SCIENCE HISTORY INSTITUTE

ALISON TAUNTON-RIGBY

Life Sciences Foundation

Transcript of a Research Interview
Conducted by

Mark Jones

Boston, Massachusetts

on

22 January 2013

(With Subsequent Corrections and Additions)

SCIENCE HISTORY INSTITUTE
Center for Oral History
FINAL RELEASE FORM

This document contains my understanding and agreement with the Science History Institute with respect to my participation in the audio- and/or video-recorded interview conducted by Mark Jones on 22 January 2013.

1. The recordings, transcripts, photographs, research materials, and memorabilia (collectively called the "Work") will be maintained by the Science History Institute and made available in accordance with general policies for research and other scholarly purposes.

2. I hereby grant, assign, and transfer to the Science History Institute all right, title, and interest in the Work, including the literary rights and the copyright, except that I shall retain the right to copy, use, and publish the Work in part or in full until my death.

3. The manuscript may be read and the recording(s) heard/viewed by scholars approved by the Science History Institute unless restrictions are placed on the transcript as listed below.

This constitutes my entire and complete understanding.

Signed release form is on file at the Science History Institute

(Signature) _____

Alison Taunton-Rigby

(Date) 21 March 2018

OPTIONAL: I wish to place the following restrictions on the use of this interview:

_____

_____

I understand that regardless of any restrictions that may be placed on the transcript of the interview, the Science History Institute retains the rights to all materials generated about my oral history interview and will make the title page, abstract, table of contents, chronology, index, et cetera (collectively called the "Front Matter and Index") available on the Science History Institute's website. Should the Science History Institute wish to post to the Internet the content of the oral history interview, that is, direct quotations, audio clips, video clips, or other material from the oral history recordings or the transcription of the recordings, the Science History Institute will be bound by the restrictions for use placed on the Work as detailed above. Should the Science History Institute wish to post to the Internet the entire oral history interview during my lifetime, I will have the opportunity to permit or deny this posting.

I understand that the Science History Institute will enforce my wishes until the time of my death, when any restrictions will be removed.

This research interview is designated **Free Access**.

Science History Institute

Chemistry · Engineering · Life Sciences

Formed by the merger of the Chemical Heritage Foundation and the Life Sciences Foundation, the Science History Institute collects and shares the stories of innovators and of discoveries that shape our lives. We preserve and interpret the history of chemistry, chemical engineering, and the life sciences. Headquartered in Philadelphia, with offices in California and Europe, the Institute houses an archive and a library for historians and researchers, a fellowship program for visiting scholars from around the globe, a community of researchers who examine historical and contemporary issues, and an acclaimed museum that is free and open to the public. For more information visit sciencehistory.org.

INTERVIEWEE

Alison Taunton-Rigby was born and educated in Great Britain. Her father was a scientist for the British government and her mother was a physiotherapist. She attended the University of Bristol for her undergraduate and graduate degrees, studying chemistry, math, and physics. She came to the United States in October of 1968 when she was offered a postdoc position at the Woods Hole Oceanographic Institute, but she began working for Collaborative Research in Waltham, Massachusetts in February of 1969. There, she worked on a number of projects, such as one with MIT to synthesize the first ribosomal RNA gene, years before recombinant DNA was developed. Throughout the seventies and eighties, biotechnology companies were beginning to expand and in 1981, Collaborative Research was the second biotechnology company to go public. Taunton-Rigby had risen to the position of Vice President of Research & Development [R&D], the only woman in a seniority role at the company. She eventually left Collaborative Research for Biogen, where she was the Vice President of Business Development. Her job entailed finding new technology or potential products coming out of academia and raise money for R&D limited partnerships. The job required Taunton-Rigby to travel extensively, so she left and joined Damon Biotech, where she was the General Manager of their subsidiary company Vivotech, which was developing pancreatic islet cells for diabetics. The work never went fully commercial and Taunton-Rigby moved on to Arthur D. Little Inc., a research and consulting organization, where she helped pharmaceutical companies restructure their R&D to enhance molecular and cellular biology.

Still facing frequent travel demands, Taunton-Rigby joined Genzyme in 1987 after she was approached by Henri Termeer, the company's CEO. There, she served as the Senior Vice President of Biotherapeutics. With Genzyme, Taunton-Rigby oversaw the development of highly successful products such as Ceredase. She eventually left Genzyme to become the CEO of Mitotix, which was developing a cancer drug but facing financial difficulties. She was later approached by Cambridge Biotech, who were in bankruptcy. She was brought in as their CEO and Director with the mission of turning the company around. The company had to go to bankruptcy auction for their diagnostics business, after which Taunton-Rigby moved the company and renamed it Aquila Biotherapeutics. When Aquila was merged with Antigenics in 2000, Taunton-Rigby left the company. She moved onto Catharsis Medical Technology, which created barcodes that nurses and doctors could use to cross reference a database and ensure a patient was receiving drugs that were compatible with one another, though found that hospitals were weary of working with a small company due to liability issues. Taunton-Rigby then helped to found RiboNovix with Phil Cunningham, which developed technology to understand the mutations of ribosomal RNA. The product never panned out due to rising costs and returned to development at Wayne State University. Taunton-Rigby sits on the board of five companies – three for healthcare and two for financial services – including Abt Associates, Boston Children's Hospital, Columbia Funds, and ICI Mutual Insurance. She also serves on a number of advisory boards.

INTERVIEWER

Mark Jones holds a PhD in history, philosophy, and social studies of science from the University of California, San Diego. He is the former director of research at the Life Sciences Foundation and executive editor of *LSF Magazine*. He has served in numerous academic posts, and is completing the definitive account of the origins of the biotechnology industry, entitled *Translating Life*, for Harvard University Press.

ABOUT THIS TRANSCRIPT

Staff of the Life Sciences Foundation conducted this interview, which became a part of our collections upon the merger of the Chemical Heritage Foundation and the Life Sciences Foundation into the Science History Institute in 2018. The Center for Oral History at the Science History Institute edited and formatted this transcript to match our style guide, but as noted, Science History Institute staff members did not conduct the interview.

The Center for Oral History, Science History Institute, is committed both to preserving the recording of each oral history interview in our collection and to enhancing research use of the interviews by preparing carefully edited transcripts of those recordings. The preparation of interview transcripts begins with the creation of a verbatim typescript of the recording and proceeds through review and editing by staff of the Center; interviewees also review the typescript and can request additions, deletions, or that sections be sealed for specified periods of time. The Center keeps track of all changes that staff, interviewers, and interviewees make to the original typescript. Please contact us if you would like additional information about these materials. We have established guidelines to help us maintain fidelity to the language and meaning of each recorded interview while making minor editorial adjustments for clarity and readability. Wherever possible, we supply the full names of people, organizations, or geographical locations mentioned during the interview. We add footnotes to the transcript to provide full citations for any publications that are discussed, to point to extant oral history interviews, and to clear up misstatements or provide context for ambiguous references in the transcript. We use brackets to indicate the addition of material that was not in the audio, and bracketed ellipses to indicate the deletion of recorded material. The transcript also includes time stamps at one-minute intervals. We omit without noting most instances of verbal crutches and all instances of nonlexical utterances. We also make small grammatical corrections where necessary to communicate interview participants' meaning. Finally, staff of the Center create the abstract, chronology, and table of contents. With the availability of online full-text searching of our transcripts, the Center for Oral History opted to discontinue the practice of preparing a back-of-the-book index for each oral history transcript in 2020.

The Science History Institute is committed to the responsible presentation of the history of science by addressing evidence of inequality and oppression as well as the subsequent silences in our collections. To that end, we recognize there may be language in our oral history collection that is outdated, offensive, or harmful, such as, but not limited to, the following: racist, sexist, Eurocentric, ableist, and/or homophobic language or depictions.

TABLE OF CONTENTS

INTERVIEWEE: **Alison Taunton-Rigby**

INTERVIEWER: **Mark Jones**

LOCATION: **Boston, Massachusetts**

DATE: **22 January 2013**

JONES: Let's start with some biographical background. [. . .]

TAUNTON-RIGBY: I was [born and] educated in Great Britain. [My father was a scientist who worked for the British government and my mother a physiotherapist. So my scientific/medical interests clearly originated from them. In addition, my mother was a pioneer in that she was a professional and a working mother—very rare in her day. I went to the University of Bristol for both undergraduate and graduate work. After being awarded a PhD, we thought it would be fun to explore more of the world and the United States was the top choice. We came as immigrants on the ship *United States*, and landed in October 1968, with four suitcases and fifty dollars—our entire worldly possessions.]

I was offered a postdoc position at Woods Hole Oceanographic Institute, but did not [take] it because [the Institute was very quiet in the winter and the research project did not seem very exciting]. So I started looking for a job. A small company in Waltham, Massachusetts, called Collaborative Research offered me a position, and I started working there in February of 1969.

JONES: [Your degrees were in chemistry?]

TAUNTON-RIGBY: [Yes, chemistry, maths and physics.] Collaborative [Research] had a [large] project with Gobind Khorana at MIT [Massachusetts Institute of Technology] to [help] synthesize the first tRNA gene, and [the company needed scientists with chemistry skills] to work on the [chemical] synthesis of [DNA]. That was my first job. [. . .]

We [synthesized oligonucleotide] building blocks. [At MIT the oligomers were assembled into the tRNA gene using enzymes to ligate the oligonucleotides together]. We had a contract with the NIH [National Institutes of Health] to make the blocks, and [. . .] made gram amounts—huge quantities [for that time]—but it was pretty inefficient stitching everything together. That was my very first job, making DNA.

JONES: Were you prepared for that job?

TAUNTON-RIGBY: No, [at that time there were] only a few academic labs that were even playing around with synthesizing DNA. [This was the early 1970s.]

JONES: Right.

TAUNTON-RIGBY: [Remember] this was [many] years before recombinant DNA [was developed]. Orrie Friedman, who was the founder of Collaborative [Research], was incredibly [farsighted]. When I joined [. . .], Collaborative was working in three [cutting-edge scientific] areas. One was [the synthesis of] DNA, because Orrie thought that being able to change [DNA] sequences and [so alter protein sequences] would be important. [The second involved trying to establish cell lines derived from human tissue biopsy samples, where the cells would grow in large-scale culture and produce the human] proteins that the cells made. [The hope was to use these proteins therapeutically. This was many years before recombinant DNA was developed—we had to hope we could establish human cells in culture, and find a cell line that still produced the protein of interest.] The third [technology we were developing involved using immunoassays as diagnostic tools. We were using] polyclonal antibodies, because monoclonal antibodies were still way in the future. Collaborative developed [and commercialized] the first radioimmunoassays [. . .] for cAMP, cGMP, LSD and THC. [. . .]

[So in the late 1960s and early 1970s, Collaborative was focused understanding the relationships between genes and disease. The company was producing human proteins for therapeutic use, synthesizing DNA, and using immunoassays to quantitate biological molecules. While the technologies have evolved, these three fields are the cornerstones of the modern biotechnology industry.]

JONES: [. . .] Tell me, if you can recall, [when you arrived] what you learned of [Collaborative Research's] history? [. . .]

TAUNTON-RIGBY: In [1970], [. . .] there were probably about thirty [. . .] people in the company. Orrie founded [Collaborative in 1961]. He thought that [much] of the research done in academic labs was too academic, meaning it was focused on getting publications and it didn't have real world applications. [However], when he talked with pharmaceutical companies **<T: 5 min>** [about the sort of research he wanted to do, their scientists thought it was] too risky. [. . .] He realized there was a need for a company between the two, that was willing to do what academics thought was too "applied" [. . .] and big pharma [scientists said was] "too risky." So, he stepped right into the middle of that gap. [. . .]

[Interestingly, you have to remember that virtually all drugs back then were small chemical molecules and pharmaceutical research labs were full of chemists, who did not know

biology. Orrie was a true pioneer in believing that protein molecules would be valuable therapeutic agents.]

JONES: [Orrie was interested in using proteins as drugs?]

TAUNTON-RIGBY: [Yes. Orrie had the view] that [when] you are healthy, [your cells are making the right proteins] in the right quantities, but people with diseases [are unable to make the correct proteins or not in appropriate quantities. So he believed that we had] to find ways of making [the missing human proteins. However], proteins are too big and too complicated [for chemists to synthesize]. [. . .] So the only way to [make] them would be to grow [human] cells [. . .] in culture, [develop] a permanent cell line, and at the same time [find cells that produce the protein that you needed. At Collaborative] we were collecting [biopsy] samples of [different] tissues from patients in [the hospital, and trying to grow cell lines. We succeeded in establishing a human] pituitary [cell line that produced] human growth hormone. We had [another] cell line that made urokinase, [. . .] an enzyme like tPA, which dissolves blood clots.[. . .] [Orrie's] vision was [to use] human proteins, and this would be the new way of treating disease.

[In the 1960s and 1970s, very few proteins were used therapeutically, other than insulin. In order to use human proteins as drugs, you needed to be able to make them, and that was a big problem. Insulin, used by diabetics, was actually bovine or porcine insulin, and extracted from animal tissues collected at the slaughterhouse. Urokinase was known, but you could only get it in microscopic quantities by extraction from human urine. Interferon was only known in the academic world, where microscopic quantities had been isolated. I do not know when human growth hormone was first used as a drug, but in the 1960s and 1970s it was obtained from pituitary tissues from human cadavers.]

JONES: Were academics doing this in any substantial way? [. . .]

TAUNTON-RIGBY: [Not really. Molecular biology was a very new discipline. At that time scientists were trying to understand how cells worked. We knew about proteins, DNA and RNA, but how cells worked, what was the structure and function of tRNA and mRNA, this information was only just then being elucidated. We did not know about the enzymes involved—remember reverse transcriptase and restriction enzymes were only discovered in the early 1970s, and recombinant DNA techniques in the second half of the 1970s. DNA sequencing had not been developed. Orrie was ahead of his time] because he had the vision of [understanding genes and disease and] using human proteins [as therapeutics]. No one else [. . .] was talking about [this in the 1960s]. [. . .]

JONES: How did the company get started? [. . .]

TAUNTON-RIGBY: [I believe that Orrie used his own money to fund the company]. **<T: 10 min>** [. . .] He was Canadian by origin [. . .], [and had degrees from McGill University. He had been a professor at the Harvard Medical School and then he moved to Brandeis University. Starting the company was a big risk. There were no venture capital investors interested in biology at that time. Collaborative was truly the first biotechnology company, but the term "biotechnology" had not even been invented!] There were [even some times] in the early 1970s when the company did not have money to make payroll. [Orrie] put his own money in [to make sure we were paid]. [. . .]

[Early on the company won] several government contracts. [. . .]

[For example, when Orrie was at Harvard he helped develop the cancer drug Cytoxan. As a result, Collaborative was able to win several large government contracts to synthesize the building blocks used to make this and a number of cancer drugs.]

[As I mentioned we also had the contract with the NIH to make the oligonucleotide building blocks for Dr. Gobind Khorana of MIT. We also managed to win government sponsorship of the programs to develop and commercialize immunoassays for drugs of abuse. We were one of the few labs in America allowed to synthesize and handle LSD and THC. There were no SBIR grants back then. Academics who wanted help had to persuade the NIH to put out an RFP (Request for a Proposal) describing the research needed. We would respond to any RFP that we thought we could win, to get support for the various programs that we had.]

The other source of funding [was pharmaceutical company research support. For example, Organon], a pharmaceutical company based in Holland, funded the [human] growth hormone work. [Organon sold] fertility hormones [extracted from natural sources, and so had some expertise in protein handing. And Abbott] funded the work on pro-urokinase, [which was] commercialized as Abbokinase. [. . .]

[Collaborative also started a Research Products division selling nucleotide sequences, biological reagents, and immunoassay kits to academic labs in the early 1970s. We made many of the nucleotide primers that Howard Temin and David Baltimore used for their work on reverse transcriptase. We made large quantities of a DNA oligomer for Hamilton Smith because he wanted to study the crystal structure of DNA. We developed and commercialized the oligo (dT)-cellulose that was used to isolate mRNA. If you read any of the early mRNA work, it will cite Collaborative as the source of T-cellulose. Selling research reagents is a model business strategy, later used by many biotechnology companies.]

So we [filled the] gap between the [. . .] pharmaceutical [companies] and academics—[another characteristic used today to describe the biotechnology industry. It was challenging research, and it was a challenge to get funding.] That is why the company was not very big, maybe thirty to forty people. [. . .]

JONES: [How did the company evolve in the 1970s?]

TAUNTON-RIGBY: Like many other companies [since], we [had a number of scientific advisors from academia, the first scientific] advisor that I really remember working closely with [. . .] was Dieter Soll from Yale University. He [helped] us with the [oligonucleotide] chemistry. [. . .] [Gordon Sato was a consultant on cell culture]. David Baltimore [and Robert Gallo were using our oligonucleotides].

[By the] mid 1970s, we [had a significant level of NIH funding, several corporate sponsors (Organon and Abbot)], and we had a research products division [generating revenues]. [. . .] [At this time] restriction enzymes [were being discovered and recombinant DNA technologies developed]. We thought seriously about making restriction enzymes, but New England Bio Labs [was the first company to make these enzymes commercially available. However, when the first publications on recombinant DNA technology appeared], Orrie immediately recognized that it could be used to make proteins—[which was] his dream. [. . .]

[We had in many ways laid the groundwork for the use of recombinant DNA technology to produce human therapeutic proteins. The cell lines that we had established from human biopsy samples made human growth hormone and human urokinase. However], we had an endless battle with the FDA [to get permission to use these proteins therapeutically in patients]. We were the first company [to go to the FDA with proteins produced in transformed cells. Transformed] cells are different than normal cells, [in that they will continue to grow and divide]. The FDA was deeply concerned about using a [permanent cell line] to produce human proteins that were going to be given to people therapeutically. So, they dragged us over the coals [. . .] and it took forever [to get FDA approval to start human clinical trials. However, our efforts initiated the work with] the FDA for when recombinant DNA technology [. . .]. [All recombinant cell lines are permanent, transformed cells]. [. . .]

JONES: [Why was the FDA concerned?]

TAUNTON-RIGBY: [The FDA was deeply concerned about the thought of using a transformed cell line since cancer cells grow continuously. The biopsy samples we collected were not usually from normal tissue. The FDA believed that there might be a risk of inducing cancer in a patient. Remember this was the 1970s—our understanding of molecular biology was not as advanced then. Today we know that risk is extremely small—even non-existent. Today's therapeutic proteins are made using permanent cell lines.]

It is interesting [in that] Genentech was the first to get a recombinant protein [approved for therapeutic use—human growth hormone. Genentech first made biosynthetic HGH in about 1980. The company] ran a clinical trial with about thirty subjects, [but the FDA was concerned that this was not enough data for approval. That was] until Creutzfeldt-Jakob [disease] surfaced. [In 1985, unusual cases of Creutzfeldt–Jakob disease were found in individuals that had

received cadaver-derived HGH ten to fifteen years previously, and cadaver-derived HGH was immediately removed from the market.]

Suddenly the FDA had no choice but to [allow] another method of making [proteins, and biosynthetic human growth hormone replaced pituitary-derived human growth hormone for therapeutic use in the U.S. and elsewhere. Collaborative Research laid] the groundwork in the 1970s [for this later acceptance by the FDA, of proteins made in the lab in cells.]

JONES: You mentioned that Dieter Soll was involved. Was he an advisor for DNA chemistry?

TAUNTON-RIGBY: Yes. He was an [important] advisor on the chemistry side. We had [several] projects with Bob Gallo at the NIH, making all sorts of [altered] nucleotides with different linkages, [and unusual modified nucleotides to try to inhibit the then newly discovered enzyme, reverse transcriptase, that is used by retroviruses to make DNA from RNA. These were] precursors for [many of today's HIV] drugs. [Many] antivirals are modified nucleotides. [. . .] We did not patent [the modified oligomers] because we did not know [there would be a therapeutic] use. [. . .]

JONES: [What was the next stage of the company's development?]

TAUNTON-RIGBY: [When] recombinant DNA technology [was developed], Orrie realized we needed to do it. [. . .] We [already] had a long-[standing] relationship with David [Baltimore] because we had been supplying him [oligonucleotides] for reverse transcriptase assays from the very early 1970s. [. . .]

[Orrie asked David to help us put together a Scientific Advisory Board. He recruited Gerry Fink, David Botstein and Ron Davis. The initial thoughts were to focus on using yeast as a host cell, as the technology for growing yeast on a large scale was well developed. (Think wine, beer and bread making!)] There was [still] a big debate as to [whether] protein drugs could ever really be used as therapeutics. [. . .] When you talked to pharmaceutical [R&D] people, they were very negative. They were chemists, and they did not think biologics could ever seriously be drugs. [Biologics are hard to make, we] could not characterize them, and there were [genetic] variations. [. . .]

<T: 25 min> We also [thought about] industrial enzymes. [I remember one brainstorming meeting on a Saturday morning involving Wally Gilbert, when we talked about cloning hydrogenase as a target protein. This might enable us to make an endless supply of hydrogen as a non-polluting] energy source. [. . .]

JONES: How far did that go?

TAUNTON-RIGBY: Not far! But the [focus on yeast and] industrial enzymes did go somewhere. We [developed a long-term relationship] with the Dow Chemical Company. Dow was one of the [. . .] early supporters of recombinant technology. The other big investor was Kirin Brewery who supported a lot of work [at Collaborative and at Amgen. In the early days it was hard to persuade the pharmaceutical industry that this new technology was useful]. [. . .]

One of the target [proteins for production using recombinant technology] that Dow came up with was chymosin [(rennet)], the enzyme that is used to make cheese. [For centuries cheese has typically been made using the enzyme rennet extracted from the lining of] milk-fed calves. [. . .]

[At Collaborative, we cloned chymosin and developed a manufacturing method. Dow licensed our technology to Pfizer, and Collaborative received royalties for quite a long time. Interestingly, today and for over twenty years now, virtually all cheese production is carried out with recombinant enzymes. I am not sure the public is aware of this!]

[. . .]

JONES: [What happened next? There were a number of new biotech companies starting up?]

TAUNTON-RIGBY: [Yes, by the late 1970s and early 1980s a number of companies were founded in Boston and on the West Coast. The venture capital industry took notice and started investing in biotechnology. But] Collaborative, remember, was funded by [NIH] contracts, and [pharmaceutical] company support. We were not [. . .] funded [by venture capital. Companies like Biogen, Genetics Institute, Cetus and Genentech raised significant] VC money. [. . .] Collaborative did [increase in size though]; it was about [one hundred and fifty] people at its biggest. [. . .]

[Around this time, so-called "professional management" was put in place at Collaborative, to take the company public.] We went public in [. . .] 1981—[I believe that] we were the second [biotechnology] company to go public. [Genentech was the first.]

[. . .] The "professional management" consisted of people [from] the pharmaceutical industry and Orrie Friedman was pushed aside for a couple of years. **<T: 30 min>** He was [chairman of the board, but no longer] CEO. [. . .]

[The Wall Street investment bankers thought of him as a professor and did not think he could lead a public company. About a year after the IPO] we did a secondary offering. I did the road shows for that. [. . .] The [CEO that had been brought in had come from a medical device company, but he had a hard time understanding the science. So he] left and Orrie stepped back in.

[Even though Collaborative was an early entrant in the biotech field, the company did not grow as fast as the other companies. We had] raised about thirty-five million dollars in the IPO, [. . .] but Orrie did not want to spend the capital. As head of R&D I was allowed to spend the interest we got from putting that money in the bank.

JONES: How did you feel about that at that time?

TAUNTON-RIGBY: Not good. [It was a] reason Collaborative was not competitive. Orrie, like a lot of people at the forefront knew what he should be doing, but then he [was conservative and did not] fully invest and throw everything into it. Recombinant DNA technology overtook him. [Other companies in the development race overtook Collaborative].

[. . .]

JONES: At this time you were the vice president of R&D?

TAUNTON-RIGBY: I was the VP of R&D and so it was tough [to be limited on funding].
[. . .]

[Also, the decision to] focus on yeast as a vehicle for recombinant [work instead of *E. coli* did not turn out for the best. **<T: 35 min>** We focused on yeast as our Scientific Advisors all worked] on yeast in their academic labs, [and thought it was the right choice because yeast puts sugars onto its proteins. Other companies focused on using CHO cells to solve this issue]. The problem with yeast is that it is too complex, too difficult to manage. Kirin Brewery uses it to make beer so it was thought of as being a commercially grown cell—people do know how to grow yeast but not under the conditions required to make therapeutics.

[. . .]

JONES: [What else did Collaborative work on?]

TAUNTON-RIGBY: [Another area we pioneered was genetic linkage. Collaborative developed and published the first RFLP (Restriction Fragment Length Polymorphisms) map of the human genome. The map was fairly crude, but RFLP analysis was an important tool in genome mapping, allowing the localization of genes for genetic disorders].

In 1983 [I moved from Collaborative to Biogen]. Wally Gilbert, whom I knew well [by that point], recruited me to [. . .] become Biogen's first VP of business development. Wally

originally wanted me to go to Geneva to [work with] Julian Davies, [. . .] but I didn't want to move to a foreign country [since I had family]. So, he created the job of VP of business development at Biogen in Cambridge.

JONES: Before we talk about Biogen I have a few [more] questions about the pre-rDNA days [using] mammalian cells to grow proteins. [. . .] Was Orrie a biochemist?

TAUNTON-RIGBY: He was a chemist. His degrees were chemistry, like mine. But remember I only did chemistry for the first couple of years. Once you [. . .] can make [and alter] DNA, you [very quickly become] interested in what you can do with [this capability]. [This leads you] into cell biology, and molecular biology. [. . .] [I think this is how Orrie learned biology too!]

[. . .]

JONES: What methods were being used to sequence [DNA]?

TAUNTON-RIGBY: **[**Fred Sanger developed one of the early sequencing methods. And Wally Gilbert and Allan Maxam at Harvard developed a subsequent method that was widely used. These methods were pretty slow and hands on, and nothing like the automated methods that exist today!]

JONES: Do you happen to know what were the first projects that Orrie Freidman started with?

TAUNTON-RIGBY: I could not tell you. [. . .] When I [joined, Collaborative was already working on cell culture, immunoassays and Gobind Khorana's gene synthesis projects. We did have a contract from the US Army to try to understand spider silk and why it is so strong. We used to milk spiders by putting them on a pencil, then letting them drop on a silk thread. You had to roll the pencil faster than the spider made silk otherwise they escaped.]

JONES: Which [research area] was the biggest?

TAUNTON-RIGBY: I think the cell culture was probably the [most important]. [. . .] When I joined there was a VP head of biology, and there was a VP head of chemistry, who I reported to. Within a year [the VP of chemistry] left, and [. . .] I took over [responsibility]. When the company [was restructured to go public, I was made the Senior VP of R&D].

[. . .]

JONES: What is your perception [of why there is less information out there about Collaborative Research]?

TAUNTON-RIGBY: **[**In the 1970s and even the early 1980s, the whole industry was new. There were none of the newsletters that exist today. None of the half dozen companies had products even in the clinic, let alone being sold. The trade organizations (BIO) did not exist. There were occasional newspaper articles about the research and the promise of the technology, but no dedicated journals].

<T: 40 min> By the early 1980s, [Collaborative Research] was being eclipsed [by other companies]. The peak for Collaborative had probably been [1978-1981 when the company employed about 150 people]. But Collaborative did not invest in the right technologies, it did not spend its capital the way it could have done, and it could not keep up. [The VC funded companies moved faster. In the 1980s the race between the large biotech companies was to clone genes and be the first to file composition of matter patents to block others].

When I left Collaborative and joined Biogen, I left a company that was around probably 150 people for one that was already two hundred plus employees.

JONES: You were pretty high in your organization?

TAUNTON-RIGBY: I was the [Senior] VP of R&D.

JONES: So you were involved in conversations about [the direction of the company?]

TAUNTON-RIGBY: Yes. But remember I had two years with [the "professional managers." Not only] a CEO who did not grasp the [nature of this] business, [but also] a sales [executive] brought in from [a pharmaceutical company, even though we did not yet have pharmaceutical products to sell]. And the CFO came from [an instrument company. Of this] management team I was the only "internal" person. [. . .]

JONES: **[**And you became close to Orrie Freidman over the years?]

TAUNTON-RIGBY: I was close to Orrie. I was there for thirteen years. I worked with Orrie, [the entire time] bar the two years of the other [CEO].

JONES: So, was it hard to leave? [. . .]

TAUNTON-RIGBY: It was, [especially as] the main reason I left was because [I felt the company was not moving forwards]. Remember we had a very powerful scientific advisory board [. . .] that was very opinionated, and they felt that yeast was the way to go.

JONES: At that time did you think no, or were you agnostic?

TAUNTON-RIGBY: I was a little agnostic. I knew [many of the research] people at Genentech and Amgen. George Rathmann had tried to get me to go out to join Amgen. I knew [what the other companies were doing, but we had to follow our] scientific advisory board. Their big ideas were to create the linkage map and use yeast [as a host cell. That was their expertise—that was what they were doing] in their academic labs.

JONES: The linkage map was a nice piece of academic [research].

TAUNTON-RIGBY: Right, exactly. By the way, when it [was] published while much of the work was done at Collaborative Research, it was published as though it was [from MIT with an acknowledgment of the work at Collaborative].

Collaborative Research is a classic business case [study] of having the right vision and setting the stage for everybody else. Think of all the ways [the company was a pioneer—putting in place a high powered Scientific Advisory Board, research being financed with NIH contracts and grants, the business model of selling research reagents, working with pharmaceutical sponsors], going public. The only thing [Collaborative] never had was [venture capital funding and VC input. If it had had VCs involved, the VCs might have steered the company in some different directions].

[. . .]

JONES: [. . .] Did Orrie Friedman ever write anything about the company strategy or his thoughts about therapeutic proteins? Or his thoughts about this emerging industry?

TAUNTON-RIGBY: **[**Not really. We were inventing strategy as we went along]. That is why I would have loved you to have been able to talk to him. I knew him for years afterwards because he and I were both on the board of Worcester Foundation.

[. . .]

JONES: <T: 45 min> Do you know the names of any people who [. . .] saw the whole thing develop in the ’60s? [. . .] Who was there when you arrived?

TAUNTON-RIGBY: Nicholas Starkovsky [. . .] was the VP of chemistry. [. . .] I was twenty-four when I joined, [and most of those already there would have been thirty or forty years old, so they would have to] be in their late eighties now. [And remember, the word biotechnology had not been invented in the 1960s or even most of the 1970s].

[. . .]

JONES: [That’s why we are writing the history. It is time for writing].

TAUNTON-RIGBY: Even the [lab] technicians I worked with were older than me. That is one reason I didn’t get the title of VP of R&D [straight away when I started] doing the job. I was the youngest person in the company.

JONES: Was there any resistance when you did get the title? [. . .]

TAUNTON-RIGBY: The only reason I did finally get the title, [. . .] was because they had to put it in the prospectus for going public. The underwriters [said], “We need a VP of R&D. Who’s doing it?” [. . .]

JONES: Was that something that bothered you at the time?

TAUNTON-RIGBY: Yes. Why did you think I did not get [the title early on? Maybe] because I am a woman!

JONES: It was a different era.

TAUNTON-RIGBY: Yes. I can tell you the CEO [the bankers] brought in [did not like having] a woman as head of R&D.[He told me] that he wanted someone who was available 24/7. I had four [children], and I said, “I am available 24/7, I just need twenty-four hours’ notice to get childcare.” [He did not think that was acceptable]. So, this was a very sexist environment.

I was one of very few women [in this fledgling business and I was] the only woman at the top level in the industry. You are talking about a whole different generation and environment.

[. . .]

JONES: [Tell me about Biogen].

TAUNTON-RIGBY: I was [Biogen's] first VP of business development. However, Wally's [ide]a of business development back then was: "Go and find some [technologies or potential products in academia] that might be useful, that we can work on and then bring them into the company." Business development today is [usually focused on finding business partners for ongoing products and programs—in other words selling]. My job was to find things that were interesting for Biogen [to develop. I was a buyer].

JONES: Did you like that idea?

TAUNTON-RIGBY: Yes. I did. Biogen had [significant] money from going public. [And the whole field was beginning to expand. **<T: 50 min>** We had to move fast]. I helped raise one of the first R&D [limited] partnerships to [continue funding development. R&D limited partnerships were a vehicle for raising money from wealthy individuals. At that time, if the investment project did not succeed, the investor could deduct the losses from his or her taxes. R&D limited partnerships became a popular vehicle for biotech companies to raise money, until the tax laws were changed. When I joined Biogen in 1983 I went straight on the road to sell the R&D partnership]. [. . .]

JONES: What was the project?

[. . .]

TAUNTON-RIGBY: [Biogen was cloning the genes for alpha and beta interferons, amongst other target proteins. The work with alpha interferon was licensed to Schering Plough, but Biogen wanted to develop its own manufacturing skills and its own proteins. R&D Partnerships were at that time a good way of raising money. Biogen spent money quite freely, and I remember asking] one of the scientists, "What do we do if we run out of money?"] and the answer was], "Oh, we'll just go and raise some more on Wall Street." It was a totally different attitude than Collaborative, where we counted every penny. Biogen [spent money fast and the attitude] was, "We will just raise more." [. . .]

JONES: [You mention Schering Plough. Was the pharmaceutical industry now interested in biotechnology?]

TAUNTON-RIGBY: [Yes. But the attitude of the pharmaceutical companies was, "We just want to keep tabs on what you biotech companies are doing. We do not think you will ever succeed. But . . . ." Because the pharma companies still did not believe that we could manufacture on a large scale, get FDA approval, and actually make drugs, biotech companies were in many cases able to retain some commercialization rights. Pharma scientists were still skeptical, even by the mid-eighties. This was wonderful for the biotech companies, and as a result we were able to get research support. If pharma had recognized early on the potential of biotechnology, our whole industry might not have evolved as it did.

Interestingly, when Collaborative spoke to Dow Chemical and they agreed to fund the chymosin project, their scientists] wanted to do it, not because they necessarily thought [it] would be commercially successful, but because they wanted a "window on the technology in case it became important."

[. . .]

[At Biogen], Charles Weissman [in Switzerland was a key person], together with Wally Gilbert, who was CEO at that [point. Phil Sharp was on the SAB as well as Ken Murray, and Danny Wang. Wally has a fantastic mind—it] is like a computer. He smiles, does not say much, but he takes it all in. After meetings he would [come] into my office and want to talk about the business side of [it. He was a spectacular scientist, and wanted to learn as much as he could about business]. I had worked in the industry for [nearly fifteen] years by that point and I [. . .] had business as well as science experience.

JONES: [Were there others with business experience]?

TAUNTON-RIGBY: [Yes]. Mark Skaletsky was [at Biogen then]. He came from [the] sales [division] at Bristol Myers Squibb, which was not a therapeutic company—it was [mainly in the device industry]. [. . .]

I was [one of the few] who really had worked in the biotech industry. So, Wally wanted to brainstorm and talk about how [to develop biological products and get FDA approval. Even in the biotech companies there were skeptics because no one at this point had run clinical trials, scaled up production, or received FDA approval for a biologic. In addition, most pharma sales organizations were very large. Small biotech companies did not have any sales capabilities and many simply licensed out the commercialization].

[Lilly commercialized Genentech's first biologic, recombinant insulin]. But [after that, Genentech typically retained US commercialization rights for their next products, and even] bought back [some European] marketing rights. [Genentech] realized that with [specialized products] you do not need a big sales force. [They pioneered the way for what became called FIPCOs—fully integrated pharmaceutical companies. Genentech also recognized that a different sales organization could be used—small and focused on one product and disease. Biologics are expensive to develop and produce, but for a targeted market they can be priced higher than the typical ten dollars a pill. Genentech realized that we can actually put in a specialized marketing and sales force and sell these things].

[. . .]

Biogen [was slower to retain commercialization rights. There were people in management] who thought, "We need a big sales force, and we can't do it [ourselves]." [The business model was to work with pharma partners and collect royalties on sales. However, at one point, in probably the early 1990s], Biogen and Genentech had the same bottom [line in terms of profit], but their market caps were totally different, because Biogen's was [from] royalties, but Genentech [had the top line—sales revenues]. [. . .] That was when Biogen realized you get [a higher] valuation on your stock if you control the top line *and* the bottom line—that is if you sell your own [biologics]. But it took [many more years for Biogen change business model and to] develop Avonex, (beta interferon) and all the multiple sclerosis [therapies].

[. . .]

JONES: [Even then], there really was only handful of companies that actually succeeded?

TAUNTON-RIGBY: Yes. [. . .]

[Companies needed to be successful at discovering and developing a biologic, and getting FDA approval themselves. That takes a lot of money and a lot of time. And there are way more failures than successes.] The other thing that changed was that companies like Genentech, Amgen, and Genzyme set the stage for a whole different pricing strategy. **<T: 55 min>** [With a focused sales force on a target market, when there was no other treatment and a biologic really worked well, you could set a higher product price.]

I remember a very early conversation with Henri Termeer [at Genzyme] when we were getting [. . .] Ceredase [. . .] approved on how we were going to price it. We did a lot of calculations and we knew what it cost us to make [Ceredase]. We were only [producing] it on a relatively small scale. [. . .] It cost six hundred thousand dollars per patient per year at that point in time. We launched [Ceredase] at [a price of three hundred thousand dollars per patient per year—and the therapy was for life. We were shocked at this pricing], but I remember Henri just looking at me, and [saying], "We have to." He had [nerves of steel] to do that. [And remember

to produce it], it cost us twice [as much as what we used for the launch price. We were assuming we would have some economies of scale, but had no idea how many patients there were in the world with Gaucher disease.] It took six months to go up the growth curve [and scale up. We recruited patients], kept the same price, and brought manufacturing costs down. But for six months we lost money. Then, after six months we broke even and then eventually got the cost [low enough that Ceredase] was profitable.

JONES: Did that make sense to you? Were you confident that [you were going to achieve that]?

TAUNTON-RIGBY: Yes [and no!] As a scientist [. . .] I would not have thought it through in the same way that Henri did. Henri was another visionary in this industry and he clearly saw what you had to do to make it a commercial success. He was [someone else with] fabulous instincts. [. . .] Cerezyme is still [one of] the world's most [successful but] expensive drugs.

[. . .]

[We took an enormous risk at Genzyme. When Ceredase was first launched] we did not even know if there were enough [Gaucher] patients. [Initially,] we got the patient numbers completely wrong. [. . .] When we did the R&D partnership to support [the development of] Ceredase, we thought there were ten thousand patients in the US and that the product would be priced at seventy-five thousand dollars [giving] a seven hundred and fifty million dollar market. There are actually only about twelve hundred patients in the US, and only about five thousand worldwide. [. . .] **<T: 60 min> [**In addition when we launched the Ceredase], we only knew the names of fifty people, in the whole world with [Gaucher] disease. [. . .] [Which of course, also means] you do not need ten thousand sales people! [We launched Ceredase with eight sales people for the US.]

JONES: What was Mark Skaletsky's role at Biogen?

TAUNTON-RIGBY: [Mark] was Chief Operating Officer [. . .].

[He] was not a scientist. [. . .] I worked very closely with him on bringing technologies and projects into the company. Wally had to sign off on the science and Mark had to sign off on the business side of it. Mark was there for a long time [and] did a great job. [. . .] When I joined Biogen the big race was with Genentech and GI [Genetics Institute] to clone genes, and to file the patents on the proteins. The big race was cloning [and patenting. If you were first on the protein patent you could block others].

JONES: The group here in Cambridge was small?

TAUNTON-RIGBY: It was initially. [Biogen had a nice] building, but it was small. [. . .] I don't remember the full numbers. [Much of] the cloning work was being done in Europe, but they were beginning to build a small manufacturing plant here.

[. . .]

JONES: What were your perceptions of what was going on at Biogen? [. . .]

TAUNTON-RIGBY: As I said the race was [to clone] genes, and to control the rights to [them]. Biogen [lost many] of those battles. GI [won on] the blood factors, Genentech [cloned a number] of enzymes, [like TPA]. [Biogen won on the interferons].

JONES: **[**You had world-class scientists] Wally Gilbert, Charles Weissmann, Phil Sharp, Ken Murray. [. . .]

TAUNTON-RIGBY: [Yes, but remember the technologies we had then are not the same as those we have today.] Every company used different viral vectors and different plasmids for [inserting genes] into cells. [It was a lot of work] to screen [clones] to find [one] that produced [. . .] the full protein in the full amount. [. . .]

JONES: You were at Biogen for a little over a year?

TAUNTON-RIGBY: [. . .] Yes, I left because of the travel. [. . .] As I said, [Biogen] had wanted me to be based in Geneva, and I [had said no]. But I still had to go to Geneva every three or four weeks [for four to five days]. The travel schedule was **<T: 65 min>** really [tough for my family. So when an executive search firm called I listened]. I left and I went to work for Damon Biotech.

JONES: Tell me about Damon Biotech.

[. . .]

TAUNTON-RIGBY: **[**I did not actually work for Damon Biotech. I was recruited to be General Manager of] a subsidiary company called VivoTech. [This company] was a joint venture between Damon and Connaught Labs [(at that time Canada's largest pharmaceutical

company)] to develop encapsulated [pancreatic] islet cells [for use as an artificial pancreas to treat diabetics. The idea was to implant the encapsulated cells] in the peritoneal cavity. [The cells would be protected, yet respond to glucose levels by making insulin which would be released].

JONES: How did that work?

TAUNTON-RIGBY: The technology worked well [for] a relatively short time frame. The alginate capsules became overgrown [with cells that blocked the pores. The] body responds to something that [it sees as] foreign by coating it with cells. [. . .]

JONES: Immunogenic?

[. . .]

TAUNTON-RIGBY: [It is more the body's reaction to a foreign object. The pancreatic cells make many proteins including growth factors.] They do not just make insulin. There are nutrients going in, waste products [coming] out and the body is probably responding to some of those. [. . .]

[There were many technical challenges with this sort of technology. Getting the right pancreatic cells—the islet cells is one problem]. Patrick Soon-Shiong [. . .] was one of the [surgeons] we worked with on trying to isolate pancreatic islet cells. [. . .]

[The diabetes knowledge] was coming from Connaught Labs—[they were a major provider of insulin for diabetics. The alginate] capsule [technology came] from Damon. [. . .] [The joint venture, VivoTech, was formed because neither Damon nor Connaught was prepared to license their technology to each other. Both put money and technology into the JV].

[However, Damon and Connaught had agreed that after two years there would be an evaluation of how to continue funding VivoTech. Under the agreement], if one company did not put [an equal amount of funding into the JV], the other company could take the technology and use it. Damon ran out of money and could not put [any more] money in and so Connaught [was able to use all of VivoTech's and Damon's technology]. Connaught took over [the whole program and moved the company to Toronto. They] wanted me to move to Toronto but I did not want to go [there] any more than I wanted to go to Switzerland. [. . .]

JONES: Where was the company located?

TAUNTON-RIGBY: We had offices and labs in Needham at Damon's facilities. [. . .]

Damon [Corporation] made instruments for diagnostics, [it was a big company, but] they also had the technology for [cellular] encapsulation [using] the alginate capsules. [. . .] They formed a subsidiary, Damon Biotech, to use the encapsulation technology [for growing mammalian cells on a large scale for protein production. They had contracts with a number of biotech companies to manufacture proteins].

Abbott Bioscience [. . .] eventually bought that technology from Damon Biotech, and the encapsulation technology [was continued at] Abbott Biotech in Worcester. **<T: 70 min>** [. . .]

[Vivotech's work was continued at Connaught, but] was never fully commercialized. Patrick Soon-Shiong [went in some different directions and as you know has been very successful].

JONES: [What did you do next?]

[. . .]

TAUNTON-RIGBY: I [moved to ADL (Arthur D. Little) a research and consulting organization. By the mid to later 1980s] pharma [scientists] had realized that biotech was useful, it was great for research, [and that biologics could be used as products. Big pharma] wanted to get into biotechnology! [. . .]

[ADL had a significant consulting business with the pharmaceutical industry. So I was brought in] to go into these big pharma companies and help them [. . .] restructure their R&D [organizations to bring in molecular and cellular biology skills, and help them develop biotech programs]. I worked with Boerhinger Ingelheim in Germany, [and Sandoz in Switzerland]. The work at J&J [led to] Ortho Biotech. [. . .]

[I really enjoyed the business challenges at ADL], but again the travel was horrible. [. . .] So, when Henri Termeer approached me in the middle of 1987 [to start to build a biotherapeutics business, I went to Genzyme

JONES: [When you were working for ADL] did you [encounter any resistance when you went] in to these organizations?

TAUNTON-RIGBY: No, [big pharma had woken up]. They were desperate to get into biotech by this point. [. . .] They no longer just wanted a "window," they wanted to get in and get in as fast as possible, [and not miss the boat].

JONES: Were they able to do it? How effective do you think they were in making the transition?

TAUNTON-RIGBY: [. . .] Today, every pharmaceutical company has [extensive] biotechnology skills. [Their focus is a little more on the development stage, —clinical trials, manufacturing, FDA etc.—and of course on marketing]. Today, I [tend to refer to early stage, startup companies as the biotechnology industry. Large companies like] Amgen, Genentech, and Genzyme [as] biopharmaceutical companies. [. . .] Once Genzyme got to be five [thousand to] ten thousand people, [. . .] the company was no longer an R&D driven company, it was a sales driven [organization]. It is important to get [revenues] to fund the research. So companies change. When they become focused on sales, [. . .] R&D becomes secondary and they are no longer as innovative. [. . .] Genzyme is not innovative [in the same way now as it was twenty-five years ago. Genzyme no longer develops many of its products from internal, basic research. These large biopharmaceutical companies are] competing with [pharmaceutical companies] to buy projects [. . .] when they are in the clinic. [. . .] So I call them biopharmaceutical companies. Biotechnology [involves] the small entrepreneurial [research companies] developing new technologies. [. . .]

JONES: It is not a secret that big organizations are not [always] good at [innovation].

TAUNTON-RIGBY: [Correct]. When I joined Genzyme [the company was small. It] had two product businesses—[Genzyme had] bought the old Koch Light pharmaceutical intermediate business in [the UK and a diagnostic enzyme business] from Whatman Reeve Angel. [. . .]

Henri wanted to build a [biotherapeutics] business. [Genzyme] had a contract with the NIH to [produce] an enzyme called glucocerebrosidase [that was being tested at the NIH by Dr. Roscoe Brady as a treatment for children with a very rare disease called Gaucher disease. The enzyme was present in small quantities in placental tissue. So Genzyme scientists were going] across the road to the Tufts Medical Center, bringing back placental tissue, chopping it up in the lab **<T: 75 min>** and extracting the enzyme. [. . .]

[Henry Blair at Tufts, one of the founders of Genzyme], had an [NIH] project with Roscoe Brady but it was more than Tufts could handle, so it was [transferred to] Genzyme to make the [. . .] bulk enzyme [for] the NIH. [. . .]

[At Genzyme we could extract the enzyme] under conditions that were a little more controlled [than in an academic lab. You have to worry about viruses and so we had to develop techniques for inactivating viruses]. Hepatitis is the big challenge, [although everyone] thinks of HIV. [. . .]

JONES: Hepatitis is harder than HIV?

TAUNTON-RIGBY: HIV is simple [to inactivate], if you treat [the virus] with alcohol it is [inactivated]. [. . .] But hepatitis is much more difficult.

JONES: To kill?

TAUNTON-RIGBY: Yes. We [had to] develop multiple [processes to inactivate viruses]. We had to be careful [not to] denature the [glucocerebrosidase] enzyme. We worked with the New York Blood [Center and used their viral inactivation procedures. We adapted the technology to be able to use it with placental tissue. We] scaled up and then [transferred it] to [. . .] the Pasteur Merieux Institute in [Lyon,] France.

In France, in the ’70s and ’80s [you could only use donated blood for blood transfusions]. You [were not allowed] use leftover blood donations to extract blood coagulation factors [. . .], like Factor VIII for example. So, [in France] they were collecting placental tissue, which is basically just a bag of blood, squeezing it, getting the blood out [. . .] and throwing the tissue away. [They used] this blood to make blood products. [. . .]

We wanted the tissue [that they were throwing away, because that could be a source of our] enzyme. It was a great partnership; we actually set up our own facilities in Lyon, France, in a [. . .] building next to where they were doing the bloodwork, and did our initial chopping and extraction there, then sent a crude frozen extract [to Cambridge where it was purified].

JONES: [. . .] That’s a [huge operation, it requires a lot of placentas, right?]

TAUNTON-RIGBY: Oh, millions. In fact, the irony was that some of the placentas [would be] collected in the US, shipped to Lyon, France, because they [were sourcing] tissue from all over the world to get enough for their Factor VIII supply.

JONES: So this is why [Ceredase] cost seven hundred thousand dollars?

TAUNTON-RIGBY: It is one of the reasons, yes. But also why Cerezyme [the recombinant version is more] profitable.

[. . .]

JONES: You were senior vice president?

TAUNTON-RIGBY: Senior VP of Biotherapeutics. **<T: 80 min>**

JONES: [. . .] You were overseeing this entire program?

TAUNTON-RIGBY: Yes. Jim Rassmussen was the VP of R&D so he directed the scientists in the lab. Henri wanted to build a biotherapeutics business, so that was my mandate. One of the technologies was this, the enzyme, which became [Ceredase and the recombinant form], Cerezyme. [Genzyme] also had a technology for making [and modifying] hyaluronic acid. [. . .] So we eventually did a big R&D partnership [for funding, and this] turned into the Seprafilm products, the surgical aids. [. . .]

Those were the two big [programs at] that early stage. [. . .] Then [Genzyme] bought Integrated Genetics. Once we [. . .] knew [Ceredase] worked, and by the way, we knew [very soon] after starting the trial because every patient responds beautifully. It is a drug that really, really works—in children who have a devastating disease. [Ceredase is well] worth the [cost]—I have no problem with the [high cost because the enzyme] changes people's lives.

But once we realized Ceredase worked, we knew Genzyme did not have recombinant DNA skills. [. . .] So [we bought Integrated Genetics in] 1989, because we needed their recombinant skills. [And] that brought in [several] more recombinant projects. Thyrogen came from Integrated Genetics. By the way when Integrated Genetics did their due diligence on Genzyme to see whether they wanted to be bought, [. . .] Alan Smith told me [that he and Bob Carpenter], never thought Ceredase would ever be a success! [. . .]

By the way [Integrated Genetics was] involved in those very early days [with the race] to clone [and patent] genes. [However], they lost [the patenting race several times. As a result IG was a potential candidate for acquisition. IG employed many] really good scientists, [and was a great addition to Genzyme].

[. . .]

We [knew] that if Ceredase worked, we would [need] to switch to recombinant form. [However, Genzyme really did not] invest much money in [recombinant technology] until we knew the Ceredase clinical results. [. . .] [Integrated also had CHO cell culture technology skills and] had developed the [techniques] for growing CHO cells on beads. [. . .] So, [the acquisition] was a good marriage on the technology side. Of course, [luckily the IG scientists] were wrong about the Ceredase [sales potential, and] Ceredase was a [tremendous] success.

JONES: Yes.

TAUNTON-RIGBY: Of course if Ceredase had not succeeded, Cerezyme would not have been either.

JONES: Right.

TAUNTON-RIGBY: **[**Acquiring Integrated also brought us Thyrogen, which we took through clinical trials and launched.]

JONES: [So, were you looking around for other opportunities in addition to Integrated Genetics?]

TAUNTON-RIGBY: Yes. [We developed the hyaluronic acid products funded with R&D Partnership], so that became a big program.

JONES: **[**But was Genzyme interested in developing more] recombinant technologies?

TAUNTON-RIGBY: Oh, yes. [Henri was very acquisitive]. Bob Carpenter played a big role in [what] Genzyme is today. He went on the board because he was the CEO [of Integrated Genetics] and he actually came into the company for a while. [. . .] Bob [worked] there for about a year, but [. . .] then stepped out of the company and started [his] Angel investing group with the Baxter Boys. [. . .] Genzyme eventually bought [some of the companies that he helped start].

JONES: Yes.

TAUNTON-RIGBY: Renagel came from one of [Bob's] companies and [also] Biosurface Technologies. [. . .] But I had left by then. I became CEO of Mitotix, which was a cell cycle company.

JONES: You [had been] successful at Genzyme [though], **<T: 85 min>** you brought in all this [technology and developed all these important products].

TAUNTON-RIGBY: Yes. Genzyme was great, but it became a very different organization. Once it became a big pseudo-pharmaceutical company with big sales, [the focus changed. Henri was a marketing and sales expert and his interests were on the revenues and profits].

[. . .]

JONES: But you felt like your job there was done?

TAUNTON-RIGBY: **[**Not really, but] I was recruited to be a CEO [of another company].

JONES: [. . .] What [was it] about this opportunity [that] was appealing?

TAUNTON-RIGBY: Mitotix was very interesting. [. . .] Cancer cells are largely malignant because some of the controls involved when a cell divides into two, are altered [. . .] genetically. So, [the controls] do not work. There [are a number of] switches [. . .] called cyclins—cyclin D, cyclin E—[that control the cell as it divides]. Mitotix was focused on cloning [these switches and] enzymes, the cyclins. The ultimate goal was to develop small molecules that would inhibit [these cellular switches], which presumably would be cancer drugs. So, I [joined. The company had] great science, [but needed financing]. I raised [. . .] the biggest series B financing [that had been completed at that time and] got the company well set up.

JONES: You came in after [the A round]?

TAUNTON-RIGBY: Yes, the company had no CEO. It had about twenty-five to thirty people and was VC funded and so the series A was [complete]. I came in [and raised] the series B, and expanded the group of investors [who were involved in the company]. We then had significant money, but it was basically [a case of having] to sit and watch while the science ticked along, and I hate to say it but I found it boring sitting waiting for the science to work. About the same time [I was approached about another company], Cambridge Biotech. [CBC] was at that time the tenth largest biotech company in the world by sales, [but] had been put into bankruptcy proceedings because of accounting fraud by the previous CEO. [I was recruited by the board as a Director and as CEO, to try to turn the company around and exit Chapter 11]. And that seemed to be an interesting challenge to me.

JONES: It was a business challenge?

TAUNTON-RIGBY: It was both [business and science].

[. . .]

Cambridge Biotech had a [large] diagnostics business, [including] the gold standard HIV [diagnostic] test, [used worldwide to confirm the disease. Another scientific area was infectious diseases and adjuvants].

JONES: Was this [company started by] Bill Haseltine?

TAUNTON-RIGBY: Yes. He was involved in the early days of the [company], but he was gone by the time I was there.

[Cambridge Biotech] had built a huge business. [While] it was the tenth largest by sales, of course [. . .] that is not big by today's standards. [. . .] The [products were not sold] under the Cambridge Biotech label. We sold to [Bayer Diagnostics, Merieux Diagnostics, and Abbot Diagnostics]. We made all the materials and reagents that went into [diagnostic] kits [for] those companies, and also had a reference lab [where we] ran a lot of diagnostic [tests]. **<T: 90 min> [**CBC] also had a [growing] therapeutics business, which was based on infectious diseases. [. . .] [The company] had an adjuvant, QS 21, also called Stimulon. [. . .]

[CBC] had several [research] contracts with [pharmaceutical companies, including] Smithkline-Beecham,[to make and provide the adjuvant for improving the immune response to vaccines**.** CBC] had fifteen clinical trials ongoing with [various] partners using this adjuvant. [. . .] So there were some research revenues, but mostly revenues were from the diagnostics business.

[After the Chapter 11 bankruptcy filing, the CFO and the CEO were both fired]. When the company [had become] profitable [these executives had altered some dates on financial transactions to try and] keep a nice, smooth growth curve. [. . .] But businesses are not like that. The accountants found [the changes, and withdrew their financial] opinion concerning the accuracy of the financial statements. The stock price dropped, and the company had to be put into Chapter 11 reorganization. The board realized that they needed someone who knew science, because there were four or five [technology programs], but they also needed someone who knew business, to be able to unravel the mess that had been created.

To cut a long story short, we did turn the company around. The diagnostics business was not profitable when I joined. We had to make it profitable so that we could sell it [and] raise money to get out of bankruptcy. [We] could not sell the therapeutics business because [the programs were] all still in the clinic. [. . .] No one could value [them] properly. [. . .] If we could make [the diagnostics business] profitable, we could [use] a PE ratio and put a hard value on it. So, we turned [the diagnostic business] around, made it profitable and then sold it through a bankruptcy auction—an interesting process. The bankruptcy judge made [us go and solicit a series of bids to buy the diagnostic business. The companies that bid, all came in with low

offers, so the judge] set up a bankruptcy auction. [. . .] He made [the bidders] come to court with [their bids in the] sealed envelopes. Then he opened [the bids] in court, having agreed that the business would be sold to the highest bidder. [Interestingly] every one of the three or four companies that were serious, came with bids that were now [suddenly much higher] and interestingly, [all very close in their numbers. They were all within a few dollars of each other].

[. . .]

The judge made us go into a backroom, and we were given one hour to evaluate the three [best] offers, [. . .] and [determine] which was the most valuable to the creditors. [. . .] [We recommended that the judge select the bid that paid] an immediate stream of money, but a slightly lower [overall] number. [. . .]

We eventually sold all the diagnostic businesses and satisfied most of the creditors. [However], we lost half the employees [while in bankruptcy—good employees were constantly being recruited out of the company. While in Chapter 11, we could not hire new employees, so] by the time we came out of bankruptcy, half the people in the company were contract employees. [After bankruptcy, we did everything we could to distance ourselves from the tainted history. So we changed the name and even moved location. The therapeutics vaccine and adjuvant business became Aquila Biotherapeutics. We did not want to have anything to do with the old history].

[. . .]

JONES: In the auction, was that the right valuation? What was your valuation?

TAUNTON-RIGBY: We had to convert it all into a direct valuation, into dollars, [. . .] because the dollars were going to be used to pay down debts and pay off the creditors. And to partially fund the new company that was going to come out [of the bankruptcy. The creditors] were given shares in the new company as well. [. . .]

I do not remember the exact numbers but I do remember how low the first bids were and how much better, [but] close, [all the subsequent ones were]. [. . .] If we thought the numbers were still not good deal we would have told the bankruptcy **<T: 95 min>** judge that the business was still undervalued. [. . .] Of course, we had investment bankers as advisors to help us value [the businesses], as we were breaking up the company. [And there] were lawyers and all sorts of people giving us additional advice, as to what numbers we should accept or not accept.

JONES: So this was, for you, a very novel process.

TAUNTON-RIGBY: Oh, yes. By the way when Enron came along, everything Enron [was reported to have done], I was familiar with. [. . .] The trouble is, a CEO's personality and style ripples through a company and if the CEO is willing to be crooked you find it [trickles down. CBC had already terminated the CFO, but I had to terminate] almost everybody in the finance department [. . .] after I stepped in and started asking questions. I still remember [. . .] I questioned [an] expense account report from a consultant. [. . .] He [had charged] for phone calls [placed] at the same time as he was supposed to be on a plane (this was before cell phones) [and had charged for a dinner in yet another place]. I had a junior person in finance look at it all in more detail and I said, "I cannot believe someone put in a fake expense report form." She looked at me, pulled open her bottom draw and she [took] out a stack of papers and said, "Every one of these is false." She had collected [. . .] them all. I asked her, "Why didn't you say something about." She said, "I would have been fired." [. . .]

[When fraud like this happens it comes from the top]. Every time I turned over a stone I found problems, it was a mess. Did I learn a lot? Yes. I learned that about the myriad ways that companies can, in gray areas, interpret [things] in slightly different ways and the problem is the more junior people cannot say much [beyond], "Are you really sure?" [. . .] because they are worried about their jobs. That is what was happening at Cambridge Biotech. [. . .] You have to get to a clean slate. You have to be confident in people.

The science was sound; [in fact] the science of that company was superb. Jerry Beltz was the head of R&D and straight as a die, and that is probably the main reason the company came out of bankruptcy and survived. By the way the technology [is still out there]. Aquila was then bought by [a company called] Antigenics, which changed its name to Agenus. [. . .] [A significant] business [for Agenus is the QS 21] adjuvant, [. . .] which is a component of several of [GSK's] vaccines. The science was solid; that is why [CBC] could come out of bankruptcy, survive and keep going as a standalone biotech company.

[. . .]

JONES: You testified to a house committee on human cloning [at one point]? [. . .]

TAUNTON-RIGBY: Yes, I did. I have testified on a lot of issues. I testified on SBIR [Small Business Innovation Research] grants, back when I was at Collaborative [Research. In the 1980s one of issues for the government involved patent rights to technology discovered using grant money. This was before Bayh-Dole. Companies did not commercialize technologies, as they had no rights to any patentable inventions discovered using grant money]. That was the biggest change that went into SBIRs, [allowing] the companies the patent rights because then they [could and] would commercialize [the discoveries. I testified before Congress on this issue]. [. . .] I also [testified] on the pricing of drugs with Henri [when I was] at Genzyme. And I testified before the recombinant DNA advisory committee.

JONES: At Collaborative?

TAUNTON-RIGBY: Yes, [and when I was at other companies. I also testified] on [the] safety [of recombinant technologies] and what we should be doing about [city] ordinances and [local regulations versus federal rules, concerning how to control rDNA technology]. I testified on a lot of different things over the years. **<T: 100 min>**

JONES: [I did have a question about] talking to the various city officials. What were their attitudes? They were waiting to see what Cambridge [would] do, but they also wanted to get the business, right?

TAUNTON-RIGBY: Exactly—and that was their big dilemma. Local people were [quite] scared, as the Cambridge newspapers were writing about how there were going to be green monsters coming out of the drains, and running around Cambridge. [. . .]

We had [. . .] a lot of public meetings [in Waltham and Lexington], where we would go and talk and try and explain what we were doing in very simple language, so that [the public] would not be scared, but also then going to the council meetings. We actually had to help write the [right] language, where it would meet their needs and meet our needs at the same time. So, it was a long [process] in each of those two towns. It took well over a year of handholding. [. . .] For a long time we had a facility in Lexington but could not do recombinant DNA work there, but we could still do it in Waltham. [. . .] We eventually [received approval and] moved the whole company to Lexington, [. . .] but there was an overlap period because it took time to get the ordinances [approved].

JONES: Did they in fact wait for Cambridge?

TAUNTON-RIGBY: I believe they were after Cambridge. Cambridge was the first and Cambridge by then, by the way, was the most restrictive. So, we actually almost had an advantage [. . .] once we got legislation in these two towns [(Waltham and Lexington)]. That is also why Lexington and Waltham have become hubs of biotech because they [approved rDNA use] early and with much simpler regulations than Cambridge.

JONES: You were at [Aquila Biopharmaceuticals] until about 2000 and then on to something else?

TAUNTON-RIGBY: Yes, [After Aquila was merged with Antigenics, I moved to] Catharsis Medical Technology [CMT]. It is a device company, VC funded, started by a nurse who had had

a medical error, [a drug error,] when she was [a patient in the hospital where she worked]. She developed a technology that involved a bar code on a patient, a bar code on the drug and a bar code on the infusion pump. [The bar codes] could be scanned and checked against a database [to determine if this was the right drug], in the right patient, at the right time, at the right dose, and [was] compatible with all the other drugs that the patient was on. [It was] the forerunner of [the kind of thing] that today is universal in hospitals [and pharmacies]. [. . .] She had [experienced] a medical error, on herself, and went out and started this company.

[. . .]

I spent a lot of time with them, [but the company had challenges because] they did not have [enough] money. Very soon after that, I also started RiboNovix with another group. The biggest problem with CMT was that most hospitals fully admitted they needed the technology, but they were not willing to buy [it] from a small company. [. . .] Because [the technology] involved changing medical practice, there are huge liability issues and the hospitals would not buy from a small company.

JONES: Because [they thought that was risky]?

TAUNTON-RIGBY: Because small companies do not have deep enough pockets to [. . .] support the liability.

JONES: Because their name is going to be on the lawsuit too and they would be [liable too]?

TAUNTON-RIGBY: Yes. I am on the board of Boston Children's Hospital [BCH]. [Many years ago when BCH signed its first IT] contract with Cerner, [BCH] demanded that [Cerner post] a thirty billion dollar bond, because if Children's [. . .] sued and it turned out [there was a problem with the IT system, and Cerner had some errors in the coding, BCH would have a claim on Cerner]. Children's [would be very unlikely] to buy from a little startup company. This is a lesson I still have to tell **<T: 105 min>** entrepreneurs who think they have got the latest, biggest gizmo that [everyone will want. When] you are a small company it is very hard to sell. The [customer] cannot take the risk.

JONES: Yes.

TAUNTON-RIGBY: CMT fell into that trap. [. . .]

[In 2003 I co-founded] RiboNovix with Phil Cunningham of Wayne State [University in Detroit]. RiboNovix came [about] because [. . .] I gave a talk out in Michigan. [. . .] The [state]

wanted to try and build a biotech business [cluster. Michigan used to be home to a number of pharmaceutical companies. But Pfizer consolidated much of the Michigan business], by buying other pharmaceutical companies and then consolidating and [laying off scientists. Some Michigan based venture capital funds were started] and one of them was called Arboretum Ventures. When I went out to [. . .] talk about how to get into [the] biotech [business], Arboretum Ventures approached me and asked me to be on their advisory board. At the same time Wayne State [introduced me to a professor (Phil Cunningham) who had invented some interesting technology, and asked me to evaluate the patents and research, and advise them as to whether a company should be formed. With a group of scientists, who actually were from] Cambridge Biotech, we took a look at [the technology, and recommended] that it should be commercialized. [Phil Cunningham and Wayne State asked us to help them]. So, that is how I got involved in [RiboNovix]

JONES: And [what was the technology?]

TAUNTON-RIGBY: [RiboNovix has] a technology that allows [understanding of the] mutations that occur in ribosomal RNA, that interfere with ribosome function. [Many] antibiotics [. . .] work because they bind to the RNA in the ribosome, and they stop RNA [from] functioning. But [the genetic material in bacteria] randomly mutates, and if [a cell picks up] a mutation in [the ribosomal RNA at] a site where the antibiotic binds, then [the antibiotic cannot bind. The bacteria will become resistant to the antibiotic, and so the bacteria can keep multiplying. However, if you can identify these critical sites in the bacterial RNA, that are essential for ribosome function, and target your antibiotic to bind to these regions, then antibiotic resistance will not happen]. Phil Cunningham had developed a [novel] technology to [identify and] target the critical regions of the ribosomal RNA. [RiboNovix was formed] to develop [a new class of antibiotics].

[RiboNovix was very successful in winning a number of NIH grants. In addition there was] significant interest from the pharmaceutical industry. [. . .] [However, to prove the concept we had to find these immutable RNA locations, and also find small molecules that would bind here and inhibit ribosomal function. We did find some active molecules but were not successful enough in finding enough funding to really develop these molecules. There has been very little pharmaceutical investment in developing new antibiotics—the development costs are high, and it is hard to recover costs on a product that is used for only a few days].

[RiboNovix] technology has gone back to Wayne State University [where the scientists are developing] it further. [One of today's challenges is funding early-stage research outside of an academic setting. Companies have little interest in new molecules] unless they are in the clinic. [. . .] RiboNovix could not get over [the chasm from research to the clinic], so the [technology] went back into the university lab.

JONES: You have any ideas for solutions to that problem?

TAUNTON-RIGBY: No. If I had, I would be [very rich!] Because so [many companies] have that problem and it is a big problem. [In Massachusetts], we have the Mass Life Science Center and the state is putting some money into grants and loans, trying to help fill that gap. Massachusetts is doing a great job, but [the MLSC] tends to only fund things that are already getting funding from someone else. [. . .] No one wants to be the lone funder—too big a risk. If [too many of the loans from the MLSC failed] the state would shut down [the program].

JONES: Yes.

TAUNTON-RIGBY: So, [our industry has] a challenge—how to fund really innovative high-risk research. When it comes down to it, [so many research programs do] not work out, [at least in a reasonable time frame. Many of the VC firms have lost money over] the last ten years.

[. . .]

I do not know what the answer is. The [funding gap] can be [many years]. The VC cycle typically [means the fund manager wants] to be in and out in five years. So does public funding. I am on a mutual fund board. The average [holding time] for a mutual fund portfolio manager is less than a year! **<T: 110 min>** [. . .]

The old [biotech business] model used to be, clone a gene, [file the patents, and take the company public]. The [IPO] funded the [clinical trials, and then a pharmaceutical company picked up the marketing and sales. That business model has gone. Now it is hard to find funding for the pre-clinical and early clinical testing. We call this the valley of death!]

[. . .]

[For the last two years,] I have not worked for any one company [. . .]. Currently, I sit on five boards, three are in healthcare, and two are in financial services. [I am also involved in some non-profit work, Boston Children's Hospital, and help with several mentoring programs focused on women leaders and entrepreneurs.]

JONES: [What is Abt Associates, where we are now?]

TAUNTON-RIGBY: [I am on the board of directors at Abt Associates. Abt is a government contractor that carries out international development work. Many programs are] research and technical assistance, [. . .] and sixty percent of the work is in healthcare.

JONES: Contract research or . . .?

TAUNTON-RIGBY: **[**The most important program sponsor is] USAID. When the US government [agrees to give] financial aid to [a country most of this is achieved by setting up programs in that country. Abt is one of the contractors who will do this and manage the programs. They work in some very challenging parts of the world—mostly developing countries.]

I just came back from [. . .] the Dominican Republic visiting some of the projects that Abt [is running there] for USAID. [Abt] is trying to improve the health care system in the Dominican Republic [and improve food security. In the US, Abt is responsible for many research and evaluation projects, to understand if government programs are working as intended. So, for example when you read] that X percent of the population has been vaccinated, Abt is behind those numbers. [. . .]

[As I mentioned, Abt carries out food security work too]. We visited a chocolate factory in the Dominican Republic. It sounds fancy, but [the facility is a co-op for local farmers and enables them to process their cacao beans and make a profit]. USAID bought the machines to [allow the locals] to grind [their own]beans and make chocolate [for sale. They get to keep more of the added value].

[. . .]

[Three years ago, the Abt board] went to Mali [in Western Africa]. We visited [some] villages where Abt [had] built dams across streams [. . .] to flood [the fields], so [that the villagers] could grow rice. [USAID provided biotech strains of rice that would grow in this region of Mali. The soil is very poor and rice would not normally grow in that region. Now the women of the village grow rice, and the men continue to herd cattle].

[. . .]

By the way, I never realized this. [One] reason Mali, [and also many other African countries are so poor is that] the government officially owns all the land. [The government] rents land to the farmers. However, [if the farmers are only renting there is no incentive to take care of the land. A farmer with a five-year lease, will not rotate crops, nor use fertilizer. After repeated use with the same crops, the land is striped of the nutrients for that crop. The farmer just moves on. He has no long-term vested interest in protecting the health of the soil]. So, that is one of the reasons [why there are food production problems].

[. . .]

JONES: The governments are not listening to economic advisors?

TAUNTON-RIGBY: There is no way these governments would change who owns the land, that is their main source of revenue. [There is no income tax revenue—these countries have cash economies]. [. . .]

Abt has more employees outside of America than it does inside. **<T: 115 min>** But they are working in the places where you do not go on vacation! [. . .] Abt [is managing several] malaria projects, in South America [and Africa]. [. . .] Abt is a great company because it is, like biotech, mission driven. A [number of Abt employees] are former Peace Corps or Teach for America volunteers. [. . .] The mission of this company is to improve the well-being of people worldwide. [. . .]

JONES: **[**How did you first get involved?]

TAUNTON-RIGBY: I have known [. . .] Clark Abt, the founder of the company, for about twenty years. [. . .]

[In addition, I sit] on the board of Healthways, [a company that is involved in] health and wellness. [Healthways manages well-being programs for many large employers and health plans.]

[I am also on the board of Boston] Children's Hospital, where I [chair the Patient Care and Assessment Committee, which oversees] the safety, quality assurance, and service programs of the hospital. It is a wonderful [organization, a great place to work]. [. . .]

I am [also on the board of] Columbia Funds, which is a mutual fund [complex]. And I [am on the board of] ICI Mutual Insurance Company. [These companies asked me to sit on their boards as I had learnt so much about financing] companies, how to raise money [and how to value a company from my involvement in the biotech industry]. When the chairman of the board at Columbia [Funds] first approached me, [at a breakfast] in Boston, [he made the comment]—"I bet you have never been to Minneapolis." [(Columbia Funds is headquartered in Minneapolis). I told him I had been to Minneapolis] about a hundred times, and [mentioned] a long list of the portfolio managers that I [had met with when selling IPOs, R&D Partnerships etc.]. He realized [. . .] it would be good to have someone who had been selling [to portfolio managers in the boardroom, since portfolio managers spend their days buying stocks].

[. . .]

[I am also on a number of advisory boards—BU School of Public Health], the Mass Life Science Center, [. . .] Springboard Enterprises, [an organization which helps] mentor women entrepreneurs, [. . .] BSCP (Biomedical Science Careers Program) [a local Boston program] to help minority [students] build careers in life sciences and medicine. [. . .]

JONES: OK. Thank you so much. A wonderfully varied career.

TAUNTON-RIGBY: Fun.

JONES: Yeah.

TAUNTON-RIGBY: I have always had fun. I have been able to work on [interesting] science, great products and [with wonderful] people, and I have always enjoyed what I do. I always learn from all of [the experiences]. You have to keep learning. [The companies I have worked with] are all [organizations] where I hope I have been able to give [to as well receive. I do not plan on stopping working—I am just involved in different activities].

JONES: Good. There is no reason why you should [stop working]. [. . .]

TAUNTON-RIGBY: Yes.

JONES: Thank you so much. [. . .]

[END OF AUDIO, FILE 1.1]

[END OF INTERVIEW]