Start with a Story

The Case Study Method of Teaching College Science

Edited by Clyde Freeman Herreid

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Arlington, Virginia

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09 08 07 4 3 2 1

Library of Congress Cataloging-in-Publication Data
Herreid, Clyde Freeman.
Start with a story: the case study method of teaching college science / by Clyde Freeman Herreid.
p. cm.
ISBN-13: 978-1-933531-06-9
1. Science--Study and teaching (Higher)--United States. 2. Science--Study and teaching--Case studies.
3. Teachers--Training of--Case studies. I. Title.
Q183.3.A1H44 2006
507.1'173--dc22
2006027392

This material is based upon work supported by NSF under Grants #0341279, #0618570, and #9752799 and a Higher Education Reform Grant from The Pew Charitable Trusts. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and editor and do not necessarily reflect the views of NSF or The Pew Charitable Trusts.

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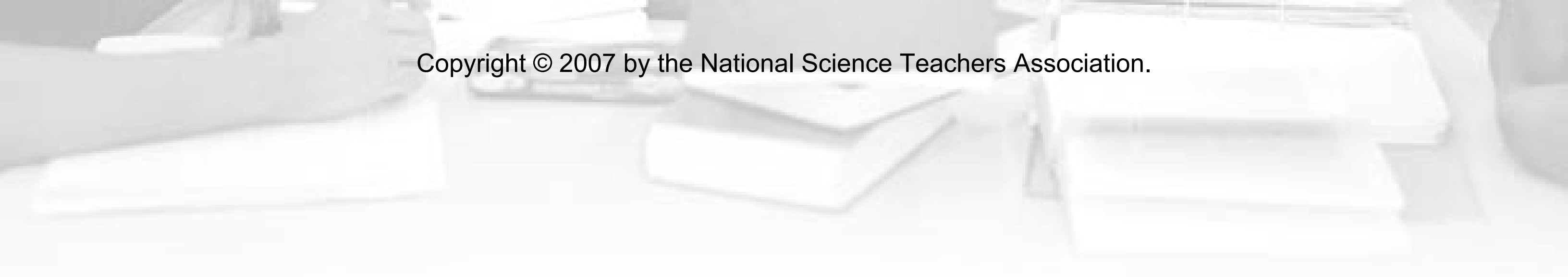

Foreword

Clyde (Kipp) Herreid's work in creating and compiling case studies for undergraduate science instruction and developing case methods previously reserved mainly for law and medical students stands as a major contribution to undergraduate science instruction, fulfilling the vision we had when we invited him to write a regular column on case instruction for the Journal of College Science Teaching more than a decade ago. The quality of those columns was so high and their content often so innovative that we soon invited him to prepare an extra annual issue devoted exclusively to case instruction.

For many of us who had experienced much of our science preparation through lectures, the cases presented in Kipp's columns were often exciting to read because they gave us a new methodology that clearly had the potential to enrich our own teaching. Instead of only helping students master material in a text, we had to think about the case problem and ways to approach it. In addition, these cases were interesting enough that we would read cases in disciplines other than our own, often finding issues and connections requiring cross-disciplinary approaches. Cases provide ample opportunity for students to think creatively. They can be used as stand-alone activities or in combination with texts and journal articles. Used thoughtfully, they can help instructors convey a sense of scientific inquiry that more traditional approaches might find difficult to match.

Watching Kipp leading NSF Chautauqua short courses on the case method for college faculty was always illuminating because of the way he involved participants, It is not easy to sustain any group's interest during three solid days of instruction, to say nothing of the challenge of motivating experienced instructors, but by using cases, Kipp was able to do so with aplomb. He made it look easy, but he is a master teacher with many years of experience. Now, this special volume will enable us to have at our fingertips Kipp's thoughtful analyses of ways to use cases in many classroom settings. This fine collection deserves a place on the book shelf of all those who want to enrich their own teaching and should surely be standard issue for new faculty and graduate teaching assistants. Our community of teaching scientists has a rare resource here and we have Kipp Herreid, his colleagues at the National Center for Case Study Teaching in Science and the other contributors to this volume to thank for it.

Les Paldy, Editor Emeritus, Journal of College Science Teaching , Distinguished Service Professor, Stony Brook Univesity, State University of New York

INTRODUCTION

I first heard about case study teaching from a neighbor—a lawyer who had taught at Cornell University and had been trained at Harvard. He and I were standing in the middle of our country road talking about teaching and education, as it was in the first few hours of our acquaintance. I asked him how he taught law. He paused and then said the magic words, "I use case studies."

He explained that lawyers used real cases in their classrooms to teach the principles of law and precedence. They discussed this with their students, teaching law as they used case after case. They had been doing this for a hundred years.

I had been searching for new ways of teaching for a long time. The lecture method had paled for me over time. I didn't know it then, but well over a thousand studies had demonstrated the inferiority of the lecture method compared to active learning strategies. I had started out my teaching career like so many young PhDs without a shred of training and was thrown into the classroom and told to "teach." So, I taught like my mentors—I lectured. As I suffered through my first year's teaching, racing through my lectures, pouring out all of the information that I had gleaned the night before, scrambling to keep ahead of the students, never once did it occur to me that there were other ways to teach. True, I had heard strange rumblings that other methods were being used on the other side of campus. There were rumors that people in "the humanities" actually used something called DISCUSSION. Now here was my neighbor talking about it again.

To be truthful, I had tried holding a discussion with students in my class from time to time with notable failure. Without warning, in the middle of my physiology lectures, I tried asking a few questions in moments of heroic chutzpa, but to no avail. I would ask questions like "What is the simple abbreviation for sodium?" Not a single eye met my inquiring gaze. None of the students dared look at me for fear that their gaze might be misinterpreted as being willing to speak. Pleading for an answer was beneath me, so like so many teachers before me, I started lecturing again. Only later, did I realize that even if someone had answered my sodium question, this would hardly lead to a discussion. But, my quest for different teaching methods was not to be stopped. I could not get over the fact that I, like so many of my colleagues, was giving a large percentage of F, D, and Withdrawal grades in my introductory science classes, 40% to be exact. This hardly seemed like success.

Years later, I ran into a paper discussing an experiment at Arizona State University. The chemistry department was teaching large numbers of introductory students. They had several sections of the course taught by faculty of different abilities. All of the sections had a common exam. When they compared the grades of the students in the different sections, they found to their surprise that there were no differences among the different sections regardless of the teaching reputation of the instructors! Physics teacher Richard Hake reported similar findings in his survey of 6,000 students taking introductory physics: The skill of the lecturer did not appear to make much difference in the student performance on tests. With these results, you can see why I might look for an alternate approach to teaching.

In my quest for the perfect method, I ran into work by Professor James Conant, a chemist at Harvard, who was President Franklin Delano Roosevelt's science adviser during World War II. He returned from his experience convinced that the public did not understand the way science worked and vowed to change his teaching at Harvard as a result. He created a science course using case studies. This was a lecture course where Conant explored the discovery of great principles, such as the second law of thermodynamics. Over a series of lectures he traced the development of the idea as it came to fruition through fits and spurts, good and bad science. The course apparently did not survive him, although his lectures did make it into print.

Then I heard about McMaster University's medical school, in Ontario, Canada. They, too, were using a case study approach to teaching. But no lectures at all! They based their entire curriculum around cases using a method called Problem-Based Learning. They put all of their students in small groups of, say, a dozen students with a faculty facilitator. Students were given a patient's history and asked to diagnose the problem. When this was complete they received another case. And so it went—case after case, small groups learning the subject on a need-to-know basis, receiving the problem in sections.

So, here was my dilemma: In three different situations I had found people using the term *case study teaching*. All were enthusiastic. Yet, plainly they were doing very different things in the classroom: law professors were leading discussions; Conant was lecturing; and the medical professors were using small groups. The conclusion was obvious: The definition of case studies could not depend upon the method of instruction.

So what was the essence of case studies? I decided to make it simple. "Case studies are stories with an educational message." That's it. The moment that I realized this, I was suddenly free to create stories with different formats for different purposes. Moreover, when I started running workshops, many faculty who only knew of the Harvard discussion model and were dreadfully afraid of it suddenly saw that there were other excellent methods that they could capitalize on the use of stories.

What's the magic of stories? People love stories. Stories put learning into context. Lectures often don't do this. They are abstract with mountains of facts. Sheila Tobias, in her book *They're Not Dumb, They're Different*, described the disagreeable nature of the lecture method. She pointed out that science majors are much more tolerant of the dull recitation of facts than non-majors. Even the redoubtable Richard Feynman spoke of his frustration with science education in the preface to his *Lectures in Physics* saying, "I think the system is a failure." He summarized, "The best teaching can be done only when there is a direct individual relationship between a student and a good teacher—a situation in which the student discusses the ideas, thinks about the things, and talks about the things. It is impossible to learn very much simply by sitting in lecture."

Clearly, I agree. And several granting agencies have been willing to give me a chance to find out if the method(s) can be used to teach basic science. For this I thank them most gratefully: The U.S. Department of Education Fund for the Improvement of Postsecondary Education; The Pew Charitable Trusts; and the National Science Foundation. In addition, I thank my colleagues who have helped develop many of the ideas that form many of the essays in this collection, especially my Co-PI on several of these grants: Nancy Schiller.

Together, we have been able to establish the National Center for Case Study Teaching in Science *(http://ublib.buffalo.edu/libraries/projects/cases/case.html)*. This center puts on workshops and conferences where we extol the virtues of case study teaching to thousands of faculty over the years. Its website has hundreds of cases and teaching notes written by faculty across the world and has thousands of visitors each day. This is truly amazing to me and is a remarkable testimony to the fact that faculty are finally trying out different teaching methods. The case study method has come of age.

In this book I have gathered together many of the columns that I have written for the *Journal of College Science Teaching* over the years. Les Paldy, longtime editor of the journal, was kind enough to ask me to start publishing these essays a dozen years ago and indeed it was he who suggested that I put this collection together so that readers could more readily access the articles. This book is the result. I have not attempted to modify the essays themselves. They stand as they were written. As a consequence, there is some redundancy and perhaps some gaps. I have attempted to smooth over the bumps by writing commentary along the way. Also, I have asked several of my colleagues to contribute to this book by including their essays that deal with important aspects of the case study approach. Hopefully, readers will find the essays useful.

It seems fitting to put case study teaching into a larger context. There is no one better able to do this than the late Carl Sagan, whose work in astronomy and relentless search for ways to engage the public resulted in outstanding books and a television special, *Cosmos*. In his last public appearance reported in the *Skepical Inquirer* (29: 29–37, 2005), knowing he was dying of cancer, he was asked a question: "Do you have any thought on what path might be taken to remedy [the bad name of science]?"

Sagan replied,

"I think one, perhaps, is to present science as it is, as something dazzling, as something tremendously exciting, as something eliciting feelings of reverence and awe, as something that our lives depend upon. If it isn't presented that way, if it's presented in very dull textbook fashion, then of course people will be turned off. If the chemistry teacher is the basketball coach, if the school boards are unable to get support for the new bond issue, if teachers' salaries, especially in the sciences, are very low, if very little is demanded of our students in terms of homework and original class time, if virtually every newspaper in the country has a daily astrology column and hardly any of them has a weekly science column, if the Sunday morning pundit shows never discuss science, if every one of the commercial television networks has somebody designated as science reporter but he (it's always a he) never presents any science (it's all technology and medicine), if an intelligent remark on science never has been uttered in living memory by a president of the United States, if in all of television there are no action-adventure series in which the hero or heroine is someone devoted to finding out how the universe works, if spiffy jackets attractive to the opposite sex are given to students who do well in football, basketball, and baseball but none are given in chemistry, physics, and mathematics, if we do all of that, then it is not surprising that a lot of people come out of the American educational system turned off, or having never experienced science."

Sagan has set us a lofty goal. Case study teaching is a step in the right direction.

Chapter 3

Saint Anthony and the Chicken Poop

An Essay on the Power of Storytelling in the Teaching of Science

By Clyde Freeman Herreid

A 16th-century painting of the Virgin Mary with St. Anthony of Padua (left) and St. Roch. St. Anthony, the subject of this chapter's "Case Study," is known in the Catholic Church as the "finder of lost objects."

The Garden of Eden must have been in northern New Mexico. In early Christian iconography Adam and Eve were always depicted buck-naked: no fig leaves. As anyone knows, there are no fig leaves in New Mexico—and in fact, covering one's private parts with pine needles is painful to even contemplate—hence, the nudity of the first couple is easy to explain.

They lived in northern New Mexico, and Bethlehem is a little south of Albuquerque. With that insight, tongue in cheek, anthropologist Charles Carrillo began his New Year's lecture in Santa Fe.

On two occasions in my life I have heard lectures that were completely structured around a series of stories. Only two! That's quite remarkable when you consider I have lived long enough to hear literally thousands of lectures.

The first occasion was shortly after the collapse of the Soviet Union, and the country had opened its doors to tourists. There, on a ship floating down the Volga River, I heard a lecture from a Russian government tour guide who told us about her country through a series of stories. She believed she could best capture the spirit and essence of her homeland with tales from the past. I was not only captivated by her stories, but also intrigued by the method of conveying information. I have often reflected upon this approach to teaching.

The second occasion was right after New Year's. I happened to be in Santa Fe, New Mexico, at a luncheon meeting. The speaker for the day was an anthropologist, Charles Carrillo. Although he had earned his PhD at the University of New Mexico, he was making his living as a santero, carving and painting icons of Christian saints.

As a Hispanic who could trace his ancestry back to the arrival of the Spanish conquistadors, he had long been impressed with the fact that anthropologists had oft analyzed Indian pottery, but the Hispanic ceramic tradition had been virtually neglected. This was a source of distress to him and ultimately led to his dissertation and the inspiration for his life as a santero. His lecture was about three unassuming pots—a bean pot, a coffee mug, and a tiny cosmetic pot. But before that he had to tell us about St. Anthony and the chicken poop.

Holding a small statuette of St. Anthony of Padua, Carrillo told us that he had discovered it was made by a santero in the early 1800s. Although apparently carved of wood, he had discovered using x-rays that only the core of the statue was made of wood and that layers of gypsum had been applied on top of the wood to build up the features of the saint. This discovery was to serve as part of his PhD thesis.

To his sorrow, the statue was missing a tiny figurine of the baby Jesus, who traditionally was held in the arms of the saint. Carrillo related how he had discovered a solitary Christ child figurine in an antique shop in California. There, lying in a forgotten corner of a doll collection, was the baby Jesus. Careful examination revealed it had come from the same santero's workshop where his St. Anthony had been crafted. It looked like a perfect fit. Perhaps it was not the missing Jesus, but it made a nice story and became another part of his thesis.

I doubt that the chicken poop story got into his thesis. Carrillo told us that Hispanic homes invariably had saint statuettes. St. Anthony was clearly his favorite for familial reasons, if no other. His grandmother revered St. Anthony because he had figured significantly in her life.

Chili peppers are a staple of every meal in Hispanic households. Even during the Thanksgiving dinner, turkey, cranberries and pumpkin pie are garnished with green and red chilies. Many Hispanic families of New Mexico raise their own crop of garden chilies. The best are raised with a rich mixture of manure.

The recipe in Grandmother Carrillo's time consisted of mixing a pail of chicken poop with an equal amount of cow dung and adding to that a bit of water to make a slurry. Then dried seeds of chili peppers were added. The housewife would take the concoction and, stepping through the garden, poke a hole in the ground. With three fingers she would reach into the mixture to obtain a pinch of seeds and manure.

One year as Grandma was following the ancient tradition, stooping to the earth and depositing the seed and manure mixture one step at a time, she discovered that a terrible thing had happened. She had lost her wedding ring! Somewhere in the garden the ring had slipped from her finger.

What to do? Like any God-fearing woman of the 1930s, Grandma went back to the house for her St. Anthony. Returning to the garden with the statuette in hand she implored St. Anthony to find the ring. This petition was totally appropriate, for the Roman Catholic Church depicts St. Anthony as "a finder of lost objects" and reveres him as a patron saint of miracles. Grandma Carrillo needed a miracle for sure. She placed St. Anthony in a hole in a nearby tree overlooking the garden, admonishing him that he would not gain reentrance to the house until the ring was recovered.

There St. Anthony stayed day after day. But this year the usual dry conditions familiar to residents of the Southwest didn't come to pass. No, this was the best growing season in memory. The rains came frequently. The chilies grew profusely. With each rain not only was the soil moistened but also water dripped steadily on St. Anthony's head, wearing away his plaster countenance.

One day, as Grandma was tending the garden, she looked in on St. Anthony. She discovered to her dismay that the water had worn away his head. Realizing the futility of leaving St. Anthony to suffer further climatic indignities, she retrieved the statuette from the tree. After all, St. Anthony no longer had eyes to search for the ring, and "What good is a man without a brain, anyway?" she reasoned.

As she lifted St. Anthony from the tree she got the surprise of her life: There, sticking to the bottom of the statuette's feet, was her ring. St. Anthony had indeed produced the demanded miracle! Thanks be to God. A family legend was born, one that would be told for generations of Carrillos.

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What good are such stories of pots and saints?

Carrillo answered it this way: Stories are a way to connect to the past—to hold on to the memories of who we were and are. He encouraged his audience to "Go home and write about yourselves, not just your genealogy, but your personal history and where you come from."

I have often been struck with how little scientists care about history. It is today that matters. Indeed, researchers' publications seldom note a reference more than 10 years old. This same temporal provincialism exists in Americans collectively, for we seldom know or care much about our ancestors prior to Grandpa or Grandma. Surely, there is more to know. After all, our lineage stretches back over 3.5 billion years.

Scientists are as fond of stories as the next person. Experimentalists tell them all the time, though their stories are stilted tales of lab and field studies in journal articles of research. Those are still stories. Astronomers, paleontologists, and evolutionary biologists spin grand Homeric tales of the universe and Earth. Yet, in spite of our obvious concern that "history matters," we seldom convey this connection to our students. Where are the stargazers, the lab workers, the diggers of fossils in our classroom lectures? A Charles Darwin or Richard Feynman gets a pat on the head, but the rest of our "artwork" is unsigned.

It is often said that the field of science is impersonal and objective. That is its strength, we are told. We scientists are out to seek and reveal "truth," which is independent of the observers. This has led to the god-awful writing style that has permeated our journals for decades where the use of the personal pronoun "I" is shunned and the use of the passive voice praised. We scientists are to remain in the background, above the fray—as mere observers and recorders, scientific voyeurs; peeping toms, prying out nature's secrets.

As teachers, we scientists are supposed to just deliver "the facts, ma'am, just the facts" (as Joe Friday in TV's *Dragnet* was fond of saying). As a result, we have sucked the life out of science, as a student of mine recently said to me about a professor who was teaching ecology. I wouldn't have believed it possible to do that to ecology—a field filled with wonderful tales of adventurous discoveries. But it happened because the teacher filled each lecture with nonstop equations, modeling this and that. What a shame. Now this may appeal to some types of learners, but certainly not to most. I have nothing against equations and models.

I can appreciate the argument that it is a sign of maturity when a field of science can express its principles mathematically (even though, as is in the case of ecology, most of these heuristic models have little empirical basis). But to have reduced the personas of the lynx and the snowshoe hare to nothing more than squiggles on graph paper or symbols in a Lotka-Volterra equation is indeed sucking the life out of the field.

Storytelling even in the field of science is not entirely dead. Jane Goodall and other notable field biologists (many of whom are women) studying animal behavior have chosen to present many of their findings in narrative form. The life in their science is still there—vibrant and alive. We do still see the scientist as a human being even as we can see the abstract architecture of their science. Compelling stories do that for us.

Donald McCloskey, professor of economics and history at the University of Iowa, made some interesting comments in an essay in the February 1995 issue of *Scientific American*. Economics has trod its own path away from the narrative style of Adam Smith to become extraordinarily mathematical and abstract. He pointed out that "the notion of 'science' as divorced from storytelling arose largely during the last century. Before then the word—like its French, Tamil, Turkish, and Japanese counterparts—meant 'systematic inquiry.' The German word for the humanities is *Geistewissenschaft,* or 'inquiry into the human spirit,' as opposed to *Naturwissenschaft,"* which is our inquiry into nature.

McCloskey goes on:

> Most sciences do storytelling and model building. At one end of the gamut sits Newtonian physics—the *Principia* (1687) is essentially geometric rather than narrative. Charles Darwin's biology in the *Origin of Species* (1859), in contrast, is almost entirely historical and devoid of mathematical models. Nevertheless, most scientists and economists among them hate to admit to something so childish-sounding as telling stories. They want to emulate Newton's elegance rather than Darwin's complexity. One suspects that the relative prestige of the two methods has more to do with age than anything else. If a proto-Darwin had published in 1687, and a neo-Newton in 1859, you can bet the prestige of storytelling versus timeless modeling would be reversed.

Storytelling in science is largely verboten. We seldom hear of the passion, emotion, or personal matters of a Newton, Einstein, Lavoisier, Lyell, or Pasteur—such things are regarded as asides or diversions from truth, the grand structure of the universe that exists separate from the observer. So, many students sit in class waiting for the suffering to be over, or they change majors to other more human-centered fields where the subjective, the individual, matters.

Some years ago, I read about someone who was asked what one thing he would most like to keep in his possession if he had to fly off to another planet to start another civilization—a copy of Newton's *Principia*, Darwin's *Origin of Species*, Einstein's papers on relativity, or Shakespeare's plays. He answered, Shakespeare's plays. All of the other works could be regenerated. They were objective. Other scientists would duplicate them. Only Shakespeare's plays were unique and personal.

Even if we accept that science is objective, must we suck the life out of our teaching by neglecting our roots? James Conant, chemist, science adviser to President Franklin Roosevelt, and eventually president of Harvard University, thought we must not. He responded by pioneering the use of storytelling case studies within the lecture method framework. He built an entire course around this approach that he described in his book, *The Growth of the Experimental Sciences* (1949).

Case study teaching, whether it is done via the lecture method, the discussion method, or small group Problem-Based Learning method, puts a human face on science. It is not that case teachers deny the ultimate reality of the universe or refuse to accept that the universe will some day be described by a set of mathematical models. But the case study approach using stories gives us a context within which to learn.

Not only are stories captivating, they make it easier to learn and recall facts, figures, and yes, equations. Moreover, stories tell us who we are as a people—the problems we face, the values we cherish, the barriers we must surmount, whether personal or societal. They help tie us with an umbilical cord of DNA to our heritage—to those who have gone before us and to those who struggle in today's world in ways we would not otherwise know.

So what value are pots and saints? They represent the mundane and spiritual. They can put the life back into teaching, where it was sucked dry before.

Chapter 16

Bad Blood

A Case Study of the Tuskegee Syphilis Project

By Ann W. Fourtner, Charles R. Fourtner, and Clyde Freeman Herreid

Syphilis is a venereal disease spread during sexual intercourse. It can also be passed from mother to child during pregnancy. It is caused by a corkscrew-shaped bacterium called a spirochete, *Treponema pallidum*. This microscopic organism resides in many organs of the body but causes sores or ulcers (called chancres) to appear on the skin of the penis, vagina, mouth, and occasionally in the rectum, or on the tongue, lips, or breast. During sex the bacteria leave the sores of one person and enter the moist membranes of their partner's penis, vagina, mouth, or rectum.

Once the spirochetes wiggle inside a victim, they begin to multiply at an amazing rate. (Some bacteria have a doubling rate of 30 minutes. You may want to consider how many bacteria you might have in 12 hours if one bacterium entered your body, doubling at that rate.) The spirochetes then enter the lymph circulation that carries them to nearby lymph glands, which may swell in response to the infection.

This first stage of the disease (called primary syphilis) lasts only a few weeks and usually causes hard red sores or ulcers to develop on the genitals of the victim who can then pass the disease on to the someone else. During this primary stage, a blood test will not reveal the presence of the disease, but the bacteria can be scraped from the sores. The sores soon heal and some people may recover entirely without treatment.

Secondary syphilis develops two-to-six weeks after the sores heal. Then flulike symptoms appear with fever, headache, eye inflammation, malaise, joint pain, a skin rash, and mouth and genital sores. These symptoms are a clear sign that the spirochetes have travelled throughout the body by way of the lymph and blood systems where they now can be readily detected by a blood test (for example, the Wassermann test). Scalp hair may drop out to give a "moth-eaten" type of look to the head. This secondary stage ends in a few weeks as the sores heal.

Signs of the disease may never reappear even though the bacteria continue to live in the person. But in about 25% of those originally infected, symptoms will flare up again in late or tertiary stage syphilis.

Almost any organ can be attacked, such as the cardiovascular system, producing leaking heart valves and aneurysms, balloon-like bulges in the aorta which may burst leading to instant death. Gummy or rubbery tumors filled with spirochetes may develop on the skin covered by a dried crust of pus. The bones may deteriorate, as in osteomyelitis or tuberculosis, and may produce disfiguring facial mutilations as nasal and palate bones are eaten away. If the nervous system is infected, a stumbling, foot-slapping gait may occur or, more severely, paralysis, senility, blindness, and insanity.

The Health Program

The cause of syphilis, the stages of the disease's development, and the complications that can result from untreated syphilis were all known to medical science in the early 1900s. In 1905, German scientists Hoffman and Schaudinn isolated the bacterium that causes syphilis. In 1907, the Wassermann blood test was developed, enabling physicians to diagnose the disease. Three years later, German scientist Paul Ehrlich created an arsenic compound called salvarsan to treat syphilis. Together with mercury, it was either injected or rubbed onto the skin and often produced serious and occasionally fatal reactions in patients. Treatment was painful and usually required more than a year to complete.

In 1908, Congress established the Division of Venereal Diseases in the U.S. Public Health Service. Within a year, 44 states had organized separate bureaus for venereal disease control. Unfortunately, free treatment clinics operated only in urban areas for many years. Data, collected in a survey begun in 1926 of 25 communities across the United States, indicated that the incidence of syphilis among patients under observation was "4.05 cases per 1,000 population, the rate for whites being 4 per 1,000, and that for Negroes 7.2 per 1,000."

In 1929, Dr. Hugh S. Cumming, the Surgeon General of the U.S. Public Health Service (PHS), asked the Julius Rosenwald Fund for financial support to study the control of venereal disease in the rural South. The Rosenwald Fund was a philanthropic organization that played a key role in promoting the welfare of African Americans. The fund agreed to help the U.S. PHS in developing health programs for southern African Americans.

One of the fund's major goals was to encourage their grantees to use black personnel whenever possible as a means to promote professional integration. Thus, the mission of the fund seemed to fit well with the plans of the PHS. Macon County, Alabama, was selected as one of five syphilis-control demonstration programs in February 1930. The local Tuskegee Institute endorsed the program. The institute and its John A. Andrew Memorial Hospital were staffed and administered entirely by African American physicians and nurses. "The demonstrations would provide training for private physicians, white and colored, in the elements of venereal disease treatments and the more extensive distribution of antisyphilitic drugs and the promotion of wider use of state diagnostic laboratory facilities."

In 1930, Macon County had 27,000 residents, 82% African American, most living in rural poverty in a shack with a dirt floor, with no plumbing and poor sanitation. This was the target population, people who "had never in their lives been treated by a doctor." Public health officials arriving on the scene announced they had come to test people for "bad blood." The term included a host of maladies and later surveys suggest that few people connected that term with syphilis.

The syphilis control study in Macon County turned up the alarming news that 36% of the African American population had syphilis. The medical director of the Rosenwald Fund was concerned about the racial implications of the findings, saying, "There is bound to be danger that the impression will be given that syphilis in the South is a Negro problem rather than one of both races." The PHS officer assured the fund and the Tuskegee Institute that demonstrations would not be used to attack the images of black Americans. He argued that the high syphilis rates were not due to "inherent racial susceptibility" but could be explained by "differences in their respective social and economic status." However, the PHS failed to persuade the fund that more work could break the cycle of poverty and disease in Macon County. So when the PHS officers suggested a larger scale extension of the work, the Rosenwald Fund trustees voted against the new project.

Building on what had been learned during the Rosenwald Fund demonstrations and the four other sites, the PHS covered the nation with the Wassermann tests. Both blacks and whites were reached with extensive testing, and in some areas mobile treatment clinics were available.

The Experiment

As the PHS officers analyzed the data for the final Rosenwald Fund report in September of 1932, and realizing that funding for the project would be discontinued, the idea for a new study evolved into the Tuskegee Study of Untreated Syphilis in the Negro Male. They would convert the original treatment program into a nontherapeutic human experiment aimed at compiling data on the progression of the disease on untreated African American males.

The precedent existed for such a study. One had been conducted in Oslo, Norway, at the turn of the century on a population of white males and females. An impressive amount of information had been gathered from these patients concerning the progression of the disease. However, questions of manifestation and progression of syphilis in individuals of African descent had not been studied. In light of the discovery that African natives had some rather unique diseases (for example, sickle cell anemia—a disease of red blood cells), a study of African males could reveal biological differences during the course of syphilis. (Later, the argument that supported continuation of the study may even have been reinforced in the early 1950s when it was suggested that native Africans with the sickle cell trait were less susceptible to the ravages of malaria.)

In fact, Dr. Joseph Earle Moore of the Venereal Disease Clinic of the Johns Hopkins University School of Medicine stated when consulted, "Syphilis in the negro is in many respects almost a different disease from syphilis in the white." The PHS doctors felt that this study would emphasize and delineate these differences. Moreover, whereas the Oslo study was retrospective (looking back at old cases), the Macon Study would be a better prospective study, following the progress of the disease through time.

It was estimated that of the 1,400 patients in Macon County admitted to treatment under the Rosenwald Fund, not one had received the full course of medication prescribed as standard therapy for syphilis. The PHS officials decided that these men could be considered untreated because they had not received enough treatment to cure them. In the county, there was a well-equipped teaching hospital (John A. Andrew Memorial Hospital at the Tuskegee Institute) that could be used for scientific purposes.

Over the next months in 1932, cooperation was ensured from the Alabama State Board of Health, the Macon County Health Department, and the Tuskegee Institute. However, Dr. J. N. Baker, the state health officer, received one important concession in exchange for his approval. Everyone found to have syphilis would have to be treated. Although this would not cure them—the nine-month study was too short—it would keep them noninfectious. Dr. Baker also argued for the involvement of local physicians.

Dr. Raymond Vonderlehr was chosen for the fieldwork that began in October 1932. Dr. Vonderlehr began his work in Alabama by spreading the word that a new syphilis control demonstration was beginning and that government doctors were giving free blood tests. Black people came to schoolhouses and churches for examination—most had never before seen a doctor. Several hundred men over 25 years old were identified as Wassermann-positive who had not been treated for "bad blood" and had been infected for over five years. Cardiovascular problems seemed particularly evident in this population in the early days, reaffirming that blacks might be different in their response. But nervous system involvement was not evident.

As Dr. Vonderlehr approached the end of his few months of study, he suggested to his superior, Dr. Clark, that the work continue for 5–10 years because "many interesting facts could be learned regarding the course and complications of untreated syphilis." Dr. Clark retired a few months later and in June 1933 Dr. Vonderlehr was promoted to director of the Division of Venereal Diseases of the PHS.

This promotion began a bureaucratic pattern over the next four decades that saw the position of director go to a physician who had worked on the Tuskegee Study. Dr. Vonderlehr spent much of the summer of 1933 working out the study's logistics that would enable the PHS to follow the men's health through their lifetime. This included gaining permission from the men and their families to perform an autopsy at the time of their death that would give the scientific community a detailed microscopic description of the diseased organs.

Neither the syphilitics nor the controls (those men free of syphilis, who were added to the project) were informed as to the study's true objective. These men knew only that they were receiving treatment for "bad blood" and money for burial. Burial stipends began in 1935, funded by the Milbank Memorial Fund.

The skill of the African American nurse, Eunice Rivers, and the cooperation of the local health providers (most of them white males), were essential in this project. They understood the project details and the fact that the patients' available medical care (other than valid treatment for syphilis) was far better than that for most African Americans in Macon County. The local draft board agreed to exclude the men in the study from medical treatment when that became an issue during the early 1940s. State health officials also cooperated.

The study was not kept secret from the national medical community. Dr. Vonderlehr in 1933 contacted a large number of experts in the field of venereal disease and related medical complications. Most responded with support for the study. The American Heart Association asked for clarification of the scientific validity, then subsequently expressed great doubt and criticism concerning the tests and procedures. Dr. Vonderlehr remained convinced that the study was valid and would prove that syphilis affected African Americans differently than those of European descent. As director of the PHS Venereal Disease Division, he controlled the funds necessary to conduct the study, as did his successors.

Key to the cooperation of the men in the Tuskegee study was the African American PHS nurse assigned to monitor them. She quickly gained their trust. She dealt with their problems. The physicians came to respect her ability to deal with the men. She not only attempted to keep the men in the study, she many times prevented them from receiving medical care from the PHS treatment clinics offering neoarsphenamine and bismuth (the treatment for syphilis) during the late 1930s and early 1940s. She never advocated treating the men. She knew these treatment drugs had side effects. As a nurse, she had been trained to follow doctor's orders. By the time penicillin became available for the treatment of syphilis, not treating these men had become a routine that she did not question. She truly felt that these men were better off because of the routine medical examinations, distribution of aspirin pink pills that relieved aches and pains, and personal nursing care. She never thought of the men as victims. She was aware of the Oslo study. "This is the way I saw it: that they were studying the Negro just like they were studying the white man, see, making a comparison." She retired from active nursing in 1965, but assisted during the annual checkups until the experiment ended.

By 1943, when the Division of Venereal Diseases began treating syphilitic patients nationwide with penicillin, the Tuskegee study men were not considered patients. They were viewed as experimental subjects and were denied antibiotic treatment. The PHS officials insisted that the study offered even more of an opportunity to study these men as a "control against which to project not only the results obtained with the rapid schedules of therapy for syphilis but also the costs involved in finding and placing under treatment the infected individuals." There is no evidence that the study had ever been discussed in the light of the Nuremberg Code, a set of 10 ethical principles for human experimentation developed during the trials of Nazi physicians in the aftermath of World War II. Again the study had become routine.

In 1951, Dr. Trygve Gjustland, then the current director of the Oslo study, joined the Tuskegee group to review the experiment. He offered suggestions on updating records and reviewing criteria. No one questioned the issue of contamination (men with partial treatment) or ethics. In 1952, the study began to focus on the study of aging, as well as heart disease, because of the long-term data that had been accumulated on the men. It became clear that syphilis generally shortened the lifespan of its victims and that the tissue damage began while the young men were in the second stage of the disease (see Tables 1–3).

In June 1965, Dr. Irwin J. Schatz became the first medical professional to object to the study. He suggested a need for PHS to reevaluate its moral judgments. The PHS did not respond to his letter. In November 1966 Peter Buxtin, a PHS venereal disease interviewer and investigator, expressed his moral concerns about the study. He continued to question the study within the PHS network.

In February 1969, the PHS called together a blue ribbon panel to discuss the Tuskegee study. The participants were all physicians. Not one had training in medical ethics. None was of African descent. At no point during the discussions did anyone remind the panel of PHS's own guidelines on human experimentation (established in February 1966).

According to records, the original study had been composed of 412 men with syphilis and 204 controls. In 1969, 56 syphilitic subjects and 36 controls were known to be living. A total of 373 men in both groups were known to be dead. The rest were unaccounted for. The age of the survivors ranged from 59 to 85, one claiming to be 102.

The outcome of this meeting was that the study would continue. The doctors convinced themselves that the syphilis in the Tuskegee men was too far along to be effectively treated by penicillin and that the men might actually suffer severe complications from such therapy. Even the Macon County Medical Society, now made up of mostly African American physicians, agreed to assist the PHS. Each was given a list of subjects.

In the late 1960s, PHS physician Dr. James Lucas stated in a memorandum that the Tuskegee study was "bad science" because it had been contaminated by treatment. PHS continued to put a positive spin on the experiment by noting that the study had been keeping laboratories supplied with blood samples for evaluating new blood tests for syphilis.

Peter Buxtin, who had left the PHS for law school and was bothered by the study and the no-change attitude of the PHS, contacted the Associated Press. Jean Heller, the reporter assigned to the story, did extensive research into the Tuskegee experiment. When interviewed by her, the PHS officials provided her with much of her information. They were men who had nothing to hide. The story broke on July 25, 1972. The study immediately stopped.

Study Questions

1. Carefully analyze this case. When you

examine the paper and the appendices, what information appears to have been gained from this study? That is, what kind of argument can be made for the benefits of the study?
2. What do you believe were the motives for the people to become involved in the study, specifically: The subjects? The PHS personnel? The Tuskegee staff? The Macon County physicians? Nurse Rivers?
3. What kind of criticisms can you offer of this study?
4. What were the factors underlying the cessation of the project?
5. Could this project (or one similar to it involving AIDS or radiation effects) be conducted today?

Introduction

This case is a synopsis of events described by James H. Jones in his book *Bad Blood: The Tuskegee Syphilis Experiment*. (All direct quotes in the case study are from this book.) It was first published in 1981 and later updated in 1993 with the addition of a chapter called "AIDS: Is it genocide?" The book has led to a play, a motion picture, and a PBS Nova special. The Tuskegee study became an instant classic on the ethics of human experimentation once the Kennedy congressional hearings in 1973 occurred.

This case is an example of a "historical" case in the sense that it happened sufficiently long ago that there are few of the major participants alive and there are no more major decisions or actions to be made. The story is largely finished. Further, the social and ethical climate is significantly different today than when the events in the case transpired. Many of the key decisions could not be made today in light of present legal and moral guidelines.

Why do we study such a case? The answer in simple: to understand the evolution in our thinking on issues of science, human experimentation, and race and to see how they are colored by our culture. In addition, we can emphasize certain long-standing principles of science that have not changed over the century; for example, proper controls are still seen as essential. Also, there are clear parallels in dealing with disease conditions within special segments of the population today (for example, breast cancer, AIDS) that lead to special research projects, with political and legal overtones.

Teaching the Case

This case seems ideally suited for the classical case discussion format used for decades in business schools, although it can easily be adapted for small group cooperative learning teams.

It is divided into three parts: *the disease, the public health program,* and *the experiment*.

- The section on the disease is a straightforward account of the symptoms of syphilis, and it normally figures only in a modest way in the discussion except as a backdrop to the case. The instructor can highlight the disease by an early focus on the disease symptoms, perhaps with graphic photos and review of included data and readings from original papers.
- The section on the public health program should be viewed from the perspective of concern regarding the extent of disease in rural southern America, the need to establish a health vehicle to address the problems of disease, and the concern of an expanding civil rights movement regarding health care and health care professionals.
- The section on the experiment itself leads to several lines of inquiry that should be pursued in discussion.
    1. Rationale for loss of funds.
    2. Rationale for study on untreated African American males and societal acceptance of such experimentations.

3. The medical importance of longitudinal studies.
4. Rationale for continuing study after penicillin was discovered.
5. The use or inappropriate use of "control" groups.
6. The meaning of "informed consent." That is, can you ever be fully informed?
7. What is the Nuremberg Code and does it really pertain to this study?
8. Of what use are the data collected from this study? Do there appear to be any significant conclusions? Review the contamination aspect of various degrees of treatment.
9. Can scientists become so intimately associated with their projects that they lose objectivity?
10. Why was the consistent care provided by one person throughout the study so necessary?

There are a myriad of other questions that the discussion could develop by reading the case study. If small groups are used, these questions and others can be divided among them to provide different perspectives on the case. These views would be shared in a general group discussion. However, our remaining comments about teaching will emphasize the group discussion technique.

In writing this case we have kept the account relatively straightforward, eschewing emotion-laden phrases, keeping in mind the science and ethics earlier in the century. It has a documentary feel to it; that is intentional. As a result, we hope to accomplish two things: (1) To keep the reader focussed on the science first; and (2) To avoid the easy criticism that comes from second guessing events that took place over 50 years ago. It helps to dampen the tendency of some individuals to use this case as a platform to deride racism without serious analysis. There is always a risk of polemics when we deal with scientific cases that im-

TABLE 1.

1963 Viability data of Tuskegee group.

	Dead		Alive		Unknown	
	number	%	number	%	number	%
Syphilitics	242	59	85	21	85	21
Controls	78	45	66	34	39	20

From Rockwell, Yobs, and Moore (1964)

TABLE 2.

Abnormal findings in 90 syphilitics and 65 controls.

	Syphilitics		Controls	
Abnormality	number	%	number	%
Electrocardiographic	41	46	21	32
Cardiomegaly via x-ray	37	42	22	34
Peripheral neuropathy	12	13	5	8
Hypertension d.b.p.>90	38	43	29	45
Cardiac murmurs	24	27	20	31
Urine	28	36	21	33

From Rockwell, Yobs, and Moore (1964)

TABLE 3.

Aortic arch and myocardial abnormalities at autopsy.

	Aortic arch		Myocardial	
	number	%	number	%
Syphilitics (140)	62	44	48	34
Controls (54)	8	15	20	37
	X2P<0.005		X2P>0.25 not different	

From Caldwell et al. (1973)

pinge on the public welfare. These moments are seldom enlightening. Careful preparation on the part of the instructor can help head off such events.

Blocks of Analysis

Every case has its major points for discussion; these vary with the teacher and audience. In this instance, we have identified three major issues for analysis: the science; the ethics of human experimentation; and the racial issue. We choose to start with the least volatile of the issues just as we would in the classroom.

The Science

Basically, was this good science? Questions that illuminate this issue include: What was the purpose of the project? How did the purpose shift through time? Was the experimental design adequate? What were the contributions of the study? On one side of the argument we have the view that many of the so-called untreated men were in fact treated and this invalidated all conclusions that might be drawn. Furthermore, one might argue that there was no need to repeat a study on untreated people since the Oslo data were adequate.

Clearly, physicians involved with the project did not agree, for they thought it likely the black population might differ, especially in their cardiovascular and neurological response to syphilis. Also, we have statements that the blood from these men was used to develop standardized blood tests, that the project served as a training ground for many PHS and other medical staff, and that the project led to several scientific publications. The Tuskegee data still serve as the reference for understanding syphilis.

Ethics of Human Experimentation

Our view of human experimentation has changed markedly over the past century. There are numerous examples of soldiers, prisoners, and citizens who have unwillingly or unknowingly participated in life-threatening "experiments" (Barber 1976). The 1993 revelation that Americans were unwillingly exposed to potentially harmful doses of nuclear radiation during tests of the 1940s and 1950s is only the most recent example.

Historically, one might think that development of the Nuremberg Code would have prevented such work. This does not seem to be the case. The notorious Nazi medical experiments, which were brought to light after World War II during the war crimes trials, led to the development of a code of ethics called the Nuremberg Code. This set of 10 principles asserts "the subjects' right to decide whether or not to become research subjects." It defines what physicians may or may not do even with the permission of the subject. An investigator must take all precautions to avoid the remote possibility of injury, and the degree of risk involved to the subject must be commensurate with the "humanitarian importance of the problem." In spite of the widespread publicity of the Nuremberg trials there appears to be no suggestion that any of the physicians in the Tuskegee syphilis experiment thought the Nuremberg Code applied to them. Nor for that matter has it appeared to have had any impact on the development of our own ethical framework in the United States (Annas and Grodin 1992).

Not until the thalidomide scandal of the 1960s did the U.S. scientific community seriously engage on the question of human experimentation. Only in the past few years have we seen universities and the National Institutes of Health establish guides for human experimentation.

How much of this checkered past needs to be part of the discussion is up to the instructor, but it might be useful to give students your school's or a local drug company's guidelines on human experimentation or ask them to develop their own principles. Certainly, any discussion on these issues will include the "right" of people to choose whether they will be part of an experiment. Also, there will be questions of whether it is possible to truly inform a person about the consequences of an experiment and whether this knowledge will influence the results of the work itself. Lawsuits have been won on the basis that even if a person signs a release, he or she cannot be held accountable; he or she may be acting under coercion or stress and without proper understanding of the work. For example, how much would you accept as adequate compensation in such an experiment: $5, $50, $500, $5,000?

The Racial Issue

This is potentially the most volatile issue in the case. If terms such as *genocide* can be applied to the AIDS crisis, so might they be applied to the syphilis epidemic and the Tuskegee study. Here is a documented case of a government agency withholding medical treatment from an ethnic minority.

If an instructor wishes to explore this issue, he or she would presumably focus on how it is possible to view the same event from different perspectives. There is evidence that the Rosenwald Fund had a long history of helping black Americans and one of its concerns about funding the second phase of the Tuskegee project was that its motives could be misconstrued. Furthermore, there is documented evidence that the prime motive for early work was to see if the progress of syphilis in the black male was similar to that first studied in the European male in Oslo. Also, we have clear cooperation of black physicians, nurses, and administrators of Macon County and the Tuskegee Institute. Yet evidence of this type can be viewed through another lens. The perspective of a person arguing the genocide scenario is captured simply with this question: Would this study have occurred (especially once penicillin was discovered) if it involved white middle-class Americans as subjects? Speculation will not provide sure answers, yet the recent revelation that such citizens have been exposed to life-threatening radiation by our government is worth considering as a model.

For instructors using the small group approach to teaching, these issues can be assigned to separate groups to discuss. Also, it is helpful to assign one group to take the affirmative side of the issue and another group to take the negative side.

The First Question

The opening question to the class is one of the most critical features of case teaching. It determines the entry point into the case, and if one chooses the wrong question or wrong person to respond, the instructor may have difficulty getting back on track. Your question will depend upon your goals in teaching the particular case. Nonetheless, good opening questions share several characteristics in that they:

(1) Encourage participation.
(2) Move toward a specific goal.
(3) Set up a discussion of the facts.
(4) Elicit different perceptions of the case.
(5) Help formulate (define) a problem.
(6) Get personal involvement.

Consider three examples of questions for the Tuskegee case:

(1) *Some people have argued that there are racial overtones in this project, yet Eunice Rivers, a black nurse, was an important participant in the experiment. Are these two points of view compatible?* This question will likely catapult the class squarely into the racial issue. It meets many of the goals of a good opening question, but it will probably not suit the tastes of most scientists as the best entry point into the discussion.

(2) *As we look at this study, one cannot help but wonder if it was ethical, given that the men were simply informed that the doctors were studying "bad blood." How important is it to have informed consent?* This question launches the class into the ethics of human experimentation and once again meets many of the qualifications of a good opening question, but if the scien-

tific data are of prime concern, the next question may be better.

(3) *The Tuskegee experiment has been criticized because its experimental design was inherently flawed. Is that really so? And even if it is true that the study was not ideal, were there valuable results to emerge from this 40-year study?* This question, although less exciting than the previous two, starts the class on an exploration of the scientific issues and facts of the case. Below we have identified some of the questions that might be addressed under each issue.

Blackboard Work

Practitioners of the Case Study Discussion almost invariably make extensive use of the blackboard or flip charts. This provides a tangible structure to the discussion. If instructors do not use the board, they are throwing away one of their most important tools in teaching. Discussion has the inherent problem that it often seems aimless. Good board work provides students with a sense that something valuable is being accomplished. When the instructor writes a brief phrase on the board summarizing a student's thoughts, he or she shows that he or she values this contribution to the discussion. This encourages other students to participate, especially if the instructor is able to use the student's name. For instance, the teacher might comment: "If I understand Kimberly's point correctly, she is arguing that we do not have an adequate control population to make the claim that the men actually suffered in this study. She's arguing that men not in the study in any way probably had much poorer health than either the experimental subjects or the official controls." As this point is summarized, the instructor might note on the board "Inadequate control for claim that men suffered in study," perhaps even jotting Kimberly's name or initials next to the writing.

The final board outline is seldom neat and tidy; rather it has phrases, arrows, circles, and lines connecting ideas from different parts in the discussion. Yet a clear pattern should emerge leaving students with a sense of "Look what we have accomplished!" To bring about order out of the emerging discussion is part of the art of case study. It not only requires practice but it requires preparation. In the current case it is logical to arrange the board around the major issues. For example if the instructor were to begin the discussion with the science issue, he or she might label it as such on the left side of the board, jotting down notes and phrases as they are developed. When other ideas pop up, the instructor might momentarily move over to other places on the board to write down these ideas, only to return to the science issue later. The teacher might set up the center of the board to develop the human experimentation theme, adding notes to other places on the board as they appear appropriate. The instructor might then shift to the right hand side of the board to develop the racial issue, making connections with previous points by moving back and forth among the issues as neglected points emerge. Thus the board has given structure to the discussion regardless of how freewheeling it might have been.

Closure

How to finish a class discussion has different answers. Some case teachers simply stop when class time runs out. They feel no obligation to give their perspective on the discussion. "Life is messy," they argue. "There are no simple solutions. It is counterproductive to the development of higher-level critical thinking to give an instructor-biased viewpoint."

Other case teachers seriously disagree. Instead, they recognize the value of a good two- or three-minute summary of the class's discussion, and some instructors turn to the students themselves for assistance, asking one or two bold souls to wrap it up. A summary,

Suggested Question Outline

A. The Science

1. What kind of disease is syphilis?
2. What did we know about the disease in 1930?
3. What was the original purpose of the study? Was the goal accomplished?
4. How did the goals of the project change over time?
5. What was the logic behind the choice of subjects?
6. What kinds of data were collected in the project and what conclusions resulted from the work?
7. What kind of scientific criticisms of the research can we offer?

B. Human Experimentation

1. What benefits did the men gain from the experiment?
2. What evidence do we have that the men were harmed by their participation in the project?
3. Was it possible to inform the men about the true goals of the experiment, given their educational status?
4. Given that men who participated in this study received health benefits, status, attention, and money, could they reasonably be expected to exercise good judgment about their participation in this project?
5. Are there circumstances that you could imagine where informed consent would interfere with an experiment?
6. Are there any circumstances where the overall good of an experiment to society overrides the harm done to a small group?

C. The Racial Issue

1. What evidence do we have that race might have been a factor in the experiment?
2. What motivated the PHS investigators to choose Macon County as one of its study sites?
3. What differences were present in the experimental designs of the Tuskegee and Oslo studies?
4. If the Tuskegee and Oslo studies had shown racial differences, how would that information have been used?
5. Is it reasonable to conclude that the administrators of the Rosenwald Fund failed to fund the second PHS project because they identified racial bias in the work?
6. Is there any way to fund research on special groups in the U.S. population without running the risk of being accused of bias?
7. Given that certain segments of the population have special health problems, is there any way not to fund research on these groups without running the risk of being accused of bias?

of course, does not imply that you have solved the problems, it merely identifies some of the signposts along the way.

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