease was Alice Hamilton. Though hindered by gender bias at the turn of the century, Hamilton persisted. Her first observations revealed that lead was harmful. She went on to diagnose phosphorous poisoning in munitions workers, silicosis in sandblasters, mercury poisoning in felt workers, and carbon monoxide poisoning in steel workers. Hamilton’s clinical observations and subsequent epidemiological studies laid the groundwork for many reforms in industrial health.²³ For example, wearing protective masks to filter out the silica particles now prevents silicosis.²⁴
Building-related illnesses such as Legionnaires’ disease, Pontiac fever, flu- and cold-like illnesses such as irritation of the upper airway, headache and difficulty focusing on the tasks at hand, allergic reactions, and immune system problems have all been discovered through epidemiology. Causes include exposure to cigarette smoke, viruses, building materials, fungi, mites, and many other negative influences.

Epidemiological studies discovered the link between folic acid deficiency and spina bifida. They also showed the cause/effect relationship between smoking and cancer, heart disease and cholesterol, high blood pressure and stroke, high blood pressure and heart disease, repetitive motion and carpal tunnel syndrome, smoking and heart disease, coal dust and black lung disease, cotton dust and byssinosis, dietary fat and cancers of the colon and prostate, laundry and dry cleaning industries and cancers, and so on. Through epidemiology we learned how AIDS is transmitted. The examples go on and on, as this book’s later data indicate. As long ago as 1980, the U.S. Congress Office of Technological Assessment Report stated that epidemiological studies were more reliable than animal studies.

Epidemiology gives us the opportunity to prevent disease but issues little profit to industry. This is probably why there is not a multimillion dollar political action committee called Americans for Epidemiology.

When computers simulate parts of the human body as mathematical equations, it is called mathematical modeling. Although this process requires the enormous simplification of various body systems, it is producing some surprisingly accurate results. For example, an American computer model of 10,000 brain cells produced signals similar to those given out by a real brain. In another example, scientists use a model of a “slice” of brain to investigate how people think and remember, as well as to shed light on disorders such as epilepsy. A computer model analyzing the body’s response to cancer at the National Cancer Institute in Maryland was able to show that the immune system could both fight cancer and stimulate it. Researcher Dr. DeLisi said, “It comes up with things you might otherwise miss.”

Breast cancer is another area illuminated by mathematical models. We describe others elsewhere. Mathematical modeling pointed out differences between breast tumors that looked identical under the microscope. This provided clinicians the basis for different therapies for what had, at first glance, appeared to be the same tumor.

Using computer graphics, programs can create the three-dimensional structure of molecules on screen. By studying the shape, structure, and active sites of molecules known to be medically useful, scientists can then attempt to design similar or improved structures. Already some drugs, such as the high blood pressure medication, Captopril, have been designed this way.
Similarly, chemical structures known to be toxic can be analyzed to predict toxicity of new substances without resorting to animal tests. One program called COMPACT, at Surrey University predicts chemical toxicity based on likely interaction with body enzymes. The system has already been tested on more than one hundred chemicals and so far has an accuracy of 82 percent. That is far greater than the average accuracy of animal testing. COMPACT could have predicted the toxicity of Opren, an anti-rheumatic, anti-arthritis drug withdrawn after causing liver damage.

The Electric Cell Substrate Impedance Sensing (ECIS) device uses electricity to study complex cell behavior. This non-invasive technique for testing cell cultures follows a cell’s behavior at quarter-second intervals. Imagine continuing the animal testing convention in an epoch when this kind of observation is possible. Some call the people who work in these computer-driven biotech industries “robochemists.”

Medical students now use interactive computer models that mimic various body systems to learn physiology. Students can prescribe drugs, monitor changes in heart rate, blood pressure, urine output, and so forth, and investigate the effects of altering certain variables. This software saves staff time, money, and space compared with animal experiments.

Instead of repeating previously conducted experiments, students, scientists, and physicians can access comprehensive medical databases to glean information, then devote valuable time and dollars to fresh explorations.

**Genetic Research**

Genetic research, such as the technologies created in the government-funded Human Genome Project and parallel pursuits funded by private enterprise, are changing the face of medicine. They have produced high-throughput DNA sequencing, gene mapping, and bioinformatics—fancy words for discovering what genes do. Scientists hope to identify the hundreds of thousands of genes that make up the genetic map by 2010.

The genetic variability that is so apparent in such features as height, skin and hair color, as well as temperament, extends to our health. Different genes alter susceptibility to disease, drug metabolism, and drug response. In other words, genes not only determine how we look, they also govern whether we will contract certain diseases, and how we will react to therapies. We do not yet understand even a small percentage of the total gene map and the Human Genome Project and private efforts will not answer all these questions. It may be a century before we know what all genes do and how they cooperate. But it goes without saying that the more research dollars devoted to this effort, the more expeditiously useful knowledge will reveal itself.
By inserting new or different genes into existing DNA strands, scientists can already correct or alter some genetic traits. They use a restriction enzyme as a sort of genetic scissors to cut a gene from a donor organism. Then they insert it into a viral DNA or plasmid (segment of DNA independent of chromosomes) that will carry it into the host cell. Scientists now use this recombinant DNA technology, as it is called, for the questionable purpose of attempting to create human diseases and human characteristics in lab animals. Instead we should be funding research that will allow the information to be used to cure human disease. It has the potential to correct birth defects and cancer susceptibility, in utero.

This research has already yielded insulin from humans instead of animals, decreasing the side effects of animal-derived insulin. (Many patients were unable to tolerate insulin injections or developed allergies to cow or pig proteins, after years of injecting it.) Vaccines, enzymes, antibody fragments, and growth hormones have also come from recombinant-DNA research. Using recombinant DNA in combination with microorganisms such as bacteria, instead of animal tissue, decreases the risk of side effects and cross-species contamination as has occurred with SV40 and the TSEs, the most notable being bovine spongiform encephalopathy or Mad Cow disease. It also allows a more pure medication, vaccine, or other product to be marketed.

Gene insertion or DNA insertion could replace the altered gene thus preventing the child from ever experiencing the birth defect. We could prevent the diseases affecting twenty million children.

Pharmacogenetics determines how genetic factors sway response to drugs. Pharmacogenomics is applied pharmacogenetics, a “gene-to-drug” strategy. It predicts a person’s response to a given drug before exposure to the drug. Though still in development, pharmacogenomics will be able to customize therapies to meet explicit genetic criteria, as described in more detail later.

John Bellenson of Pangea Systems Inc., says this about technology’s contribution to studies of the human genome:

Robotics, automated sequencing, and data compilation software have enabled the sequencing of thousands of genes and gene fragments... Making sense of this information, and understanding how these DNA sequences and sequence fragments correlate to specific genes and molecular targets has required the development of new analytic and visualization tools and the ability to think about biology in new ways.
“New ways,” as he describes them, are essentially more sensible ways. Watching the basic components of our human systems to see how they respond to medications and our environment makes sense. The old way—working exhaustively to give animals diseases that only vaguely resemble human diseases then trying to cure them—does not.

Dr. David Valle of Johns Hopkins University emphasized that the informational biology that is emerging from human systems analysis is synonymous with transferring the focus on treatment to a focus on prevention. “There’s no question that if you can find a way to prevent disease onset, you’re way ahead of the game.”

Diagnostic Imaging

Why should researchers plumb animals when state-of-the-art diagnostic imaging technology lets physicians peer into afflicted and non-inflicted patients without invasive dangers or discomforts? The most commonly used scanning tests are ultrasound, positron electron tomography (PET), computer tomography or computer-aided tomography (CT or CAT), and magnetic resonance imaging (MRI). A new imaging technique called the Fly-Through uses software to assemble slices of CAT or MRI imagery into a 3-D image of a patient’s interior. Physicians can use this to simulate the operation before touching the patient.

Postmarketing Drug Surveillance

After drugs make it through clinical trials and are approved, pharmaceutical companies release them to the public. Postmarketing drug surveillance (PMDS) is the reporting of any side effect of a medication after its release. Since no surveillance systems are presently required, and only infrequently do doctors volunteer to report side effects, it is impossible to keep comprehensive data on any given drug’s potential for negative reactions. Moreover, there is often confusion as to what caused a side effect. Without reporting systems and methods of analyzing input, the key postmarketing drug surveillance component is almost nonexistent.

Nevertheless, were PMDS in place, it could prevent many disasters. Thalidomide might have affected a few children, but not 10,000. The methodology would also increase the odds of finding new uses for old drugs. As you will read, many of the medications used today were intended for other illnesses. Only serendipity allowed us to discover their real potential.
Scientists have this to say regarding post marketing drug surveillance:

Another objective of PMDS is to discover beneficial drug effects (anticipated or unanticipated) after a drug has been marketed. Although it is not possible to systematize serendipitous discoveries, it is desirable to approach the discovery of new indications for drugs more systematically. For example, careful follow-up of published reports of new effects of marketed drugs . . . or the monitoring of trends in medical events (e.g., cardiovascular deaths) in our population may provide useful clues about unanticipated beneficial effects of drugs. This objective is by no means a trivial one, as many additional benefits of drugs have been discovered after the drugs have been approved for marketing. Such discovery is not only beneficial for populations having a disease treatable by the new use of the approved drug, but also represents an improvement in safety and economy in drug development, since many new uses may reduce the cost of development and simultaneously prevent unnecessary exposure of subjects to potentially toxic and/or ineffective experimental drugs.33

The sheer bulk of these viable alternatives knocks the legs out from under the animal experimentation community’s position, yet government, research institutions, and corporations continue to insist that animals are necessary to “validate” human findings. You will read throughout this book how ludicrous the insistence is. Scientists have gone on record supporting the fact that laboratory tests on animals “ . . . cannot provide reliable risk assessment.” and that, “ . . . for the great majority of disease entities, the animal models either do not exist or are really very poor.”34,35

Many of the causes of disease in humans cannot even be reproduced in animals. Even if animals could model the actual diseases exactly, which they cannot, the influence of human genetics, emotions, and lifestyle is essentially irreproducible.

In conclusion, it is becoming increasingly difficult to marginalize these outstanding alternative modalities, given their overwhelming superiority. Plus, scientists who recognize the inefficacy of extrapolating animal data to humans, as well as the efforts of biotech firms that wish to replace animals with their superior technologies, are making some inroads into change. As Stephen Sullivan, chairman of the board of biotechnology company Xenometrix, Inc., said,

I’m going to guess it could be ten or twenty years, but eventually, gene expression and protein expression testing will probably replace animal testing . . . It’s going to be an evolutionary process, not a revolutionary process.36

Many people and conventions thwart a rapid conversion of animal studies to these sophisticated alternatives. But it will happen. Why wait in the dark ages when the Star Trek sick bay is at hand?
And How to Test Their Safety

Animal tests conducted to establish the effect of medicaments for humans are nonsense.

—Dr. Herdeg, animal experimenter presenting at Conference on Laboratory Animals, Hanover, Germany, as quoted in 1,000 Doctors against Vivisection

The alternatives to animal experimentation are elegant. They are forward thinking. They save lives. But the public is still mired in the atavistic mindset that medicine will not progress without cages full of furry quadrupeds. They keep asking, “Where will medications come from if we do not test them on animals?” The truth is that new medications do not spring from lab rat to bottle.

Lab animals are only an unnecessary intermediary step between the design phase and clinical trials. Before the animal-testing stage, other factors suggest a given substance’s usefulness and deploy scientists to verify their hypothesis. Great new medications are not hiding in mouse urine or chimp spit. There are four tried and true methods for finding fresh drugs:

- Discover new substances from nature.
- Uncover a different curative value in an existing medication.
- Modify the chemical structure of a similar medication.
- Design a new medication from scratch: based on what you want the medication to do.

Once researchers have theorized about a substance’s usefulness and tested it in test tubes, they administer it to animals to see whether or not it works on them. They obtain plenty of feedback about its effectiveness in the species tested, and if it is positive they will find out about it in the media. Nevertheless, just because it cures mice does not mean it will do the same for humans. As demonstrated in previous chapters, this animal testing often works at cross-purposes to discovery.

From prehistory forward, humans have gathered information about human cures only from trying them out on humans. Everything we know about drugs relates back to this data. The truth is, even now with the prevalence of the animal-model, real developments always arise from a human-modeled foundation.
Natural Legacy

Prior to the 1900s, all medications resulted from astute observation and skillful application. Though certainly pharmaceutical development has accelerated enormously since the mid-nineteenth century—a pill for every ill—many, indeed most therapies have their foundation in curative ingredients passed from generation to generation throughout time. To say otherwise is deceptive. Of these, the following are but a few examples:

• Curare, a substance the Incas used to paralyze their prey, is now used to relax muscles during surgery. The drug is extracted from the wouali root.
• Vincreistine, an anticancer drug is derived from the rose periwinkle plant. It is a frequently used chemotherapeutic.
• Yohimbine, a medication used to reduce high blood pressure in humans came from the bark of the African Rubaceae tree. (Yohimbine is used for the opposite purpose in dogs, in which it increases blood pressure following certain types of anesthesia.)
• Digoxin is also a botanical extract, from the foxglove plant, digitalis. William Withering, an English physician interested in botany, heard of this folk-remedy for “dropsy” from his patients. Unlike many physicians, he listened. He found foxglove in 1775, extracted digitalis from the plant, and gave it to patients suffering from the condition. It worked. Today “dropsy” is known to be a symptom of heart failure, and is treated with the modern version of digitalis, digoxin. Doctors also prescribe the medication for irregular heartbeats. In 1995, Dr. James Mackenzie gave the drug to patients suffering from rapid heart rates. It improved their condition and has been used ever since. This was discovered clinically as well.
• Morphine is a potent painkiller extracted from poppy flowers.
• Quinine, a medication to treat malaria comes from cinchona bark. Serendipitously, a famous physician discovered that quinine, also derived from cinchona bark, could treat irregular heartbeats. In 1914, a patient of the now legendary Dr. K. F. Wenkebach was diagnosed with atrial fibrillation, which then had no treatment. The patient told the great doctor that he would just take care of it himself. The next day the patient returned, apparently cured. Wenkebach reportedly locked the door and told the patient that neither of them was leaving until the patient had explained how this miracle occurred. The patient was a businessman whose travel required him to take quinine for malaria protection. He had noticed that this sometimes helped his atrial fibrillation. Wenkebach took this information and published it. He noticed that quinine did, in fact, work, but not all the time. He, and others, therefore studied quinine, quinidine, and cinchonine and compared their ability to inhibit atrial fibrillation. Quinidine was the most effective and is still used today.
• Artemether, a new antimalarial medication, was derived from the Chinese shrub wormwood plant. Physicians use artemether to treat cerebral malaria and forms of malaria that are resistant to more commonly used medications for malaria such as quinine.  

• Atanine, a drug derived from the plant Evodia rutaecarpa, kills the parasite responsible for schistosomiasis, a debilitating disease.  

• Aspirin was first prescribed by Hippocrates, around 400 B.C.E., in the form of willow bark. In 1853, a German scientist refined the active ingredient from willow bark. Bayer began commercially producing aspirin on August 16, 1897, making it the first mass-produced drug. The most commonly used medication in the world, it owes nothing to animal experimentation.

Weighing the whole of modern pharmaceutical progress, it is impossible to disagree with the following assessment by Dr. Anthony Dayan of Wellcome Research Laboratories:

The weakness and intellectual poverty of a naive trust in animal tests may be shown in several ways, e.g. the humiliatingly large number of medicines discovered only by serendipitous observation in man (ranging from diuretics to antidepressants), or by astute analysis of deliberate or accidental poisoning, the notorious examples of valuable medicines which have seemingly “unacceptable” toxicity in animals, e.g. griseofulvin producing tumors and furosemide causing hepatic necrosis in mice, the stimulant action of morphine in cats, and such instances of unpredicted toxicity in man, such as the production of pulmonary hypertension by Aminex and SMON. The rapidly increasing interest in clinical pharmacology, and the drive to better means of measurements in man, also reflect the uncertainty of animal experimentation and realization that the study of man alone can ever prove entirely valid for other men.

Modifying Chance Cures

Consider what actually raises scientists’ awareness of a compound’s therapeutic potential for a particular condition. Look back over the history of drug development. Trace the antecedents of drugs like protease inhibitors. They were developed by rearranging chemical structures already known to produce specific effects. You will find that each has, at its origins, one aspect, and one aspect alone that directed recognition of the drugs’ applicability to specific purposes. That aspect is chance.
Some scientists take credit for discoveries which, in fact, were brought about by observing unexpected results. True, they had to notice the results and that demanded attentiveness, but the truth is they were just lucky. *Chance favors the prepared mind.* It is time that science and society stop crediting new drugs to animal experimentation and instead credit serendipity when appropriate.

We have already described what is possibly the most serendipitous occasion in medical history—the discovery of penicillin. Many other fortuitous discoveries, made without use of the animal model, or despite the use of the animal model, are described throughout this book. Examples are the use of nitrogen mustard, prednisone, and actinomycin D as cancer treatments, as noted in Chapter 8, Cancer, Our Modern-Day Plague. Potassium bromide was introduced as an epilepsy treatment when in 1853 it prevented a young woman from having further seizures. The bulk of curative compounds, accidentally discovered throughout history and acting as the foundation for present-day pharmaceutical development, is persuasive.

You have read how animal testing frequently attributes properties to compounds that ultimately prove incorrect when they reach the clinical trial phase. The effects that these compounds demonstrate during human testing sometimes suggest other uses. Or as one authority described,

Perhaps a look into the past can give a glimpse of the future. In this regard, the potential of serendipity cannot be overlooked when evaluating treatment strategies. Throughout the history of medicine, there are examples of significant advances coming about as a result of careful clinical monitoring of a drug that was supposed to do something but had an effect in an unpredicted direction.

Hence, humans now use the same drugs for entirely different purposes. Some are as follows:

- Catapres (Clonidine) is a drug originally intended to control headaches and sinus congestion. Allegedly, animal experiments suggested clonidine’s effectiveness for these symptoms, though this does beg the question, how does one know when a rat no longer has a headache? It was tested and FDA-approved as a headache remedy. In point of fact, clonidine proved more useful as an anti-hypertensive agent, a use discovered clinically by physicians. One unfortunate side effect of this drug is a withdrawal phenomenon. Patients must taper off the medication over a prolonged period of time, lest they suffer severe withdrawal symptoms. After the fact, scientists were unable to reproduce this withdrawal in rats, cats, or dogs. Ironically, physicians discovered that clonidine aids humans in withdrawing from other drugs, a purpose for which it is now routinely administered.
Another drug category, antidepressants, issued from clinical observation, not animal experimentation. Doctors administered iproniazid to tuberculosis patients to control secretions. The euphoria it caused suggested a new class of antidepressants. In 1983, N. Sitaram and E. S. Gershon noted iproniazid was effective in relieving depression in humans, and found that the drug induced hypothermia in mice. They conjectured that any other drug that could induce hypothermia in mice might also act as a human antidepressant. However, it turned out that this effect was unique to iproniazid. Iproniazid provided the basis for monoamine oxidase inhibitors. Another example of drugs conceived for other purposes are the tricyclic antidepressants originally developed as antipsychotics.

Antabuse developers designed the drug as an antiparasitic agent. They took it themselves, then had a cocktail and became violently nauseous. Antabuse is now used to discourage alcoholics from imbibing.

Non-steroidal anti-inflammatory drugs introduced as arthritis treatments are now used for dysmenorrhea, pain, and other orthopedic conditions.

Selective serotonin-reuptake inhibitors such as fluoxetine (Prozac) and sertraline (Zoloft), first prescribed for depression, are now used for bulimia, anxiety, obsessive-compulsive disorder, alcoholism and other psychiatric conditions.

Insulin has been found effective for lowering potassium as well as for treating diabetes.

Calcium channel blockers, introduced for treating angina, now help patients with high blood pressure, headaches, coronary vasospasm, and dysrhythmias.

Lidocaine is a commonly used medication for ventricular dysrhythmias. Its use was discovered accidentally during a heart catheterization. Another medication used for irregular heartbeats is phenytoin. It was originally designed for use in epilepsy and is still used for that. However, during clinical trials it affected the irregular heartbeats of some patients.

Beta-blockers were originally used for irregular heartbeats, and still are, but during clinical use scientists noticed that the medication lowers blood pressure and relieves angina and headaches.

Grapefruit has an enzyme-suppressing ingredient that, should it be added to certain drugs, will reduce the needed dose. This was discovered accidentally by a doctor with a preference for grapefruit juice.

These are but a few random examples. The point is this: Nature, experience, and human observation have always provided us with abundant direction. They continue to do so, and the directions benefit from all that modern biotechnology has to offer. This reservoir of indicators is more than sufficient, used in tandem with human-modeled assays, for drug development and testing. Any processes that employ nonhumans are senseless and dangerous.
As we have already pointed out in previous chapters, the inability to extrapolate data even between species of animals exaggerates this meaninglessness. A recent article in the *Journal of the Veterinary Medical Association* reinforced this with examples: the LD50 of digitoxin is 670 times greater in the rat than in the cat. The anticancer medication azauridine is tolerated by people but causes lethal bone marrow suppression in dogs. Serotonin raises blood pressure in dogs and people, but lowers it in cats. To examine other incongruities, how about diphenhydramine, marketed most commonly as Benadryl? Benadryl works well in humans and dogs, but at widely discrepant dosages. If humans take more than one-fourth the dose recommended for their Labrador retriever, they sleep for two days. The female mouse microsome metabolizes chloroform ten times slower than the male. Male mice are more susceptible to kidney damage from chloroform than are females.40 Mice, rabbits, and horses cannot vomit, while dogs and cats can. As the journal author concluded, “It is unwise to extrapolate information concerning drugs from one species to another.”41 And this from the journal *Bio/Technology* in 1992: “One fundamental deficiency of animal tissue is that it contains animal receptors—a boon in the development of drugs for rats, cats, and dogs but of dubious value in human health care.”42 (Emphasis added.) Since animals cannot predict the reactions of other animals to a drug, it is not surprising that they fail to predict human reactions.

No matter how exhaustive the animal testing, problems can still develop. Fenclozic acid, a potential new anti-inflammatory drug, showed no side effects in mice, rats, dogs, rhesus monkeys, patas monkeys, rabbits, guinea pigs, ferrets, cats, pigs, cows, or horses. But the drug caused acute choledastic jaundice, a type of liver failure, in humans.43 Tragedies like these happen all the time.

Animal models for human reactions to medications simply do not exist. A renowned pharmacologist, Dr. B. B. Brodie, while accepting a prize for pharmacology, said this to a room full of scientists who make their living testing drugs for toxicity on animals, it is “a matter of pure luck that animal experiments lead to clinically useful drugs.”44 Relying on luck to prove efficacy is neither scientific nor safe.

Non-animal methods are not comprehensive, but they certainly offer more security than animal tests. And eliminating animal tests would free up funds for more comprehensive non-animal methods.

One important point glossed over by the animal-experimentation lobby is this: new medications must still go through clinical trials prior to being released to the public. This stage alone has the potential to predict adverse reactions accurately. Unfortunately, clinical trials are usually way too brief, both in scope and duration.