Ars Synthetica: Designs for Human Practice

By:
Paul Rabinow
Gaymon Bennett

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C O N N E X I O N S

Rice University, Houston, Texas

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Table of Contents

1 Invitation: Synthetic Biology and Human Practices: A Problem 1
2 Orientation. Toward a Diagnostic of Contemporary Equipment 11
3 A Diagnostic of Equipmental Platforms 21
4 Test Case. Figuring Human Embryonic Stem Cells 47
5 Prelude. Framing an Experiment 73
6 Manifesto 2006. From Bio-ethics to Human Practices 75
7 Human Practices 2007. Interfacing Three Modes of Collaboration 83
8 Synthetic Biology 2007. From Manifestos to Ramifying Research Programs 99
9 Lessons Learned 2008. Discordancy 113
10 Test Case. Trust but No Confidence: Benign Indifference or Malign Neglect in Synthetic Biology 123
11 Recapitulation. In Search of a Venue: Biopower and Synthetic Anthropos 135
12 Rectification and Ramification. Toward Ars Synthetica 143
Index 153
Attributions 154

Chapter 1

Invitation: Synthetic Biology and Human Practices: A Problem[1]

Two Tasks: to defend the new against the old and to link the old with the new.
—Friedrich Nietzsche. [2]

Two Tasks: to link the recent past to the near future & the near future to the recent past.
—ARC. [3]

Today, in the wake of the various genome sequencing projects of the 1990s, the life sciences are being redesigned and recast with an eye to productive forms of experimentation and organization. Although varied and intensive alternatives are being tried out, it is one of the central working hypotheses in this book that the life sciences, once again, are unsure of their objects, the best venues in which to work on them, and the broader ethical framing of their undertakings. We have undertaken the work that follows—in media res—in the spirit of understanding what is at issue, the stakes involved, and in the hope of taking preliminary steps toward remediating the situation to the limited extent that we have the capacity and the power to do so.

For decades the primary object of interest for the cutting-edge life sciences was the molecule. Major discoveries of far-reaching significance for understanding living beings documented its structure and function; molecular biology and its sister sciences demonstrated that DNA is shared by all forms of life and that it is a remarkably pliable molecule. With the advent of the genome sequencing and mapping projects, it can be argued, the primary object of interest shifted to the gene, albeit understood in diverse manners. Although the gene and genome sequencing projects did not deliver the promised "code of codes," the secret to life, they did provide invaluable, foundational information as well as preliminary insights about the functional and material basis of living systems. High on the list of that information was the discovery that (understood in traditional terms) the human genome contained many fewer genes than had been predicted. It follows, as Sydney Brenner has so astutely observed, that the sequencing projects were "the end of the beginning" of biology, that these discoveries troubled the status of the gene. In our terms, the ontological status of biological objects is in question once again as they had been previously at the beginning of major periods of the growth of knowledge. On the one hand, this discovery means that if there are questions to be posed about qualitative distinctiveness of living beings—and there are—such questions almost certainly must be posed at a different level than the molecular or the genetic, although these remain pertinent and salient components.

[1] This content is available online at <http://cnx.org/content/m18812/1.2/>.

[2] Freidrich Nietzsche, Unpublished Writings from the period of Unfashionable Observations, translated, with an Afterword, by Richard T. Gray, (Stanford: Stanford University Press, 1995),. 276, Notebook 29, p. 212, Summer-Autumn, 1873.

[3] www.anthropos-lab.net (<http://www.anthropos-lab.net/>)

1.1 Synthetic Biology

The dominant (if not unique) mode of rationality guiding the life sciences today is instrumental. The factors contributing to this orientation are diverse: the predominance of the biotech industry as an increasingly widespread model for all scientific research; the demands of funding agencies (private and public) that experimental results be immediately commercialized; the tendency to reduce the worth of science to instrumental norms and the dismissal of those who don't accept this position; and, of course, the express desire both sincere and insincere to make science serve the common good.

As of 2008, one exemplary area of the life sciences is synthetic biology. Although for a time the term was basically a place-holder, or a hoped-for brand, during 2007 synthetic biology began to coalesce into a number of stable research programs. In its early years synthetic biology has received attention from media and funders for two principle reasons: first, the audacious claims made by some spokespersons that synthetic biology will fashion living systems into—pick your analogy—the equivalent of biological Lego sets, or plug-and-play genetic robots, etc. In this way, we are told, biological complexity will be re-factored, and rational design and composition made child's play (that is to say, undergraduates and high school students will be doing it with increasing facility); second, the seemingly unassailable claim that the manipulation of biological systems is uniquely suited to solve the world's most pressing and significant problems. The self-styled prophets confidently assert that synthetic biology is going to discover new therapeutics and lower their cost, afford the means to solve the energy crisis, be the key to bio-security, and repair the environment.

Most broadly, post-genomics has seen the intensification of an engineering disposition in biology: understanding through making and remaking. Living systems, and their components, are being redesigned and refashioned. The challenge, for synthetic biologists, is to take biology beyond the guild-like restrictions of artisanal savior faire and to make it into a full-fledged engineering discipline, with all this entails in terms of standardization, modularization, and regularization. Though there is disagreement about how exactly this feat might be accomplished, there is broad agreement that the goal of standardized biological engineering will require a re-assemblage of scientific sub-disciplines, diverse forms of funding, institutional networks, governmental and non-governmental agencies, legal standards, and the like. Given that in emerging problem-spaces such as post-genomic biology existing expertise is by definition insufficient and that new experts do not yet exist, how to give form to collaboration remains a central challenge whose significance cannot be over-estimated. Although this type of claim is readily accepted and supported when it comes to the life sciences, the same type of claim is rarely addressed and easily dismissed when it comes to the human sciences. We maintain that such a position is dangerous.

1.2 SynBERC: the Synthetic Biology Engineering Research Center

During 2006 a group of researchers submitted a proposal to start an engineering center for synthetic biology—what they eventually called the Synthetic Biology Engineering Research Center, or SynBERC. The ambitious proposal was enthusiastically received by the reviewers and officials of the NSF. Before making the official award, however, NSF officials informed Jay Keasling, a professor of chemistry at UC Berkeley and the future director of the center, that the award was contingent on including an "ethics" component. Keasling et. al. were perfectly willing to accept this proposal although neither the NSF nor the principle scientists and engineers who were to guide the Center had a very clear or well-formulated idea about what such a component would look like or what it would do.

Keasling (apparently) turned to the Dean of Public Policy at Berkeley for advice (or was approached by the Dean). The Dean proposed that an adjunct professor, Stephen Maurer, a lawyer with strong interests in economics, would be a suitable person to lead this component. Keasling, following the informal style of leadership that characterizes his approach to such matters, accepted the proposal. The short tenure of the first occupant of this ethics position was a troubled one. Maurer proposed, and argued forcefully for, two things. First, a mechanism to monitor "experiments of concern". Second, a procedure whereby the "community" of synthetic biologists would vote on a set of regulatory controls that would govern the relations of the nascent DNA synthesis industry and the community of synthetic biologists. The substance of

Maurer's proposals was eventually worked out in a report funded by the Sloan Foundation. They consisted in drawing attention to the need to monitor the solicitation of DNA sequences that could be identified by as yet to be developed software as of possible use in known pathogenic agents. Although the substance of Maurer's proposals were taken to be reasonable and desirable by most of the concerned actors, personality conflicts, and a battle over who set the terms for governance and potential regulation, built to a point of total breakdown. After a contentious behind the scenes set of confrontations, in June 2006, in a melo-dramatic incident, Maurer's proposals were pulled at the very last minute, from the agenda of Synthetic Biology 2.0, at UC Berkeley. This was done without informing Maurer, and no vote was taken.

In the wake of this theatrical turn of events—one that foreshadowed a governance style and a use of unequal power relations that would linger in SynBERC—a proposal was made to Paul Rabinow, a Professor of Anthropology at Berkeley and Ken Oye, an Associate Professor of Political Science, at MIT to jointly direct the so-called ethics, social consequences, public perception, legal considerations, risk assessment, policy implications, component. Both had been speakers at SynBio2; each had found the other's presentation interesting. The proposal made sense as there appeared to be a clear division of labor with Oye concentrating on policy issues, and Rabinow on ethics and the innovations in organizational form as well as the scientific objects to be produced by the Center. Oye and Rabinow accepted. They would henceforth be the co-Principal Investigators of Thrust IV.

1.3 In search of a collaborative venue

It is not the 'actual' interconnections of 'things' but the conceptual interconnections of problems which define the scope of the various sciences. A new 'science' emerges where new problems are pursued by new methods and truths are thereby discovered which open up significant new points of view.[4] **—Max Weber**

During the period 2004-06, a group of (mainly) anthropologists (currently or formerly associated in various capacities with the University of California at Berkeley) undertook experiments designed to create modes and venues more collaborative, scientifically rigorous, ethical, and rewarding than those available in the academy as currently constituted. The impetus for these efforts was dissatisfaction—existing, we discovered in variant forms in multiple different locales—with pedagogy, research design, modes of interaction, as well as existing genres of academic production and dissemination. Experiments were undertaken and within a short period of time, these efforts were formalized as the **Anthropology of the Contemporary Research Collaboratory**, or **ARC**. [5]

In designing a venue for collaboration we took seriously Max Weber's insight into the character of the sciences, quoted above. We sought to constitute this insight as a principle of design for our work. We wanted to design and compose innovative and remediative pathways among the human sciences, the life sciences, and ethics by attending to conceptual interconnections among problems. A number of additional

[4] Max Weber, "Objectivity in the Social Sciences," in The Methodology of the Social Sciences, Edward A. Shils and Henry A. Finch, trans. (New York: The Free Press, 1949), 68.

[5] www.anthropos-lab.net (<http://www.anthropos-lab.net/>) A fundamental distinction, we discovered, exists between collaborative and cooperative modes of work. A cooperative mode of work consists in demarcated tasking on distinct problems and objects, with occasional if regular exchange at the interfaces of those problems, exchanges that are structurally or institutional organized and mediated. As a work mode, cooperation flourishes where problems and their principle features have been stabilized such that a cadre of experts and techniques can grow up around those problems in a more or less rationalized manner. When such conditions are in place, the question of significance and ends can be taken for granted or held stable; means-ends relations can be rendered efficient and productive. Cooperation, however, does not entail either a common definition of problems or shared techniques of remediation. // A collaborative mode of work proceeds from an interdependent division of labor on shared problems. It entails a common definition of problems (or acceptance of a problem-space) as well as shared techniques of remediation. Collaboration is appropriate where problems and their significance are in question, or where the where the heterogeneity, complexity, instability, or dynamics of a problem space requires the skills and contributions of co-laborers of diverse capacities and dispositions. Collaboration requires the reworking of existing modes of reasoning and intervention, adjusting these modes to the topography of the emerging problem-space. The goal of collaboration—of a collaboratory—in our view, coheres with a maxim articulated by Michel Foucault (slightly altered): to increase capacities while not increasing relations of domination or exploitation. If we have found existing work modes and venues insufficient this is due in no small part to their relative scientific and ethical inadequacy to the problems we wish to take up.

design considerations followed. The first: to invent a form of collaborative work required attention to common problem formulation. This task required attention to individuation where appropriate and to de-individuation where preferable. Second, a strong and clear distinction needed to be drawn between individual **projects** and shared **problems**. A collaboratory qua collaboratory addresses problems. Individual projects are selected as means of working on shared problems. This distinction underscored an outside boundary to the space and reach of the collaboratory. But it follows that there is an inside and a specific intensity to the work of the collaboratory. A reflective and recursive return to this point of shared problems, these limits, those processes, must be built into the critical limits of a collaboratory more generally.

A third design principle for collaboration concerned concept work. Concept work consists in constructing, elaborating and testing a conceptual inventory as well as specifying and experimenting with multi-dimensional diagnostic and analytic frames. We hold that concepts are tools designed to be used on specified problems and calibrated to the production of pragmatic outcomes both analytic and ethical. As such, concepts must be adjusted to the changing topology of problem spaces. Concept work involves archaeological, genealogical, and diagnostic dimensions. Archaeologically, concept work involves investigating and characterizing concepts as part of a prior repertoire or structured conceptual ensemble. Genealogically, concept work frees concepts from their field of emergence by showing the contingent history of their selection, formation, as well as their potential contemporary significance. Diagnostically, concept work involves a critical function: testing the adequacy and appropriateness of a given concept or repertoire of concepts to new problems and purposes.

As one moves from the **History of the Present** to the **Anthropology of the Contemporary** (a distinction that will be clarified below) the challenge of further elaborating concepts is joined by the critical work of judging their limits of applicability in emergent situations. Inquiry into the contemporary will almost always require both old and new conceptual work and elaboration. Hence timeless theory or universal concepts are at best unlikely to be very helpful and at worst will function as real impediments to thought.

Given that the organization and practices of the social sciences and humanities in the U.S. university system are essentially still those of the nineteenth century (at least in their formal arrangements and methods), and that there is little motivation from within the disciplines to abolish (or even reform) these arrangements and their attendant career and reward structures, it is doubtful that the kind of work proposed can be exclusively based in the university. Nonetheless, the university remains a source of employment, of resources such as libraries, and, above all, of pedagogy. Today, more than ever, we adhere steadfastly to a sense that the mission or calling of the university is more than instrumental. In that light, we imagine new hybrid organizations, adjacent to and in many ways dependent on, the existing university.

At Berkeley, reform attempts or requests for aid had been rebuffed by recalcitrant and/or disinterested colleagues and unresponsive and dismissive administrators. So, the choices seemed to be capitulation to a desultory, if not disastrous situation—a form of complicity that compromised our vocational commitments—or what we have come to call "secession." [6] Such a strategy recognizes the economy in minimizing academic politics and bureaucracy while maximizing those elements of the current research university world that are positive and very hard to duplicate—salaries, job security, extra-ordinary graduate students, pedagogy. Thus, the challenge has been to create and integrate other elements into a hybrid configuration, an assemblage that flanks the current university world.

Crucially such work entails a willingness to wonder what would happen if one put aside (or suspended) previously useful concepts, practices, and venues knowing that such concepts retain a certain utility. Not to fret: these tried and true concepts, methods and worldviews will not be neglected. We can rest assured that the academic world does not lack utility workers and fervent defenders of that which was. But if the task is to forge new ramifications of the recent past into the near future and by so doing to establish connections not previously cared for between that near future and the recent past, the price to be paid for the transit seems to be not that high.

[6] The picture is mixed. Rabinow was awarded a campus wide Letters and Sciences course with Roger Brent (see below) "Genomics and Citizenship" for two years that provided graduate student instructor support. In a second and third iteration several assistants worked without pay. When Rabinow asked his Dean for research funds for his graduate students, he was turned down with the comment "If I give it to you, I will have to give it to everybody. Go get an outside offer and we can negotiate." Rabinow responded "If I get an outside offer, I will leave." As described he found other ways around this situation but wants to give no credit where no credit is due.

1.4 Human Practices

Having been actively engaged in the experiment of developing a collaborative venue in ARC for close to two years, the unexpected invitation to become active participants in the construction of a multi-disciplinary Center was both welcome and enticing. It was welcome in that Rabinow had already contributed to the early developments in synthetic biology, albeit as an anthropological observer. He had been asked to give a presentation at the first international conference on synthetic biology, SB 1.0, at MIT, in 2005 and another at SB 2.0 at Berkeley in 2006.[7] It was enticing given the programmatic statements that characterized the Center's initial strategic plan. The Center's stated intent to be inter-disciplinary as well as inter-institutional (UC Berkeley, UCSF, Harvard, MIT, Prairie View A&M) seemed to provide the right scale and the right set of challenges. The mandate from the NSF that ethical concerns and issues be part of the technical and scientific program for the Center from the outset equally sounded right. It was exhilarating to even imagine that the life sciences and the human sciences could create a collaborative working environment.

Rabinow proposed to Gaymon Bennett that they take the proverbial plunge together. Bennett, at the time a graduate student at the Graduate Theological Union in Berkeley, had been an active member and contributor to the formation of ARC, making especially positive and constructive interventions in the working group at Berkeley. Hence this collaboration began with two years of conceptual work under their proverbial belts; conceptual work that seemed salient to the challenge at hand. Both agreed that it would be an exciting challenge to try and think through and put into practice a form of "post-ELSI" program. What this implied is that the mandated ethical, legal, and social implications program of the Human Genome Sequencing Initiative, while valuable in a number of ways, could not serve as a direct model for the future. Essentially, the ELSI model (to simplify but not betray) had a mandate to work outside and downstream of the technological and scientific work. ELSI's directive was to deal with consequences, specifically "social consequences." There was a broad agreement that at SynBERC (as well as at the NSF funded nano-technology engineering centers) the ethics work should be conducted alongside and collaboratively with the engineering programs.

Rabinow and Bennett were fully aware that the power relations between the life sciences and human sciences were certain to be unequal. For more than a decade Rabinow had conducted anthropological work in the worlds of biotechnology and genomics. Bennett had spent several years engaged as a bio-ethicist working on genomics and stem cell research. Both were aware that ambitious life scientists would have had a minimum of preparation and education, not to mention even an awareness, of the issues and developments in the human sciences and ethics in recent decades. Both were aware that government officials might well be well-meaning but that they were under pressure to produce "first-order deliverables" and that their openness was likely to fade as pressures on them from within their own institutions to have such deliverables mounted. Nonetheless, against fairly large negative chances of success, the time seemed ripe to take a proverbial plunge and to see whether one form or another of collaboration could be designed (and put into practice).

1.5 Human Practices Manifesto 2006

From the fall of 2006 to the spring of 2007, the post-ELSI component took shape. Rabinow suggested the title of **Human Practices** as a substitute for "ethical and social consequences" and the other SynBERC PIs accepted. Human Practices officially became a core research thrust of the Center—Thrust IV (parts, devices, chasses, Human Practices). As with the imagination, grant writing, and framing coming from those driving for the creation and institutionalization of a new biological discipline, it seemed appropriate that as human scientists, in a newly minted Human Practices Thrust that we ought to set to work and sketch out the broad lines of what we thought the orientation and goals of Human Practices should look like.

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[7] Although situated at this time as an anthropological observer in relation to SynBERC, he had been engaged with his colleagues, Stephen Collier and Andrew Lakoff, in a project on the Global Biopolitics of Security that was interfacing with policy makers, even if that interface never developed into anything fruitful.

Our work is oriented to the goals, practices and experiences of the synthetic biology community broadly and SynBERC in particular. We are addressing the question: How is it that one does or does not flourish as a researcher, as a citizen, and as a human being? Flourishing here involves more than success in achieving projects; it extends to the kind of human being one is personally, vocationally, and communally. As a placeholder, we note here that flourishing is a translation of a classical term (eudaemonia) and as such a range of other possible words could be used: thriving, the good life, happiness, fulfillment, felicity, abundance and the like. [8] Above all, eudaemonia should not be confused with technical optimization as we hold that our capacities are not already known and that we do not understand flourishing to be uncontrolled growth, progressivism, or the undirected maximization of existing capacities. Adequate pedagogy of a bioscientist in the 21st century entails active engagement with those adjacent to biological work: ethicists, anthropologists, political scientists, administrators, foundation and government funders, students, and so on. Contemporary scientists, whether their initial dispositions incline them in this direction or not, actually have no other option but to be engaged with multiple other practitioners. The only question is: how best to engage, not whether one will engage. Pedagogy teaches that flourishing is a life-long formative process, one that is collaborative, making space for the active contribution of all participants.

Our goal is to design new practices that bring the biosciences and the human sciences into a mutually collaborative and enriching relationship, a relationship designed to facilitate a remediation of the currently existing relations between knowledge and care in terms of mutual flourishing. The means to inquire and explore to what extent these new relationships will be fruitful consist in the invention, design, and practice of what we refer to as equipment. Equipment is a technical term referring to a practice situated between the traditional terms of method and technology. The diagnostic tables we have developed to orient our practice and our inquiry will spell out the meaning of the term equipment as far as we currently understand it.

If successful, such equipment should facilitate our work in synthetic biology (understood as a Human Practices undertaking) through improved pedagogy, focused work on shared problem-spaces, and the vigilant assessment of events:

- Pedagogy: Pedagogy involves reflective processes by which one become capable of flourishing. Pedagogy is not equivalent to training, which involves reproduction of knowledge and technique. Rather, it involves the development of a disposition to learn how one's practices and experiences form or deform one's existence and how the sciences, understood in the broadest terms, enrich or impoverish those dispositions.
- Events: A second set of concerns involves events that produce significant change in objects, relations, purposes, and modes of evaluation and action. By definition, these events cannot be adequately characterized until they happen. Past events that have catalyzed new relationships between science and ethics include: scandals in experimentation with human subjects and the invention of equipment to limit them, the promise of recombinant DNA and its regulation, crises around global epidemics and significant biotechnological interventions, the Human Genome Initiative and the growth of bioethics as a profession, and 9/11 and the rise of a security state within whose strictures science must now function. Just as scientists are trained to be alert to what is significant in scientific results, our work is to develop techniques of discernment and analysis that alert the community to emergent problems and opportunities as they take shape.
- Problem-space: Events proper to research, as well as adjacent events, combine to produce significant changes in the parameters of scientific work. These combinations of heterogeneous elements are historically specific and contingent. At the same time, they produce genuine and often pressing demands that must be dealt with, including ethical and anthropological demands. In sum, our understanding of the contemporary challenge is to meet what Max Weber calls "the demands of the day" through the design and development of equipment. Such equipment must be adequate to remediating these heterogeneous combinations, the problems raised, and a near future in which it would be possible to flourish.

[8] We will address these issues at more length in another article.

Our initial task is to provide a set of conceptual tools adequate for an analysis of this problem-space so as to reflect in a rigorous fashion on its ethical significance and ontological status; as well as to provide equipment that contributes to solutions that are more responsive and responsible.

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Our experiment concerns the relations among and between knowledge, thought, and care, as well as the different forms and venues within which these relations might be brought together and assembled. Our commitment is anthropological, a combination of disciplined conceptual work and empirical inquiry. Our challenge is to produce knowledge in such a way that the work involved enhances us ethically, politically, and ontologically. Such a project obliges us to think. Thinking no doubt involves the work of "freeing-up" possibilities: demonstrating contingency precisely where necessity is expected. But in zones where contingency has become dominant, where heterogeneous truth claims abound, where stable relations have become unstable, and elements, old and new, are being re-assembled, thinking must shift modes. Thinking in such a case involves the work of contributing to the form of the near future, scientifically and ethically. Such form-giving, we are persuaded, should be oriented, guided, and evaluated by the hope and goal, the metric, of mutual flourishing. That today we have barely any idea of what such flourishing might consist in, only underscores the urgency and joy of undertaking the challenge.

It follows that our challenge is to invent and to practice new forms of inquiry, writing and ethics for anthropology and her sister sciences and to invite others to do likewise. The dominant knowledge production practices, institutions, and venues for providing an understanding of things human in the 21st century are derisory when measured against the ethical, political, and ontological significance of such work. Thinking requires sustained work on the self, with all this requires in terms of adjustments in modes of reasoning and the venues whose mandates are to foster thought. The human sciences are at an ethical impasse: how to connect knowledge of things human to care of things human. To use the classical term, the human sciences are in need of paraskeue—equipment. To restate the challenge: anthropology and her sister sciences are in need of new forms of inquiry and equipment. In that light, we have taken up the experimental work of: imagining, designing and putting into practice, one mode of remediating the conditions of contemporary human scientific knowledge production, dissemination, and critique. Such a mode is currently being put "to the test of reality, of contemporary reality, both to grasp the points where change is possible and desirable, and to determine the precise form this change should take." [9] It is an experimental mode: an anthropology of the contemporary.

Progressing in this direction entails changing the metrics and forms of current practices, habits, and affects. Above all, it entails recursive experimentation and learning of a collaborative sort. In its initial stages, experimentation simply means trying out different configurations of inquiry, critique and co-labor and then evaluating those practices and their results in a manner such that one can learn from these experiences. Recursive means punctual assessment and re-configuration of those efforts. Collaboration means inventing new forms of work that redistribute individual and collective contributions and limitations. Redistribution alone, of course, is insufficient: such work must be remediative; it must remedy significant dimensions of current pathologies through diagnostic analysis of the current state of things, followed by the design and practice of pathways operating in a different mode and in a modified medium. Such pathways are designed so as not to inflame the wounds of ressentiment which plague the academy through more ressentiment. Rather, they are designed to realize the hope and goal of mutual enrichment, of flourishing, as we have already suggested. Here we are merely insisting that the question of what constitutes a good life today, and the contribution of the life sciences and the human sciences to that form of life must be vigilantly posed and re-posed.

1.6 Blockage and Secession

Several trends, whose significance would become apparent later on, were taking shape during this period. First, the hoped for collaboration between the two parts of Thrust IV was not becoming a reality. Funda-

[9] Foucault, "What is Enlightenment?" in Paul Rabinow, ed., Ethics: Subjectivity and Truth (New York: The New Press, 1997).

mentally, the scholarly reference groups and career trajectories of the two PIs were quite different. The social studies of science and history of science community (fractured though it might be) in the Cambridge area is among the largest and most important in the world. Rabinow had extensive connections to the History of Science Department at as well as the Kennedy School of Government at Harvard. He also had long term engagements with scholars (spanning both senior and junior colleagues) in the history and social studies of science scholars at MIT. Oye was not actively engaged with the core activity of these groups, in fact he actively distanced himself from them, and his center of interest was more in the policy end of things. Oye was not an active researcher himself but rather had made his career as an organizer, committee member, and facilitator of other's activities. Rabinow's path was research and publication. Although this division of achievements and skills might have been turned into a productive division of labor, an active cooperation, this pathway was not the one taken.

Over time this fault line of style, temperament and career choices, would prove to be a significant one. On a visit to California in 2006, Oye listened attentively to an overview presentation of their view of Thrust IV by Rabinow and Bennett; translating it into his own terms, he said confidently and approvingly "OK, you are not post-modern." The culture wars lurked in the background of that ultimately ridiculous claim. The tacit assumption that his role was to make scholarly and even moral judgments of a senior colleague rather than engage in exchange proved to be a harbinger of things to come.

Second, during the first year, our fledgling attempts at forging a post-ELSI Human Practices Thrust were met by the bioscientists and engineers either with a benign disinterest or were disrupted (or dismissed) by a self-assured demand for self-justification, rhetorically and institutionally. The bioscientists and engineers were not averse to including ethics as part of the enterprise, at least from their perspective. Synthetic biology was frequently framed as more than a set of technological challenges, but also as "perfectly suited" to solving "the world's most significant problems." Such framing is not new, either rhetorically or in terms of work modes. Established research habits, as well as the reward and career structures connected to them, have long included a cooperative interface with ethics. In one sense, then, the "we don't understand what you are saying" responses were perfectly legitimate and not surprising. Our Human Practices undertaking was a new one entailing a certain amount of muddling and testing of preliminary approaches and modes of presentation.

But over the ensuing months it became clearer that more than an initial strangeness was involved. There was basically no effort made to do any of the background work that was required to make sense of some of our technical or scholarly terms. Still less effort was spent actively contributing to the work of forging collaboration. Such collaboration would require a change of work habits; and the proposal of such change was received, at best, as an encumberment to funding and career trajectories. These academically successful biologists and engineers by and large had been trained in the highly specialized American system and were rarely informed, or interested, in a broader range of topics and issues; especially if such interested required more than simply voicing opinions on matters of security and the like.

This asymmetry (and conceit) was a familiar one to both Rabinow and Bennett. After a decade or more working with people in the biosciences, Rabinow knew that their general formation was restricted and that they were very unlikely to be either aware or troubled by this state of affairs. [10] Having worked as a bio-ethicist in Washington and Silicon Valley, Bennett understood the structural positioning of ethics as either downstream and regulative, or outside and advisory. What was new in the SynBERC setting, however, was that Rabinow was not just an anthropological observer, but a Principal Investigator; Bennett was not just a bio-ethical consultant, but a Director of Ethics. Human Practices had a mandate to accomplish a certain program of collaborative work. Despite that mandate, there was an often polite, but unbending refusal to make this engagement mutual—it seemed to be taken for granted as natural that members of the Berkeley Thrust IV team were conversant with the molecular biology and eager to learn more of the chemistry and engineering. No reciprocity emerged nor was it encouraged (or discouraged) by the other PIs, it simply was not considered.

What remained therefore was a hierarchy of power and privilege. Despite a series of non-exchanges, we concluded that this exercise of power relations was not intended to oppress us but only to keep us at a distance. Basically everyone including the MIT Human Practices group assumed that the ELSI mode of

[10] Conceit: a high opinion of your own qualities or abilities, especially one that is not justified.

external and social consequences was the norm, and a perfectly good one at that. In contrast, a post-ELSI undertaking required a change in habits, dispositions, and expectations during the process of forming the Center, orienting the research objectives, and forming the daily practices of the researchers. There were no takers for such changes especially given all the work required to put into effect the proposed biological disciplinary interfacing. When we pressed the point we were often ignored by the senior members or met with overt hostility from younger scientists who saw our interventions as an encroachment on their time and career goals. We explore and conceptualize these dynamics in Section II.

The first year site visit by the NSF required a fair amount of preparation. This preparation proved to be excessive given that the time allotted to Thrust IV was roughly twenty minutes over two days. The bulk of the materials presented by each of the Thrusts essentially recapitulated the materials in the original grant proposal. Since Thrust IV was not included in that proposal we had more work to do. Few suggestions were returned to us, none of which strengthened our position within the center. Although officials at the NSF had enthusiastically agreed that new forms of post-ELSI collaboration were needed, they had little idea of how to review and evaluate such forms. And although design and invention of experimental practices in engineering and biology were mandated and expected, the privilege of experimentation was not extended to Human Practices. Given all this, it was disappointing, though not surprising, that familiar deliverables were demanded (i.e. policy recommendations derived through the "application" of "principles"), as were additional justifications of our work according to familiar instrumental criteria.

It became clear that the labor of justifying our position within the center, our research program, and our vision for collaborative ethics constituted an ever-receding future. In early May, Rabinow "secession," in Blumenberg's sense of refusing predominant practices, concepts, and problems, where they prove unhelpful for work on the problematization at hand. Scientifically and ethically, relations among and between the life sciences, human sciences, and ethics need sustained re-thinking and re-working. Such labor cannot be conducted, it seemed to us, unless the adequacy of reigning habits, dispositions, and deliverables are vigorously contested. It was at that point of secession that a period of extremely intense conceptual work began, culminating several months later in the production of a diagnostic grid for re-thinking relations among the life sciences, human sciences, and ethics. The diagnostic has since become the orienting table for our work.

Chapter 2

Orientation. Toward a Diagnostic of Contemporary Equipment[1]

We began this work intending to produce a diagnosis of a new "problematization" or "diagram" or "rationality" taking shape in the world. Although the contours of what seemed to be emerging were vague, we had a strong sense arising from a great deal of discussion, analysis, seminar work, and reading, that whatever was taking shape could not be sufficiently characterized by reigning analytic doxa. Whatever the terms "biopower" and "biopolitics" might mean – and they are being used in a growing number of ways, most of which seemed to us misleading and misguided – those terms or concepts or brands are clearly not sufficient for understanding contemporary reality. Furthermore, as an additional support for our unease with how these terms were being used, we knew that Michel Foucault, who coined the terms, never had intended them to serve the undisciplined and heterogeneous uses to which they are currently being put. Foucault's focus had been historical and conceptual and, at least in his later work, non-totalizing. Above all, concepts like "biopower" or "governmentality" had been conceived and put forth in a mode that was expressively capable of recursive rectification. Neither naming a unique meaning of Western or world history nor uncovering the nefarious workings of "governmentality" everywhere can meet the criteria of recursive rectification.

We oriented our efforts toward diagnosing what we took to be an emergent assemblage, approached from the vantage point of two stable apparatuses. The two apparatuses we designated "biopower" and "human dignity," the assemblage we initially referred to as "the vital." Our aim was to characterize zones, such as bio-security and bio-ethics, in which elements of the two apparatuses were being recombined in the formation of a third. We resisted the familiar proposals that these apparatuses were either epochs, or reducible to one another. Rather, we understood them as consisting of quite specific, if heterogeneous elements, such as objects and practices, elements in flux and in the course of re-assemblage. Once we actually began sustained conceptual work, after multiple delays and blockages, however, we concluded that it was currently premature to diagnose a new "problematization" or "diagram" or "rationality." First, it became clear that what each of these terms means is far from clear. Second, we came to think that while major changes in diverse empirical domains were unquestionably underway, it was not at all obvious that they had taken anything like a general and definitive form. Furthermore, we concluded that it was conceptually hazardous to assume that they ever would. Having reached an impasse, we decided to change strategies by shifting registers.

At first, we decided to move from characterizing a general diagram or rationality to attempting to distinguish the contours of the problematization to which that general diagram was presumably responding. Even there, however, after two semesters' travail with multiple empirical projects laid out and discussed, it gradually began to seem likely that even the task of attempting to distinguish and characterize the parameters of an emergent problematization in anything like a comprehensive manner was premature. Unlike the question of what problematization comes "after" biopower, however, the challenge of specifying the vectors and contours of an emergent problem-space remains, in our view, a valid one. Consequently, we decided

[1] This content is available online at <http://cnx.org/content/m18817/1.1/>.

to return to the concrete: our site of inquiry and the actual practices being elaborated. We shifted our efforts back to the challenge of figuring out how best to comprehend, invent, and practice the work we were mandated to take up as part of SynBERC.

This correction of our course proved to be serendipitous providing the means of rectification that we lacked. It led us to conclude that what we needed currently was a diagnostic of equipment. Said another way, we shifted our attention from the attempt to characterize the "actual interconnections of things," to an attempt to distinguish "the conceptual interconnections of problems" with the hope that we would be "opening up significant new points of view." Such points of view, we came to think, would be significant to the degree that we could transform these perspectives into actual practices. The production of actual practices, after all, is what equipment, as we understand it, is all about.

We began to concentrate our efforts on conceptualizing, designing, and experimenting with equipment rather that a general problematization per se. Given that choice, we decided that the next critical step was to construct a diagnostic. This diagnostic work should assist us in experimenting with and adjusting practices in our particular project, but should leave open the broader issue of whether or not a distinctive figure is emerging within and along side of existing figures, as responses to and factors in shifts in a larger problematization.

A **diagnostic** has two functions. The first is analytic. It functions to lay out tables of categories. That is to say, a diagnostic serves a critical function; it facilitates the work of decomposition of complex wholes in order to test the logic on the basis of which composition has taken place. In diagnostics, the work of decomposition cannot be an end-in-itself. Rather, analysis must be followed by recomposition. This synthetic work is the second function of a diagnostic. A diagnostic is thus a device operating to distinguish and designate, as well as characterize and fashion categories and elements so as to give them an appropriate form. Here as elsewhere what we mean by **appropriate** ranges over elective affinity, mutual consistency, coherence, and co-operability.

The diagnostic that we have developed is composed of three figures and their equipmental correlates. (The terms **figure** and **equipment**, will receive careful consideration momentarily.) The purpose of the diagnostic is to distinguish, designate, characterize, and fashion the third figure and its equipmental correlates. The three figures in our diagnostic include two well recognized if often misinterpreted figures, **Biopower** and **Human Dignity**, and an emerging constellation of elements that are being brought into relation to one another and may well be coalescing into a third figure. Provisionally, we name this emergent configuration Synthetic Anthropos.

The term Synthetic Anthropos is a placeholder. It draws attention to the ways in which real-world problems are being taken up through the redesign and reconfiguration of pathways so as to produce significant new forms. Examples of this work include synthetic biology, bio- complexity, and bio-security, to name three sites where re-assemblage of elements is underway.

Before moving to a presentation of the diagnostic a certain amount of additional conceptual work is called for. As noted in the invitation, our work on the diagnostic was anticipated and oriented by two years of conceptual work. The core repertoire of this work—designating our modes of engagement as well as our objects of concern—facilitated the initial construction of the diagnostic, and has facilitated subsequent experiments by others to put the diagnostic to work.

2.1 History of the Present and Anthropology of the Contemporary

Our orientation to the diagnostic began with a distinction between Foucault's **History of the Present** and Rabinow's **Anthropology of the Contemporary**, two analytic modes which orient inquiry to **problematizations** in consonant and complementary ways, but which bear on different objects and are designed for different outcomes.

Foucault experimented throughout his life with developing methods of analysis adequate to diagnosing and conceptualizing problematizations in history. Although he never settled on a fixed or definitive method, his consistent, if not unique goal, was to contribute to a "History of the Present." In that project, a certain understanding of the past would provide a means of showing the contingency of the present and thereby

contribute to making a more open future. Although we have frequently been blocked by the entrenchment of prior practices, it is an orienting supposition of our work that the life sciences generally, and synthetic biology specifically is in a zone of transition and instability. It follows that techniques for demonstrating contingency and for opening up possibilities are not the principal demand. Rather, analytic modes are needed for giving form to under-determined and emergent relations, and for specifying the significance of these relations.

What is the contemporary? The ordinary English language meaning of the term "the contemporary" is: "existing or occurring at, or dating from, the same period of time as something or somebody else." But there is the second meaning of "distinctively modern in style" as in "a variety of favorite contemporary styles."[2] The first use has no historical connotations, only temporal ones; Cicero was the contemporary of Caesar just as Thelonious Monk was the contemporary of John Coltrane or Gerhard Richter is the contemporary of Gerhard Schroeder. The second meaning, however, does carry an historical connotation and a curious one that can be used to both equate and differentiate the contemporary from the modern. It is that marking that is pertinent to the project at hand. Just as one can take up the "modern" as an ethos and not a period, one can take it up as a moving ratio. In that perspective, tradition and modernity are not opposed but paired: "tradition is a moving image of the past, opposed not to modernity but to alienation."[3] To quote Rabinow: "The contemporary is a moving ratio of modernity, moving through the recent past and near future in a (non-linear) space that gauges modernity as an ethos already becoming historical."

The anthropology of the contemporary seeks to develop methods, practices, and forms of inquiry and narration coherent and co- operable with understandings of the mode (or modes) taken by **anthropos** as figure and an assemblage today.[4]

2.2 Problematization

How does the distinction between the history of the present and the anthropology of the contemporary reorient work on problematizations? A problematization, Michel Foucault writes, "does not mean the representation of a pre-existent object nor the creation through discourse of an object that did not exist. It is the ensemble of discursive and non- discursive practices that make something enter into the play of true and false and constitute it as an object of thought (whether in the form of moral reflection, scientific knowledge, political analysis, etc)."[5] The reason that problematizations are problematic, not surprisingly, is that, something prior "must have happened to introduce uncertainty, a loss of familiarity; that loss, that uncertainty is the result of difficulties in our previous way of understanding, acting, relating."[6]

The primary task of the analyst is not to proceed directly toward intervention and repair of the situation's discordancy, as one could imagine those in the pragmatist traditions advocating, but rather to pause, reflect, and put forth a diagnosis of "what makes these responses simultaneously possible." [7] For Foucault, the specific diacritic of thought is not uniquely in this act of diagnosis but additionally in the attempt to achieve a modal change from seeing a situation not only as "a given" but equally as "a question." Such a modal shift seeks to accomplish a number of things. First it asserts that not only are there always multiple constraints at work in any historically troubled situation, but that multiple responses exist as well. Foucault underscores this condition of heterogeneous, if constrained, contingency – "this transformation of an ensemble of difficulties into problems to which diverse solutions are proposed." – in order to propose a particular style of inquiry. The act of thinking is an act of modal transformation from the constative to the subjunctive: from the singular to the multiple, from the necessary to the contingent.

A problematization then refers to both a kind of general historical formation as well as a nexus of

[2] Definitions from the online Windows dictionary.

[3] Paul Rabinow, Symbolic Domination: Cultural Form and Historical Change in Morocco, Chicago: University of Chicago Press, 1975.

[4] On the anthropology of the contemporary see: Paul Rabinow, Anthropos Today: Reflections on Modern Equipment, Princeton: Princeton University Press, 2005, Marking Time: On the Anthropology of the Contemporary, Princeton: Princeton University Press, 2007.

[5] Michel Foucault, p.670.

[6] Foucault, p.598.

[7] Ibid. p. 598.

responses to that formation. The diverse but not entirely disparate responses, it follows, eventually form (an increasingly significant) aspect of the problematization. Foucault is characterizing a historical space of conditioned contingency that emerges in relation to (and then forms a feed back situation with) a more general state of affairs, one that is real enough, but neither fixed nor static. Thus, the domain of problematization is constituted by and through economic conditions, scientific knowledge, political actors, and other related vectors. What is distinctive is Foucault's identification of the problematic state of affairs (the dynamic of the process of a specific type of problem description, characterization and reworking), as simultaneously the object, the site, and ultimately the substance, of thinking.

Foucault's concept of problematization is broad but not unlimited in scope. It is not as general as John Dewey's "discordance." Rather, Foucault's term requires that the situation in question contain institutionally legitimated claims to truth or one or another type of sanctioned seriousness, "serious speech acts." Without the presence of serious speech acts there is no problematization in the strict sense of the term (although obviously there could be any number and type of problems).

Foucault designed his concept for archaeological and genealogical work in a History of the Present that aims to demonstrate or present contingency. For an Anthropology of the Contemporary concerned with emergent assemblages, developing a method or critical concepts, to demonstrate their contingency makes no sense. By definition, emergent assemblages are contingent. Consequently, the current challenge is to design and invent modes of experimentation and verification with modified forms of critical analysis. We are orienting ourselves differently than Foucault. In the present one can look back or look forward. Foucault provided the lineaments of a problematization understood as historical phenomena involving blockages, problems, and diverse solutions. In the History of the Present the question of what it is that is being problematized is approached by specifying the ways in which a range of solutions can be traced back to a set of prior problematizations as responses to those problematizations. For example, taken up in a History of the Present two of the figures addressed in our work—biopower and human dignity—can be analyzed as responses to prior problematizations and not as sites of problematization themselves.

By contrast, we are attempting to provide a diagnostic that is oriented to the near future. In this position the challenge is not to make the present seem contingent, but situating ourselves among contemporary blockages and opportunities the challenge is to reformulate these blockages and opportunities as problems so as to make available a range of possible solutions. In an Anthropology of the Contemporary the question of what is being problematized is approached by identifying the ways in which formerly stable figures and their elements are becoming recombined and reconfigured such that a present challenge is to diagnose nascent figures, equipment, and assemblages. In our approach these nascent figures are not epochal, that is to say they are not simply replacing prior figures. Rather, they share elements of existing figures in the process of recombination and reconfiguration, such that a primary task is to identify the relations among and between figures and their elements, and to identify pathways of transformation as distinctive forms are taking shape. In sum, problematization taken up as a task of an Anthropology of the Contemporary rather than a History of the Present, is not to trace current figures back to prior problematizations, but to remediate current blockages and opportunities by conceptualizing the near future as a series of problems in relationship to which possible solutions become available to thought.

2.3 What is a Figure?

The concept of figuration designates a way of establishing connections among events, actors, discourses, practices, and objects such that a more or less stable and integrated ensemble is produced whose form is such that the significance and functions of the ensemble cannot be reduced to the its constitutive elements. Figuration thus also designates a way of connecting elements into an ensemble such that the significance and functions of each element depends on, though may not be reducible to, the form produced by the connections. Figuration involves a kind of synthesis—the production of a composite whole whose logic of composition cannot be reduced to its constitutive elements. If figuration designates a way of connecting and synthesizing elements, the resulting ensemble can be designated a figure.

The terms figuration and figure have a long history extending back to the Greeks.[8] In our present work we find pertinent and helpful Erich Auerbach's concept of figural interpretation. We have been made aware of the hermeneutic controversies attached to Auerbach's work, to which we do not intend to enter. Stripped of this controversy, we find a central point that Auerbach makes extremely helpful to our work. Figural interpretation, as Auerbach describes it, is a method of taking up reality in which connections are established between "two events or persons in such a way that the first signifies not only itself, but also the second, while the second involves or fulfills the first." For Auerbach, the poles of the figure are integrated in and by a shared temporality. Making use of this insight, we want to draw attention to the shared ontology of figural integration. The crucial integrating aspect of this shared ontology is its mode. Mode is a term that can indicate a way of doing something, the form in which something exists, and the form's temporality. In figural interpretation the temporal aspect of the way in which the poles of a figure exist and are connected is crucial. The poles of a figure, although historical, may in fact be separated in time or place. Their ontologically constitutive connection—the connection that integrates them as a single figure—is thus likely not established through the "horizontal dimension" of direct historical causality.[9] Rather, the integrative connections are established "vertically." That is to say, the poles are linked by way of factors whose ontology is characterized by a mode other than historical causality, per se. In classical figural interpretation, such modal connections usually pass through a primordial, eternal, or otherwise transcendent factor whose temporality is beyond, comprehensive, or definitive of history. The ontological mode of such a factor establishes the integration of elements as a single figure.[10]

Unlike Auerbach's figural interpretations, the ontological mode of the figures taken up in this diagnostic is characterized neither by the eternal, nor transcendental, nor historically comprehensive. Rather, the temporality which characterizes the ontological mode is **contemporary** (although each of the figures consists of elements which themselves are characterized by other temporalities). This means that, unlike Auerbach's figural interpretation, the distinction of "horizontal" and "vertical" connections is less pronounced. However, this also means that like figural interpretation direct historical causality recedes as a prominent type of connection. The pathways through which the elements of the figures in the diagnostic are connected up are neither historically horizontal nor transcendentally vertical, per se. Rather, the pathways by way of which the elements are connected and given form are contemporary.

2.4 What is Equipment?

We proceeded with an informed awareness that there is a still rather inchoate, if insistent, demand for new equipment to reconfigure and reconstruct the relations between and among the life sciences, the human sciences, and diverse citizenries both national and global. This conviction stems from the pragmatic situation in which we are working: the National Science Foundation funds our work. But the commonplace also resonates with a year's work with members of the Anthropology of the Contemporary Research Collaboratory (ARC) indicating that parallel questioning, and the need for new equipment, exists in other domains such as bio-security, bio-complexity, etc.

Equipment, though conceptual in design and formulation, is pragmatic in use. Defined abstractly equipment is a set of **truth claims**, **affects**, and **ethical orientations** designed and combined into a practice.[11] Equipment, which has historically taken different forms, enables practical responses to changing conditions brought about by specific problems, events, and general reconfigurations.[12]

Equipment is a term (word+ concept + referent) that, by definition, does not retain a constant meaning.

[8] See Aristotle's Posterior Analytics, and Girard Genette's Narrtive Discourse Revisited, Jane E. Lewin trans. (Ithica: Cornell University Press, 1988).

[9] Erich Auerbach, Mimesis (Princeton: Princeton University Press), 73.

[10] Ibid., 74.

[11] On "practice" see Alisdair MacIntyre, After Virtue: A Study in Moral Theory, 2nd ed. Notre Dame: Notre Dame University Press, 1984.

[12] Paul Rabinow and Gaymon Bennett. "From Bio-Ethics to Human Practices or Assembling Contemporary Equipment," in Beatriz da Costa and Kavita Philip, eds. Tactical Biopolitics: Art, Activism, and Technoscience (Cambridge, MA: MIT Press, 2008).

Such variation is a source of its richness and flexibility. Mapping and analyzing its distributions would be the kind of work a much more extended genealogy would have to undertake; how to undertake such an enterprise within the anthropology of the contemporary as opposed to the history of the present is, currently, largely unexplored, lacking the requisite navigational concepts and methods.

Equipment takes different forms in the contemporary. This variability stems from the fact that: the contemporary is neither a unified epoch nor a culture and consequently there is no reason to expect there would be a single form within it; as well as to the fact that scholarly work in the history of the present have shown that there are multiple facets to even a settled problematization and thus, it follows, multiple solutions requiring, it would be logical to assume, diverse equipment.

The challenge of constructing a diagnostic of contemporary equipment is three-fold: (a) to provide a tool-kit of concepts that enable one to conduct inquiries into the contemporary world in its actuality; (b) to conduct those inquiries in a manner such that those concepts and those inquiries function so as to make the relations (connections and disjunctions) between **logos** and **ethos** apparent, and available, to oneself and to others. That is to say, to make those relations part of the inquiry itself as well as part of a way of life. (c) To take into account the **pathos** encountered and engendered by such an undertaking, and to find a place for it within the form under construction. In our technical vocabulary, these challenges consist in designing and synthesizing a form which can maintain a constantly available level of generality. Such forms must be able to function effectively to reconstruct specific problems while being plausibly applicable to a range of analogous problems. That is, the challenge is to compose a form of equipment that will be able to function as an equipmental platform.

The briefest of reminders of what general forms equipment has taken in the ancient and modern configurations – taken up from a contemporary problem-space – will help distinguish contemporary forms. The will do so, in part, by indicating a certain continuity of terms, elements, and problems across equipmental forms, as well as a certain discontinuity of metrics, modes, and objects.

2.4.1 Form 1: Antique Equipment

The guiding hypothesis of Foucault's lectures during 1981-2 at the **Collège de France**, **L'Herméneutique du sujet** was that in antiquity the challenge to "know thyself" had been inextricably coupled with another Delphic command to take "care of the self."[13] The twinned imperatives had made sense for as long as the goal of thinking had been linked to "a good life," or a "flourishing existence." Thus, for millennia, while truth-seeking was an essential part of a life well-led, it was not an autonomous goal or practice, nor was it disconnected from ethical work of the subject on himself and others. Rather the purpose of equipment and its precondition was to contribute to a thriving existence both individual and communal. It was within that context that the problem of how to transform logos into ethos made sense. Remarkably, today the problem of the relations of science, ethics, and a thriving existence seem once again to be under-going a process of a re-problematization.

There existed in antiquity a corpus of arts and techniques essential to the care of the self. Much of Foucault's inquiry in the 1981-2 lectures focused on this corpus, these practices, these exercises, constituent of, and essential to, self-formation and care.[14]

"The test of one self as a thinking subject, who acts and thinks accordingly, who has as his goal, a certain transformation of the subject such that there is a self-constitution as an ethical subject of truth."

The challenge was to develop forms of exercises of thought whose goal was to connect thought to **ethos**.[15]

[13] Michel Foucault, L'Herméneutique du sujet, Cours au Collège de France, 1981-82. 'Hautes Études,' Paris: Éditions de l'École des Hautes Etudes, Éditions Gallimard, Éditions du Seuil, 2001. Scholarly édition and After-word by Frédéric Gros. P. 312.

[14] Foucault, « [L]'épreuve de soi-même comme sujet qui pense effectivement ce qu'il pense et qui agit comme il pense, avec comme objectif, une certaine transformation du sujet qui doit le constituer comme, disons : sujet éthique de la vérité.» Ibid., 442.

[15] An example of meditation understood as a practice and a test of the state of a subject seeking an êthos is found in Épictète, Livre 1,16. Épictète speaks of a distinctive faculty we have that functions differently than other faculties. We have other faculties such as those that enable us to play a musical instrument or to use language. These faculties, however, cannot tell us whether or not we should be playing an instrument or speaking. If one wants to know whether it is good or bad to play an

In the late antique world there existed a range of equipment developed in order to aid those engaged in these exercises. The key equipment that was required to take care of the self, to aid it in its confrontations with the external world, or most generally to accomplish the complex task of facing the future, was "**un équipement de discours vraies**."[16] An arsenal, if you will, of **logoi**. The Greek word for these "**discours vraies**" is **paraskeuē**, which the French translate as **équipement**. As the name suggests, this equipment was designed to achieve a practical end. These "true discourses," these "**logoi**" were neither abstractions nor, as we say today, "merely discursive." They had their own materiality, their own concreteness, and consistency.

What was at stake in the use of this equipment was not primarily a quest for truth about the world or the self. Rather, the practice consisted in means of assimilating these true discourses as aids in confronting and coping with external events and internal passions. The challenge was not just to learn these maxims, often banal in themselves, but to make them an embodied dimension of one's existence. The purpose of equipment was to have them ready at hand when they were needed. True discourses were equipment to the extent they had been assimilated thoroughly, made to function as rational principles of action: «**fait du logos enseigné, appris, répété, assimilé, la forms pontanée du sujet agissant**.»[17] Learning these maxims was not hard, accomplishing the goal of making these **logoi** a principle of action, of self-mastery, of a flourishing existence, was a life-long process.

2.4.2 Form 2: Modern Equipment

Many other forms of equipment were no doubt developed in the ensuing centuries, especially in the Christian monasteries, and later more broadly in the wake of the Reformation. It was at the dawn of what is referred to as modern times, however, that a vastly powerful and comprehensive set of power relations, truth claims, modes of life, and their interfaces began to be given shape. That formation has been referred to most famously by Michel Foucault as the regime of bio-power. We argue that the regime of bio-power became the bio-political and expanded into ever-increasing spheres of life once its rulers and its specialists started experimenting with equipment.

In **French Modern, Norms and Forms of the Social Environment**, Rabinow traced some of the dimensions of how modern urban planning had gradually developed over the course of the nineteenth and twentieth centuries. Urban planning had started with the rational reform of physical space but had gradually included more and more elements into its purview. By the time such planning had become a socialist project during the 1930s it was proud of having expanded its scope from city planning – **un plan de ville** – to planning that included all those elements (spatial, social, psychological, architectural, hygienic, etc.,) that contributed to shaping an individual life – **un plan de vie**. The goal of planning was social and individual health as well as a well-policed order, as the expression goes. By 1942, the French "**Plan d'Équipement National**," defined **équipement** as everything that was not a "**don gratuit**" ("a gratuitous gift") of the soil, subsoil or climate. It is the work of each day and the country as a whole."[18]

A tool chest of **logoi** had been assembled gradually, and eventually (partially) put into practice by the State. Further, social technologies had been invented to oblige individuals to have these rational aids ready at hand on all occasions; or, failing that, at least to have social specialists nearby who could bring the corrective benefits of these technologies (and their "**discours varies**") to bear with the shortest possible delay.[19]

While the core of welfare technologies continued to be developed after the Second World War in Europe and in certain Communist countries, around the ever-expanding domain of the social, in the United States

instrument, it is necessary to turn elsewhere. And the place one must turn is to that other faculty, a faculty that is given the name of 'reason.' Reason therefore is assigned a kind of regulatory position, one whose function turns on taking care of the 'souci de soi.' Foucault, L'Herméneutique du sujet, 438.

[16] Foucault, Résumé du cours, L'Herméneutique du sujet, 479.

[17] Gros, "After-word," L'Herméneutique du sujet, 510.

[18] Paul Rabinow French Modern: Norms and Forms of Modern Equipment, (Chicago: University of Chicago Press, 1989), 2.

[19] It has been plausibly argued, and empirically demonstrated in various instances, that the regime of governmentality to which the state equipment form of political rationality was indebted has undergone a fundamental transformations in recent decades. For example, Nikolas Rose, Powers of Freedom (Cambridge :Cambridge University Press, 1999).

a different problem-space and object domain was gradually emerging.

Through the 1960s concerns arose regarding the capacity of the developing medical and biological sciences to provide adequate means of analysis for understanding and coping with the ethical and ontological consequences of their own advances. A small number of leading scientists took the initiative to invite philosophers and theologians to think about ways in which research might be moving in the direction of transforming or even destroying human life.[20] Out of these and other political encounters, by the middle of the 1970s a new kind of specialist, the "bio-ethicist," had appeared alongside the life scientist as someone authorized to offer serious truth claims about the relation of science and society. The bio-ethicists were assigned the task of elaborating principles according to which "good" science could be discerned from "bad" science. Such discernment was intended to provide an ordering and regulating function, assuring that science would contribute to a healthy society and would guard against pathological practices.

From the first, efforts to bring together experts from the biological, human, and philosophical disciplines to address innovations in the biological sciences faced a central practical problem: the development of methodological practices and forms adequate to the task of precisely defining and effectively responding to challenges and opportunities. In our terms, they faced the challenge of designing and implementing new equipment.

In retrospect, we can see that these efforts remained in a modern equipmental mode. In the first place, bio-ethical equipment was still being guided by the standards and objects of the social. Although bio- ethics appealed to such ethical figures as "the autonomous subject," "the person," and "marginalized communities," these ethical figures were taken up within the narrative of science and society. In the second place, bio-ethical equipment attempted to make visible critical limits within the sciences themselves. Thus, bio-ethical equipment was modern given its object (the social) and given its mode of operation (reform).

An important example of the early development of such equipment is the work of the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. The National Commission was tasked with developing practices appropriate to the protection of human subjects of research. It needed to respond to public outrage over the Tuskegee and Willowbrook experiments. And it needed to be adequate to the task of preventing the abuse of research subjects in the future. In sum, the National Commission was faced with the task of developing equipment appropriate to particular kinds of problems under particular circumstances and addressing those problems in particular kinds of ways.

The form these practices took was guided by the following considerations: a **serious speech act** (human beings are subjects whose autonomy must be respected), an **affect** (outrage at the abuse of such infamous research projects as the Tuskegee experiments), and an **ethical mode** (human subjects must be protected from such abuse in future through the guarantee of their free and informed consent).[21]

2.4.3 Form 3: Contemporary Equipment

These bio-ethical objects appeared to function well as regulatory guardians of the objects of bio-power: the population (taken up as the community) and the body (taken up as the person). However, in the 1990s this set of arrangements became increasingly problematic. Advances in molecular and developmental genetics (viz. the Human Genome Project, somatic cell nuclear transfer, and human embryonic stem cell research) excited the fear that the life sciences not only put bodies and populations at risk, but human nature and even humanity itself. The human had been introduced as a solution; instead it had become a problem. In a discursive and regulatory flood, bio- ethicists advanced the concept of human dignity as a bulwark against the danger of dehumanization. The attempt to reform the bio-ethical by bringing a humanitarian equipmental apparatus into this problem-space began to produce a new figure.

With advances in molecular and developmental genetics, the figure of the dignified human began to displace and reconfigure the social. Thus, a number of specific events originally anchored in the apparatus of bio-ethics functioned as vectors to bring elements of the figure of human dignity into shared spaces with the figure of biopower. This meant, among other things, that assemblages of power relations, truth claims,

[20] It shouldn't be overlooked that with the Belmont Report ethicists, for the first time, are made part of the U.S. government, despite the increasing turn to moral discourse as the site of truth distinctions since 1950.

[21] Albert Jonsen, The Birth of Bioethics (New York: Oxford University Press, 2003).

ethical issues, and affective zones were partially recomposed. This process of recomposition resulted in modulation, disarticulation, and reconfiguration of previously stabilized interfaces and connections, ethical issues, and zones of affect.

In short, the figure of human dignity gradually became a trading zone within which discourses and practices associated with the development of medical and biological sciences began to be reassembled such that the objects, discourses, and practices of bio-power were connected to and put in tension with the objects, discourses, and practices of human dignity. Heterogeneous truth claims were being made about what figure of anthropos was at stake, which specialists were authorized to distinguish true and false, and what might be the art of governance appropriate to the situation. Unwittingly, within this zone of turbulence other problem-spaces that would prove to be beyond the metrics of bio-power or human dignity both veridictionally and jurisdictionally began to be given form.

Today, which truth claims, ethical modes, and affects are appropriate to such a turbulent zone is far from clear. However, given that the contemporary is neither a unified epoch nor a culture, any new forms of equipment will likely be variable and flexible. There is no reason to expect a single form to coalesce as the dominant figure. Quite the opposite, the complex interfaces, interferences, and synergies of multiple figures and multiple equipment are ontologically the way things are and the ethical challenge is to find forms to the turbulent complexity of anthropos today.

Chapter 3

A Diagnostic of Equipmental Platforms[1]

3.1 A Human Practices Diagnostic

A diagnostic, as an analytic and synthetic device, is initially used to decompose figures and their equipmental counterparts. Such analysis facilitates testing and experimentation with the externalities and critical limitations of figures and equipment. This testing and experimentation can be followed by the recompositional work of developing new equipmental platforms for work on emerging figures, i.e. design and synthesis.

Our diagnostic is composed of four tables consisting of fifteen categories and fifty-one conceptual distinctions. The diagnostic is designed to aid inquiry, and, where appropriate and possible, the design and composition of equipment. The tables, categories, and distinctions are not representational. In fashioning them we did not suffer the conceit often attributed to the functionalist projects of the early twentieth century; we do not presume that our categories are comprehensive, and thereby adequate, if abstract, distillations of the real essence of things across comparative domains. The diagnostic does not explain, but rather orients. It is our hope that such orientation is both generative and formative: generative of potentials by proliferating analytic distinctions and modularizing their relations, formative of possibilities by providing a basis for the discrimination of significance and co-operability. To this end our categories maintain the status of topics, or common places.

Our approach is in the line of the construction of "ideal-types" proposed by Max Weber a century ago. The tables, categories, and elements of the diagnostic are fashioned so as to be analytically distinct one from the others. We are fully aware that in the "real world" these divisions are not so neat and compartmentalized. The function of the ideal-type, after all, is to highlight distinctions so as to enable inquiry into the specifics of existing cases. At the same time, of course, these ideal types have been constructed from materials drawn from pre-existing efforts and examples. Hence there can appear to be a slippage between the ideal typical function of producing an analysis and a description of existing configurations. Further, in the case that most immediately concerns us, our own work on synthetic biology, we are engaged both in a projective thought-experiment, a **Gedankenbild**, to use another of Weber's pertinent expressions, and the initial attempts to make this construction operative. Hence our task is both analytic and observational as well as being synthetic and participatory. We hope to keep these moments clear in our presentation while realizing that empirical reality is never so stable, clear, or neat.

3.2 From Regimes to Modes

Our diagnostic work takes initial orientation from, but functions differently than, an analysis of regimes of veridiction and regimes of jurisdiction first articulated by Michel Foucault in 1978.[2]

[1] This content is available online at <http://cnx.org/content/m18810/1.2/>.

[2] Michel Foucault, "Questions of Method," in James D. Faubion and Paul Rabinow, eds. Power: Essential Works of Michel Foucault 1954-1984 (New York: The New Press, 2000), 230-233.

Regimes of veridiction and regimes of jurisdiction, on our reading, are diagnostic categories that distinguish the connections between ways of dividing up true and false and ways of governing oneself and others. Foucault suggested that the effort to grasp these "ensembles of practices," these "fragments of reality that induce such particular effects in the real as the distinction between true and false implicit in the ways men 'direct,' 'govern,' and 'conducted' themselves and others," were defining themes of his work. The challenge, as he articulated it, was to analyze the history of the connection between these regimes in view of the fact that the knowledge one needs to take up such analysis is inevitably produced by the very history of the regimes under consideration. The analytic question thus becomes modal: "How can one analyze the connection between ways of distinguishing true and false and ways of governing oneself and others?"[3]

Foucault indicated that the function and purpose of his analytic question was, in the end, more than critical. It was designed to facilitate the opening up of spaces of inventiveness. That is to say, analysis of regimes of veridiction and jurisdiction and the connections between them, constitutes:

> *The search for a new foundation for each of these practices, in itself and relative to the other, the will to discover a different way of governing oneself through a different way of dividing up true and false— this is what I would call "political spirituality."*

An analysis of regimes of veridiction and jurisdiction and their forms and connections provides a means to test the critical limits of truth and governance, so as to question these critical limits. The work of the analytic is oriented to politics as the question of truth and governance.

Diagnostics, as we are devising it, has a related but different orientation. In the first place, the difference in orientation entails a shift from the political and governance to the ontology and ethics of figures and equipment. Such a shift facilitates both the testing and experimentation with the critical limits and appropriateness of given figures to given equipmental platforms, as well as the recomposition of these figures and platforms.

In the second place, we shift from **regimes** to **modes**. Rather than regimes of veridiction and regimes of jurisdiction, our diagnostic attends to the mode of veridiction and mode of jurisdiction at work in contemporary figures. Foucault's analysis was conducted as a history of the present. The ensemble of veridictional and jurisdictional practices he examined were more or less stable and coherent. The archive of materials consisted in long established systems of interactions; his inquiry, after all, may have been animated by contemporary concerns, but concentrated on historical materials.

By contrast **mode of veridiction** and **mode of jurisdiction** are diagnostic categories that distinguish ways of dividing up true and false in contemporary figures, and ways of ordering interventionary practices in contemporary types of equipment. Mode of veridiction distinguishes the ways in which, within a given figure, speech acts are taken to count in the register of true and false, as well as the ways in which such speech acts are produced and authorized. Similarly, mode of jurisdiction distinguishes the ways in which within a given equipmental type a specified range of activities is discriminated as appropriate and subsequently ordered, i.e. organized in relation to one another. The kinds of activities the mode of jurisdiction discriminates and orders are those that appropriately govern the object of a given figure. A mode of jurisdiction thus must be made to cohere and co-operate with a particular set of standards laid out according to a mode of veridiction, and vice versa.

A mode of veridiction and a mode of jurisdiction in a diagnostic functions to test the legitimate limits and appropriateness of the interface between truth and ontology on the one hand and ethical practices on the other. Given the pragmatic challenge of designing and synthesizing new equipmental platforms for work on emerging figures, attention to and analysis of these two modes is particularly crucial.

3.3 Equipmental Platforms

If our diagnostic is oriented by attention to modes of veridiction and modes of jurisdiction, it is oriented to **equipmental platforms**. Equipmental platforms are characterized by a constantly available generality.

[3] Ibid., 238.

Platforms are designed to function effectively in the reconstruction of specific problems, while being plausibly applicable to a range of analogous problems.

An equipmental platform can be distinguished from equipmental activities and from specific instances of equipment. An equipmental platform discriminates appropriate (i.e. coherent and co-operable) equipmental activities and functions as the basis for the organization of these activities. The kinds of activities it distinguishes and organizes are those activities that govern objects within a given contemporary figure. These activities taken as an integrated series are instantiated as specific instances of equipment. Put briefly, equipmental platforms function as the basis for the organization of the activities of specific equipment.

Equipmental platforms function in relation to contemporary figures in two important ways. First, platforms contribute to the determination of a problem within a broad field of problematization. Second, platforms contribute to the specification and design of possible solutions to this problem. Equipmental platforms, in short, function as a pragmatic means of transforming aspects (e.g. blockages, difficulties, disruptions of the play of true and false, etc.) of a broader problematization into concrete problems such that these problems can be taken up as a set of possible solutions.

3.4 Tables, Categories, and Connections

The diagnostic consists of four **tables**, each of which is composed of **categories** that are made into series by **connections** among conceptual elements.

3.4.1 Tables: Figures and Equipment

Two different types of tables are included in the diagnostic. The first type, which consists of only one table, provides a diagnostic of **contemporary figures**. The second type, which consists of three tables, provides a diagnostic of **equipmental types**. What is the relation between these two types of figures in this diagnostic? In this diagnostic a contemporary figure worked over for a pragmatic purpose in a problem-space is an equipmental type.

The **table of contemporary figures** is designed to provide the categorical distinctions needed to address the question: what, in the contemporary, is being problematized? We have selected three contemporary figures: the **figure of Biopower**, **the figure of Human Dignity**, and **the figure of Synthetic Anthropos**.

These figures do not have a single defining or summary diacritic. A common error is to identify one element, make it the defining diacritic, and come to believe that these figures are epochal or totalizing. Rather, each figure consists of a series. Diagnostically speaking, the series is composed of integral and integrating categories. That is to say, the synthesis of the categories that make up a series is a figure.

The **table of equipmental types** is designed to provide the categorical distinctions needed to address three interrelated questions. The first concerns the question: what does equipment consist of? The second concerns the question: how is equipment composed? The third concerns the question: what is equipment used for? The tables of equipmental figures themselves thus form a series.

The equipmental types are connected to but can be distinguished from the contemporary figures. A contemporary figure worked over for a pragmatic purpose in a problem-space—i.e. made equipmental—is an equipmental figure. The **figure of biopower** made equipmental is **biopolitical equipment**. The **figure of human dignity** made equipmental is **human rights equipment**. The figure of **synthetic anthropos** made equipmental is **Human Practices equipment**.

As with contemporary figures, equipmental types are analytically composed of series. Equipmental types thus do not have a single defining or summary diacritic. Analytically speaking, the series is composed of integral and integrating categories. That is to say the consolidation of the categories that make up a series is a type.

3.4.2 Categories: Recombination

Analytically, each of the figures and types is composed of a series, which in turn are composed of integral and integrated categories. The categories in the diagnostic have been selected for their discriminatory power. Further, they provide heuristic utility, aiding the work of composing new equipment as well as orienting inquiry.

The categories are designed to be recombinatorial. That is to say, the categories that make up each series can be recombined in any number of different ways, although such recombination would likely result in the production or identification of figures other than those elaborated here. In addition, inquiry into empirical cases, which this diagnostic is designed to facilitate, may well suggest other recombinations.

The series of which the contemporary figures are composed consist of four categories: (1) **Mode of Veridiction**, (2) **Metric (relational field)**, (3) **Mode of Ontology**, and (4) **Object (relation)**. Equipmental types consist of the series: (1) **Mode of Êthika**, (2) **Serious Speech Act**, and (3) **Affect**. Equipmental composition diagnostically consists of the series: (1) **Mode of Composition**, (2) **Specialist**, and (3) **Venue**. Equipmental platforms consist of the series: (1) **Mode of Jurisdiction**, (2) **Method**, and (3) **Purpose**.

3.4.3 Connections: Composing Pathways

The connections among the categories in the table consist of both horizontal and vertical sequences. In the narrative portion of the diagnostic, the sequences by which we explain the relations among categories that have been selected and traversed serve to define and stabilize the categories, their relations, and their significance within series. However, in principle, any number of other sequences and combinations of connections could be selected and followed.

3.5 Reconstruction

It is crucial to note from the outset that the diagnostic itself has been composed using the modes, metrics, and relations characteristic of the third figure—synthetic anthropos—as we understand it today. This means, among other things, that we have composed the diagnostic as a reconstructive project. John Dewey[4] writes:

> *Reconstruction can be nothing less than the work of developing, of forming, of producing (in the literal sense of that word) the intellectual instrumentalities which will progressively direct inquiry into the deeply and inclusively human—that is to say moral—facts of the present scene and situation.*

The ethical metric, or standard, to which and by which synthetic anthropos is calibrated, is likely not the "inclusively human," but rather something closer to flourishing. And the temporal zone in which synthetic anthropos is taking shape is not the "present scene and situation," but rather contemporary assemblages. Nevertheless, Dewey's definition summarizes well the stakes of our project. If the proposal to join SynBERC was enticing, this is in no small part because we understood it to be a venue capable of and committed to a reconstructive enterprise. Synthetic biology, according to the early manifestos, consists in the work of inventing new forms of collaboration among the biological and human sciences so as to develop the concepts, tools, standards, and products needed to address significant problem areas. Whether or not synthetic biology is capable of such a reconstructive mode, or, if it is, whether or not SynBERC is a venue capable of facilitating reconstruction is far from clear.

In any case, the reconstructive challenge at the heart of synthetic anthropos—again, as we understand it today as a provisional and emerging set of relations—remains compelling: to design equipment capable of contributing to the form of the near future, scientifically and ethically, by both multiplying potentials as well as discerning which possibilities need to be picked out and actualized. Our diagnostic is designed to

[4] John Dewey, Reconstruction in Philosophy (Boston: Beacon Press, 1948).

aid work on this challenge. Its status is something like an equipmental platform, though we would not be so presumptive as to give it that status. However, like an equipmental platform, the diagnostic facilitates the work of discriminating how to appropriately relate modes of veridiction and jurisdiction so as to make it more rather than less likely that a particularly outcome can be realized. To this end, the diagnostic functions as "a pragmatic means of transforming aspects (e.g. blockages, difficulties, disruptions of the play of true and false, etc.) of a broader problematization into concrete problems such that these problems can be taken up as a set of possible solutions."

A final word of orientation: it bears repeating that the figures, categories, and equipmental platforms presented in the diagnostic are in no way to be taken as epochal indicators. There have been other figures and other equipmental platforms in the past, there are others in the present, and without doubt there will be others in the future. The three figures, their equipmental correlates, and salient features have been selected from among other possible candidates. Moreover, other diagnostics of contemporary equipmental platforms could and probably should be designed and synthesized. It is our hope, therefore, dear reader, that our current diagnostic will facilitate further compositional work on contemporary equipment.

A Human Practices Diagnostic

Table 3.1

Contemporary figures: What is Being Problematized

Table 3.2

Figure	**Mode of Veridiction**	**Metric (Relational Field)**	**Mode of Ontology**	**Object (Relation)**
Biopower	Logos (verification)	Normalization	Probabilistic (series)	Population-Bodies
Human Dignity	Nomos (declamation)	Dignity	Archonic (being)	Humanity-Human
Synthetic Anthropos	Ethos (reconstruction)	Flourishing	Emergent (assemblages)	Forms-Pathways

Table 3.3

Equipmental Modules: What Does Equipment Consist Of?

Table 3.4

Types	**Mode of Êthika**	**Serious Speech Act**	**Affect**
Biopolitical	Prudential	Verified Reduction	Disinterest
Human Rights	Vigilance	Authorized Testimony	Commitment
Human Practices	Vigorous Insistence	Warranted Assertion	Assurance

Table 3.5

Equipmental Composition: How is Equipment Composed?

Table 3.6

Types	**Mode of Composition**	**Specialist**	**Venue**
Biopolitical	Planning	Social Technocrats	Governmental
Human Rights	Redressing	Humanitarian Technocrats	Rights Based NGOs
Human Practices	Leveraging (T,T,R)	Second Order Participant	Agile Assemblages

Table 3.7

Equipmental Platforms: What is Equipment Used For?

Table 3.8

Types	**Mode of Jurisdiction**	**Method**	**Purpose**
Biopolitical	Regulation	Modulation	Security
Human Rights	Protection	Emergency Intervention	Restoration
Human Practices	Remediation	Collaboration	Resourceful solutions

Table 3.9

A contemporary figure taken up in a mode of synthetic analysis consists of the series:
Mode of veridiction, Metric (relational field), Mode of Ontology, Object (relation):

Table 3.10

Figure	**Mode of Veridiction**	**Metric (Relational Field)**	**Mode of Ontology**	**Object (Relation)**
Biopower	Logos (verification)	Normalization	Probabilistic (series)	Population-Body
Human Dignity	Nomos (declamation)	Dignity	Archonic (being)	Humanity-Human
Synthetic Anthropos	Ethos (reconstruction)	Flourishing	Emergent (assemblages)	Forms-Pathways

Table 3.11

3.5.1 What is the Mode of Veridiction in a contemporary figure?

The **mode of veridiction** in a contemporary figure distinguishes the ways in which, within a given figure, the speech acts that are taken to be true and false are produced and authorized. Of these authorized speech acts only those will qualify as part of the figure which can be made to operate in a given relational field according to a specific **metric**.

3.5.2 What is a Metric (Relational Field) in a contemporary figure?

A **metric** in a contemporary figure designates the standard by which serious speech acts are ordered. By so doing, the metric specifies and associates aspects of things as elements and allows those elements to be displayed and coordinated as a relational field. A given relational field is characterized by a defined mode of ontology.

3.5.3 What is a Mode of Ontology in a contemporary figure?

A **mode of ontology** in a contemporary figure characterizes the way in which elements in a relational field exist and are taken up. The mode of ontology interfaces elements so as to be connectable in order to constitute a single object. Given that the mode of ontology characterizes a relational field, it follows that the **objects** in a figure of contemporary ontology must be taken up as **relations**.

3.5.4 What is an Object in a contemporary figure?

An **object** in a contemporary figure is fashioned, in part, by the reworking of things and elements. Fashioning consists of association, coordination, and connection. The operation of fashioning homogenizes elements otherwise of heterogeneous scale and quality. The object can then function as an integral and integrating part of the overall series. That is to say, it functions within the series as an anchor point, thereby consolidating the series as a figure.

The figure of biopower taken up in a mode of synthetic analysis consists of the series:
Logos (verification), Normalization, Probabilistic (series), Population-Body:

Table 3.12

Figure	**Mode of Veridiction**	**Metric (Relational Field)**	**Mode of Ontology**	**Object (Relation)**
Biopower	Logos (verification)	Normalization	Probabilistic (series)	Population-Body

Table 3.13

3.5.5 What is Logos (Verification) as a mode of veridiction in the figure of biopower?

Logos (verification) as a mode of veridiction distinguishes the ways in which, within the figure of biopower, the speech acts that are taken to be true and false are produced and authorized. This mode of veridiction only permits those speech acts to be taken seriously which can be verified through the reduction of particulars to calculable regularities or patterns. Within the figure of biopower such calculable regularities and patterns constitute **logoi**. Verification means both "to substantiate," that is, to make into cases (this is the hermeneutic side of verification) and to "prove the truth of something" (this is the positivist side). Within the figure of biopower, **logoi** take form as the human sciences. The human sciences expand through an ever- accumulating collection of facts and an ever-receding attempt to ground this collection of facts in a definitive manner. The way in which serious speech acts are produced involves incessant movement between an attempt to verify, on the one hand, truth claims through facts, and on the other hand generalization or theory. Thus, the human sciences generate systematic verification through the reduction of particulars to calculable regularities or patterns. Of such authorized speech acts only those will qualify as part of the figure of biopower, which can be made to operate according to a **metric of normalization**.

3.5.6 What is Normalization as a metric in the figure of biopower?

Normalization as a metric in the figure of biopower designates the standard by which **verifications** are ordered. The term norm is normative: it designates a project to order aspects of things according to regular distributions. Norms constitute the grounds for normalization. The standard by which things are distributed in a regular fashion is a **metric**. As a metric, normalization designates what type of thing is to be taken seriously (i.e., social facts). Normalization specifies aspects of social facts as elements. The elements that normalization as a metric specifies are those that can be brought into a field and normed. The term "normed" designates the way in which elements are associated, displayed, and coordinated as a relational field. This relational field is characterized by a defined mode of ontology: **probabilistic**.

3.5.7 What is probabilistic as a mode of ontology in a figure of biopower?

A **probabilistic** mode of ontology in a figure of biopower characterizes the way in which elements in a relational field of normalization exist and are distributed. A probabilistic mode is neither geometric nor arithmetic; rather it requires a type of logic that is capable of characterizing a series and the likelihood of that series unfolding in a particular manner. That is to say, the kind of element that counts in a probabilistic mode of ontology is a series. A probabilistic mode of ontology interfaces elements so as to be connectable into a single object. The kinds of interfaces required within a probabilistic mode of ontology are those that can be fit into a series. Elements can only take on their significance for the figure of biopower (i.e., become an object) when placed within a series (i.e., a probabilistic relation). For example, the meaning of an individual suicide takes on its social meaning only when placed in a series. A probabilistic series as an ontological mode is appropriate to the generation of calculable regularities characteristic of verification as a mode of veridiction. Given that probabilistic series characterize a relational field, it follows that the **objects** in a figure of biopower must be taken up as **relations**. The object (relation) of concern in the figure of biopower is **population-body**.

3.5.8 What is population-body as an object in the figure of biopower?

Population-body as an object in a figure of biopower is fashioned, in part, by the reworking of distributed elements. Fashioning, consisting of association, coordination, and connection, homogenizes elements otherwise of heterogeneous scale and quality (i.e., populations and bodies). The object population-body can then function as an integral and integrating part of the overall series that makes up the figure of biopower. That is to say, the object population-body functions within the series as an anchor point, thereby consolidating the series as the figure of biopower.

The figure of human dignity taken up in a mode of synthetic analysis consists of the series:
Nomos (declamation), Dignity, Archonic (being), Humanity- Human:

Table 3.14

Figure	**Mode of Veridiction**	**Metric (Relational Field)**	**Mode of Ontology**	**Object (Relation)**
continued on next page				

Human Dignity	Nomos (declamation)	Dignity	Archonic (being)	Humanity-Human

Table 3.15

3.5.9 What is Nomos (Declamation) as a mode of veridiction in the figure of human dignity?

Nomos (declamation) as a mode of veridiction distinguishes the ways in which, in the figure of human dignity, speech acts that are taken to be true and false are produced and authorized. For example, the Universal Declaration of Human Rights declaims the status of **anthropos** as dignified. This serious speech act is not established by any **logos**. Only those serious speech acts will qualify as part of the figure of human dignity which can be made to operate in a **relational field** according to the **metric of dignity**.

3.5.10 What is Dignity as a metric in a figure of human dignity?

Dignity as a metric in the figure of human dignity designates the standard by which **declamations** are ordered. As a metric, dignity specifies those aspects of things that count as elements and are taken seriously. The elements that dignity as a metric specifies are incommensurability, incomparability, autonomy, and inalterability. The elements specified can then be associated, displayed, and coordinated as a relational field. This relational field is characterized by a defined mode of ontology: the **archonic**.

3.5.11 What is the Archonic as an ontological mode in the figure of human dignity?

The **archonic** as an ontological mode in the figure of human dignity characterizes the way in which essential, incomparable, and inalterable elements in a field of dignity exist and are taken up. The elements that count in an archonic mode of ontology are beings. Dignity in an archonic mode of ontology brings these elements into a relational field so as to constitute them as a single object. Elements only take on their significance for the figure of human dignity (i.e., become an object) when constituted as an archonic being. Given that the mode of ontology characterizes a relational field, it follows that the **object** in a figure of human dignity must be taken up as a **relation**. The object in the figure of human dignity is **humanity-human**.

3.5.12 What is Humanity-Human as an object in a figure of human dignity?

Humanity-human as an object is fashioned, in part, by the reworking of things and elements. Fashioning consists of association, coordination, and connection. The operation of fashioning homogenizes elements otherwise of heterogeneous scale and quality (i.e., the human and humanity). Humanity-human can then function as an integral and integrating part of the overall series that constitutes the figure of human dignity. That is to say, it functions within the series as an anchor point, thereby consolidating the series as the figure of human dignity.

The figure of synthetic anthropos taken up in a mode of synthetic analysis consists of the series:
Ethos (reconstrution), Flourishing, Emergent (assemblage), Forms-Pathways:

Table 3.16

Figure	Mode of Veridiction	Metric (Relational Field)	Mode of Ontology	Object (Relation)
Synthetic Anthropos	Ethos (reconstruction)	Flourishing	Emergent (assemblages)	Forms-Pathways

Table 3.17

3.5.13 What is Ethos (reconstruction) as a mode of veridiction in the figure of synthetic anthropos?

Ethos (reconstruction) as a mode of veridiction distinguishes the ways in which, within the figure of synthetic anthropos, the speech acts that are taken to be true and false are authorized and produced. The speech acts that can be authorized as true and false in reconstruction as a mode of veridiction are those assertions that can be put to the test in experimental and pragmatic situations and subsequently can be reused in reworked form. These experimental and pragmatic situations are more than just laboratory parameters per se. Rather; they contribute to and are conditioned by an **ethos**. As such, although technical virtuosity and prowess are significant capacities within this mode of veridiction, such capacities only enter fully into the play of true and false when they contribute to and are conditioned by an **ethos**. Reconstruction as a mode of veridiction acknowledges that thinking takes place not only within a problem-space in which knowledge of the problem-space depends not only on prior experimental and pragmatic conditions and results, but equally on an orientation to the near future. **Ethos** (reconstruction) as a mode of veridiction functions to provide determinations for an indeterminate and unsatisfactory situation in more than technical or declamatory terms. Rather, only those authorized speech acts will qualify as part of the figure of synthetic anthropos which can be made to operate according to a **metric of flourishing**.

3.5.14 What is Flourishing as a metric in the figure of synthetic anthropos?

Flourishing as a metric in the figure of synthetic anthropos designates the standard by which reconstructive speech acts are ordered. This standard operates within a reconstructed situation. Consequently, the standard can be specified, although it is neither universalistic nor relativist. Flourishing as a metric thus designates which things count as real and of concern in the figure of synthetic anthropos. As a metric it specifies those aspects of things as elements that are amenable to and in need of reconstruction. These elements are not characterized by a pre-given and fixed form but are themselves products of previous reconstructions. Once elements are specified, they can then be associated, displayed, and coordinated as a relational field. In sum, as a metric, flourishing brings elements into relation with one another and indicates how they should be associated. How these connections are made depends on the mode of ontology. Within the figure of synthetic anthropos the **mode of ontology** is **emergence**.

3.5.15 What is Emergence as a mode of ontology in the figure of synthetic anthropos?

Emergence as a mode of ontology in the figure of synthetic anthropos characterizes the way in which elements in a relational field of flourishing exist and are assembled. The elements that qualify in an emergent mode of ontology are those that can be made into assemblages. Emergence as a mode of ontology brings elements into adjacency and interfaces them so that they can be assembled into a single object. Elements take on their significance for the figure of synthetic anthropos (i.e., become an object) when made to be an operative part of an assemblage. The significance of such an assembled object cannot be reduced to its constitutive elements and relations. Emergence characterizes a mode of the real in which previous arrangements are necessary but not determinative. Given that emergence characterizes a relational field of flourishing, it follows that the assembled **objects** in a figure of synthetic anthropos are brought together and reconstructed as the **relation forms-pathways**.

3.5.16 What is forms-pathways as an object in a figure of synthetic anthropos?

Forms-pathways as an object is fashioned, in part, through the reworking of things and elements. Fashioning, consisting of association, coordination, and connection, homogenizes elements previously of heterogeneous scale and quality (i.e., forms and pathways). The first reworked element is a connective one—a pathway. Pathways are synthesized and integrated into different forms. Forms are the second reworked element. Forms-pathways as a single object relation can then function as an integral and integrating part of the overall series that constitutes the figure of synthetic anthropos. That is to say, it functions within the series as an anchor point, thereby consolidating the series as a figure of synthetic anthropos.

A contemporary figure worked over for a pragmatic purpose in a problem-space is
An equipmental figure.

- The figure of **biopower** made equipmental is **biopolitical** equipment.
- The figure of **human dignity** made equipmental is **human rights** equipment.
- The figure of **synthetic anthropos** made equipmental is **human practices** equipment.

Equipment is composed analytically of the modules: Mode of Êthika, Serious Speech Act, Affect

Table 3.18

Figure	**Mode of Êthika**	**Serious Speech Act**	**Affect**
Biopolitical	Prudential	Verified Reduction	Disinterest
Human Rights	Vigilance	Authorized Testimony	Commitment
Human Practices	Vigorous Insistence	Warranted Assertion	Assurance

Table 3.19

3.5.17 What is a Mode of Êthika as an equipmental module?

A **mode of êthika** as a module distinguishes the way in which, within a given equipmental figure, practices are taken up as ethical. Those practices qualify as **ethical** which can be made to operate on an axis of better and worse. How does a given mode of **êthika** qualify as a **module** in a given equipmental figure? It qualifies as an equipmental module when it can be made to operate on an axis of better and worse relative to a metric, i.e., the standards that order the contemporary figure from which an equipmental figure is made. That is to say, a given mode of **êthika** will qualify as an equipmental module once it is calibrated according to a specific metric of a contemporary figure. Recall, that in a contemporary figure the metric orders a mode of veridiction and is characterized by a mode of ontology. Given this alignment between the metric and a mode of **êthika**, the question of what qualifies as a claim in the register of true and false within an equipmental figure, i.e., a serious speech act, must always be adjusted to a mode of **êthika**. In the modularization of equipment, prior to equipmental composition, the mode of veridiction and the mode of ontology function as relay points between a mode of **êthika** and a **serious speech act**.

3.5.18 What is a Serious Speech act as an equipmental module?

A **serious speech act** as a module designates that subset of speech acts that count as true and false in an equipmental figure. Within this class of serious speech acts, only those that can be made to cohere with a given figure's mode of veridiction and that meet the requirements of a given figure's mode of ontology qualify as equipmental modules. Just as the mode of **êthika** must be made to operate with a given figure's **metric** in order to qualify as an equipmental module, and just as qualified serious speech acts must be made to cohere with a mode of veridiction and meet the requirements of a **mode of ontology** to qualify as an equipmental module, equipment also consists of affective modules that must also be made to cohere with a given figure's **mode of veridiction** in order to qualify.

3.5.19 What is affect an equipmental module?

Affect as a module in an equipmental figure characterizes the way in which a **relational field** is maintained such that a specific type of disposition can be generated. Of all the possible dispositions generated in a relational field, only those that can be made to cohere with a given figure's **mode of veridiction** qualify as equipmental modules. Affect coheres with a mode of veridiction when it functions in a relational field such that other dispositions will be less likely to disrupt production of the kind of serious speech acts and modes of **êthika** appropriate to work in and on a given figure. Recall that a given figure's mode of veridiction and mode of ontology serve as the relay points between a mode of **êthika** and serious speech acts. Given the relations between affect, relational field, and mode of veridiction, of those affects that qualify only those will count that can be made to coalesce with an equipmental figure's mode of **êthika** and serious speech acts. Those affects which count operate to bolster and stabilize a disposition to a modular mode of **êthika** and modular serious speech acts. As such affect is integral to equipmental composition.

The figure of biopower made equipmental is biopolitical equipment.

Table 3.20

Biopolitical equipment is composed analytically of the modules:
Prudential, Verified Reduction, Disinterest.

Table 3.21

Figure	**Mode of Êthika**	**Serious Speech Act**	**Affect**
Biopolitical	Prudential	Verified Reduction	Disinterest

Table 3.22

3.5.20 What is prudential as a module in biopolitical equipment?

Prudential as mode of **êthika** distinguishes the way in which, in biopolitical equipment, practices are taken up as ethical. The metric of normalization in the figure of biopower orients and directs practice toward an ever-receding future such that the present can always be improved by small incremental steps. Concomitantly and definitionally, a final and fixed state is never achieved. As such, those practices will be taken to be ethical that are ordered so as to contribute to the normalization of populations-bodies through constant observation and inflection. A prudential mode of **êthika** operates in a way that includes but cannot be reduced to a direct means-ends calculus. Rather, prudence calibrates practice along an axis of better and worse relative to the metric of normalization. Biopolitical equipment thus involves optimization, but optimization should not be confused with prudence because within this mode of **êthika** optimization can function as a means but not as an end. In the contemporary figure of biopower the field of normalization structures a specific mode of veridiction— **logos** (verification)—and is characterized by a specific mode of ontology—probabilistic (series). Therefore, in biopolitical equipment the question of what qualifies as a claim in the register of true and false, i.e., a serious speech act, must always be accounted for in evaluations about how prudential a given judgment or action is. In biopolitical equipment, verification as a mode of veridiction functions as a relay point between normalization and probabilistic series. In a homologous manner, the mode of veridiction will also function as a relay between a prudential mode and **verified reduction** as a type of serious speech act.

3.5.21 What is verified reduction as a module in biopolitical equipment?

Verified reduction as a module in biopolitical equipment designates that class of speech acts that qualify as true and false in the human sciences. Within this class of authorized serious speech acts, only those that can be made to cohere with **logos** (verification) as a mode of veridiction and meet the requirements of probabilistic series as the mode of ontology qualify as equipmental modules. Just as a prudential **êthika** must be made to operate with **normalization** in order to qualify as an equipmental module, and just as verified reduction must be made to cohere with **verification** and meet the requirements of a **probabilistic series** to qualify as an equipmental module, biopolitical equipment also consists of an affect module—disinterest—generated in a relational field that must also be made to cohere with **logos (verification)** in order to qualify.

3.5.22 What is disinterest as a module in biopolitical equipment?

Disinterest as a module characterizes the way in which a field of normalization is maintained such that a specific type of disposition is generated. Of all the possible dispositions generated in this relational field, only those that can be made to cohere with **verification** as a mode of veridiction qualify as an equipmental module. Disinterest coheres with this mode of veridiction when it serves to function in the relational field such that other dispositions will be less likely to disrupt production of the **logoi** and prudential **êthika** needed to work in and on a field of normalization. For this reason, an affect of disinterest contributes to the authorization of speech acts and maintenance of relational fields. Recall that verification and probabilistic series serve as the relay points between a prudential **êthika** and verified reductions. Thus, in biopolitical equipment, those dispositions are privileged that can be made to coalesce with a prudential **êthika** and verified reductions. Disinterest operates to bolster and stabilize a disposition to a prudential **êthika** and verified reductions as modules that count in biopolitical equipment.

The figure of human dignity made equipmental is human rights equipment.

Table 3.23

Human rights equipment is composed analytically of the modules:
Vigilance, Authorized Testimony, Commitment.

Table 3.24

Figure	**Mode of Êthika**	**Serious Speech Act**	**Affect**
Human Rights	Vigilance	Authorized Testimony	Commitment

Table 3.25

3.5.23 What is vigilance as a module in human rights equipment?

Vigilance as an equipmental module distinguishes the way in which, within human rights equipment, practices are taken up as ethical. Given that dignity as the metric of the figure of human dignity is archonic, and therefore cannot be produced, modified, or improved (but can be ignored, transgressed, or violated), equipment that coheres and co- operates with it requires a distinctive mode of **êthika**. **Vigilance** as a mode of **êthika** appropriate to dignity is animated by a universal moral essence. However, this mode always operates in a particular and changing present, in which, consequently, human rights equipment is made to function in a mode of continual alertness, scanning for threats and generating an increasing number of cases

that count as violations of rights. Vigilance calibrates practice in universal terms always in tension with specific cases relative to the metric of dignity. The metric of dignity, recall, structures a specific mode of veridiction—nomos (declamation). Therefore, in human rights equipment, that which counts as a claim in the register of true and false, i.e., declamation, stems from a vigilant mode of **êthika** in which threats and violations are identified. In human rights equipment, declamation as a mode of veridiction functions as a relay point between dignity and an archonic being. In a homologous manner, declamation functions as a relay point between a vigilant mode and **authorized testimony**.

3.5.24 What is authorized testimony as a module in human rights equipment?

Authorized testimony as a module in human rights equipment designates that class of speech acts that qualify as true and false in human rights equipment. Within this class of serious speech acts, only those that can be made to cohere with **nomos** (declamation) as a mode of veridiction and which meet the requirements of archonic being as the mode of ontology qualify as equipmental modules for human rights. Just as a vigilant **êthika** must be made to cohere with dignity in order to qualify as an equipmental module, and just as authorized testimony must be made to cohere with **declamation** and meet the requirements of **archonic being** to qualify as an equipmental module, human rights equipment also consists of an affect module—commitment—generated in a relational field that must be made to cohere with **declamation** in order to qualify.

3.5.25 What is commitment as a module in human rights equipment?

Commitment as a module in human rights equipment characterizes the way in which a field of dignity is maintained such that a specific type of disposition is generated. Of all the possible dispositions generated in this relational field, only those that can be made to cohere with **declamation** as a mode of veridiction qualify as an equipmental module. Commitment coheres with declamation when it functions in a relational field such that violations of dignity are likely to be identified and such that those whose task it is to identify violations maintain the appropriate vigilance. For this reason, an affect of commitment contributes to the authorization of speech acts and the maintenance of relational fields. Recall that declamation and archonic being serve as relay points between a vigilant **êthika** and authorized testimony. Thus, in human rights equipment, an affect of commitment is required that not only can be made to cohere with a disposition to a vigilant mode of **êthika** and authorized testimony, but that also operates to bolster and sustain a vigilant **êthika** and the production of authorized testimony.

The figure of synthetic anthropos made equipmental is human practices equipment.

Human practices equipment is composed analytically of the modules:
Vigorous Insistence, Warranted Assertions, Assurance.

Table 3.26

Figure	**Mode of Êthika**	**Serious Speech Act**	**Affect**
Human Practices	Vigorous Insistence	Warranted Assertion	Assurance

Table 3.27

3.5.26 What is vigorous insistence as a module in human practices equipment?

Vigorous insistence as a mode of **êthika** distinguishes how human practices equipment is put into use in a relational field of flourishing through constant attention and interventions into problems that are held

to be significant, real-world, and remediable in the near future. A mode of vigorous insistence orients and directs human practices equipment toward the near future such that indeterminate and unstable situations can be remediated. Vigorous insistence thus shares an elective affinity with the relational field characteristic of the figure of **synthetic anthropos**, flourishing. A vigorously insistent mode of **êthika** is appropriate to human practices equipment not because it optimizes means-ends relationships. Rather, vigorous insistence pragmatically favors and encourages practices according to an axis of helpful and unhelpful relative to the metric of flourishing. Human practices equipment involves utility, but should not be confused with optimization or standardization as ends-in-themselves. The metric of flourishing, recall, structures a specific mode of veridiction—**ethos** (reconstruction)—and is characterized by a specific mode of ontology—emergent assemblages. In this way, the metric flourishing functions as a relay point between a mode of vigorous insistence and **warranted assertion** as a type of serious speech act. Given the alignment of flourishing and vigorous insistence, the question of what counts as a claim in the register of true and false, i.e., **warranted assertion**, is likely to be generated through a vigorous search for helpful solutions to the problems specified by a metric.

3.5.27 What is warranted assertion as a module in human practices equipment?

Warranted assertion designates the class of speech acts that are authorized to count as true and false in human practices equipment. Within this class of serious speech acts, only those that contribute to and are capable of cohering with **ethos** (reconstruction) as a mode of veridiction, and meeting the requirements of emergent assemblages as the mode of ontology, qualify as equipmental modules. Just as **vigorous insistence** as a mode of **êthika** must be capable of contributing to **flourishing** in order to qualify as an equipmental module, and just as **warranted assertion** must contribute to **reconstruction** and **emergent assemblages** to qualify as an equipmental module, human practices equipment also consists of an affect module—**assurance**— generated in a relational field that must be made to contribute to reconstruction in order to qualify.

3.5.28 What is assurance as a module in human practice equipment?

Assurance as a module in human practices equipment characterizes the way in which a field of **flourishing** is organized such that a specific type of disposition is generated. Of all the possible dispositions generated in this relational field, only those that contribute to **reconstruction** as a mode of veridiction qualify as an equipmental module. Assurance contributes to this mode of veridiction when it bolsters the insistence that, given existing resources, solutions must be possible even when the path to them remains to be invented. For this reason among others, an affect of assurance positions one to make warranted assertions and contributes to the maintenance of a relational field of flourishing. Human practices equipment is strengthened by passing through experimental testing. Recall that reconstruction and emergent assemblages serve as relay points between vigorous insistence as a mode of **êthika** and warranted assertions as a privileged type of serious speech act. Thus, in human practices equipment, an affect of assurance is encouraged in that it contributes to vigorous insistence and warranted assertions. Assurance operates to enable and favor an ethical disposition toward **vigorous insistence** and a resolve that **warranted assertions** can be devised. As such, assurance is integral to the composition of human practices equipment.

The design of the interfaces of equipmental modules and their synthesis is equipmental composition.

Table 3.28

Equipmental composition analytically consists of the series:
Mode of Composition, Specialist, Venue.

Table 3.29

Figure	Mode of Composition	Specialist	Venue
Biopolitical	Planning	Social Technocrats	Governmental
Human Rights	Redressing	Humanitarian Technocrats	Rights-based NGOs
Human Practices	Leveraging (T,T,R)	Second Order Participants	Agile Assemblages

Table 3.30

3.5.29 What is an equipmental mode of composition?

An equipmental **mode of composition** distinguishes the way in which equipmental modules are worked on such that their interfaces can be designed in such a way as to synthesize them as equipmental platforms. The mode of composition is constituted by a set of design parameters. These design parameters can be distinguished as both upstream and downstream. The first set of upstream parameters is that the synthesized equipment must function according to the requirements of a particular metric (relational field). The second set of upstream parameters concerns the requirement that the mode of composition must take into account the specific challenge of interfacing heterogeneous elements that qualify as equipmental modules (i.e., mode of **êthika**, serious speech acts, affects), such that these heterogeneous modules can be made to function in an integrated way. Downstream parameters consist of the challenge of composing these modules in such a way that they will function in specific cases but simultaneously will be capable of spanning or covering a range of cases, conditions, and problems characteristic of a given figure and the available modules. That is, compositions must be designed and synthesized so that they will be able to function as platforms. Successful synthesis of design parameters requires a specific type of **specialist** with distinctive skill sets, authority, and access to resources.

3.5.30 What is a Specialist in equipmental composition?

A **specialist** in equipmental composition designates the type of individual who designs module interfaces such that disparate modules can be synthesized into a single set capable of functioning according to the requirements of a given figure and capable of managing specific cases. The challenge for the specialist is to interface the modules in such a way that the resulting composition functions as the basis for the organization of specific equipmental activities within a given relational field. Analytically, it is useful to think of these specialists as technocrats who can be distinguished from technicians, in the sense that technocrats are the managers of technicians and technologies. Said another way, these specialists, who are charged with the task of invention, oversight, and management (but usually not with detailed implementation) can be called "technicians of general ideas." Such invention, oversight, and management draw on, and, given its position within specific figures, have an elective affinity with affect modules and modes of **êthika**. Where do these specialists conduct their design resolutions? What is the **venue** within which composition occurs?

3.5.31 What is a venue in equipmental composition?

A **venue** in equipmental composition characterizes the scene, site, or setting in which specialists work on design and synthesis. Such venues may have been already stabilized or institutionalized, they may coincide with the articulation of the practice itself, or they may emerge through the practice of equipmental composition. The venue is not a neutral scene in which specialists work, nor is it only the site within which a given mode of composition is advanced. Rather, it is a facility. That is to say, when composition is successful, the venue facilitates rather than obstructs the design and synthesis of specific interfaces. Consequently, there are venues in which particular interfaces are more likely to be obstructed than facilitated. Once the equipment is successfully synthesized in relation to upstream and downstream design parameters, then of course it has to be put to use. The consideration of venue thus raises the question of how, where, and when the composed equipment actually will be used as an equipmental platform.

Biopolitical equipment is composed when:
The interfaces of biopolitical modules are designed and synthesized as equipment.

Table 3.31

Biopolitical equipmental composition analytically consists of the series:
Planning, Social Technocrats, Governmental.

Table 3.32

Figure	**Mode of Composition**	**Specialist**	**Venue**
Biopolitical	Planning	Social Technocrats	Governmental

Table 3.33

3.5.32 What is planning as a mode of composition in biopolitical equipmental composition?

Planning distinguishes the way in which equipmental modules are worked on such that their interfaces can be designed and such that they can be synthesized into a biopolitical equipmental platform. In this mode of composition, the first set of upstream design parameters derives from the constraints of a field of normalization. That is to say, planning is a mode of composing equipmental modules such that the resulting equipment operates to distribute a set of elements in a relational field according to a specific **metric**. The second set of upstream parameters concerns the requirement that planning must take into account the specific challenge of adjusting the interfaces of heterogeneous elements that qualify as equipmental modules (i.e., prudential mode of **êthika**, verified reductions, and disinterest), such that these heterogeneous modules can be made to function in an integrated way. Downstream parameters consist of the challenge of composing the modules in such a way that they will function effectively in specific cases of the normalization of populations-bodies but simultaneously will be capable of spanning or covering a range of cases, conditions, and problems characteristic of the figure of biopower and the qualified modules. That is, biopolitical compositions must be designed and synthesized so that they will be able to function as biopolitical platforms. A successful synthesis of these design parameters requires a specific type of specialist, i.e. a **social technocrat**, with a distinctive skill set, authority, and access to resources.

3.5.33 What is a social technocrat in a biopolitical equipmental composition?

A **social technocrat** in biopolitical equipmental composition designates the type of actor who designs module interfaces such that disparate modules can be synthesized into equipment that meets the requirements of the figure of biopower and is capable of managing specific cases. When population-body is taken up in a field of normalization as "society," and when "society" is worked on in a biopolitical equipmental mode, it (i.e., "society") becomes the "social." Analytically, it is useful to think of specialists who compose biopolitical equipment as social **technocrats** who can be distinguished from social **technicians**, in the sense that technocrats are the managers of technicians and technologies, while technicians are charged with the production of the **verified reductions** that constitute the elements in a **probabilistic series**. Said another way, social technocrats, who are charged with the task of equipmental invention, oversight, and management within a biopolitical figure (but not the details of its technical implementation per se) can be called "technicians of general ideas." The challenge for the social technocrat is to interface modules in such a way that the resulting composition functions as the basis for the organization of equipmental activities for normalization.

Biopolitical invention, oversight, and management draw on, and have an elective affinity with, a prudential mode of **êthika** and an affect of disinterest. What is the **venue** in which social technocrats come to their design resolutions? The venue of their work is **governmental**.

3.5.34 What is governmental as a venue in biopolitical equipmental composition?

A **governmental** venue characterizes where and how social technocrats work on the design and synthesis of biopolitical equipment. Such a venue is not a neutral scene in which social technocrats work. Rather, it is a facility. That is to say, it facilitates rather than obstructs the construction of specific interfaces and their synthesis providing a venue appropriate to the work of planning. Social technocrats work with probabilistic series in fields of normalization. Such work requires a stable venue in which large amounts of material, produced and collected by social technicians, can be gathered, sorted, and distributed in an ongoing fashion. It follows that the composition of biopolitical equipment requires a venue in which long term stability and continuity are institutionalized. Once biopolitical equipment is successfully synthesized in relation to upstream and downstream design parameters, then of course it has to be put to use. Consideration of the specifics of governmental venues thus raises the question of how, where, and when the biopolitical equipmental platform actually will be used.

Human rights equipment is composed when interfaces of human rights modules are designed and synthesized as equipment.

Table 3.34

Human rights equipmental composition analytically consists of the series:
Redressing, Humanitarian Technocrats, and Rights- Based NGOs.

Table 3.35

Figure	**Mode of Composition**	**Specialist**	**Venue**
Human Rights	Redressing	Humanitarian Technocrats	Rights-based NGOs

Table 3.36

3.5.35 What is redressing as a mode of composition in human rights equipmental composition?

Redressing distinguishes the way in which modules that qualify for human rights equipment are worked on such that their interfaces can be designed and such that these interfaces can be synthesized into a human rights equipmental platform. Redress as a mode of composition entails the production of equipment capable of rectifying human rights violations in a timely fashion. A first set of upstream design parameters derives from the constraints of a relational field of dignity. That is to say, redressing is a mode of composing equipmental modules such that the resulting synthesis functions to acknowledge or recognize the presence of archonic dignity in the object (relation) humanity-human as a bearer of rights. The second set of upstream parameters concerns the requirement that redressing must take into account the specific challenge of designing and synthesizing the interfaces of heterogeneous elements that qualify as equipmental modules (i.e., vigilance as a mode of **êthika**, authorized testimonies, and righteousness) in the figure of human rights, such that these heterogeneous modules can be made to function in an integrated way. Downstream parameters consist of the challenge of composing the modules in such a way that they will function effectively in specific

instances of rights violation but simultaneously will be capable of identifying and addressing a range of instances, conditions, and problems characteristic of the figure of human dignity and qualified modules. That is, human rights compositions must be designed and synthesized so that they will be able to function as human rights platforms. Successful synthesis requires a specific type of specialist, i.e., a **humanitarian technocrat**, with a distinctive skill set, authority, and access to resources.

3.5.36 What is a humanitarian technocrat as a specialist in human rights equipmental composition?

A **humanitarian technocrat** in human rights equipmental composition designates the type of actor who designs interfaces such that disparate human rights modules can be synthesized into equipment consonant with human dignity and capable of rectifying specific instances of rights violations. When human dignity is made into human rights equipment, objects in the relational field of dignity (i.e., the relation humanity-human) are rendered susceptible of being worked on in an equipmental mode. Those specialists authorized to oversee the composition of human rights equipment are humanitarian technocrats. Analytically, it is useful to think of specialists who compose human rights equipment as humanitarian **technocrats** who can be distinguished from humanitarian **technicians**, in the sense that technocrats are the managers of technicians and technologies, while technicians are charged with the production of the authorized testimonies. Said another way, humanitarian technocrats, who are charged with the task of equipmental invention, oversight, and management within the figure of human rights (but not the details of its technical implementation per se) can be called "technicians of general ideas." The challenge for the humanitarian technocrat is to interface modules in such a way that the resulting composition functions as the basis for the organization of activities that cohere with and operate in the name of the protection of human dignity. The invention, oversight, and management of human rights equipment draw on, and have an elective affinity with, a vigilant mode of **êthika** and an affect of commitment. What is the **venue** in which humanitarian technocrats come to their design resolutions? The venue of their work is **rights-based NGOs**.

3.5.37 What is a rights-based NGO as a venue of human rights equipmental composition?

A **rights-based NGO** as a venue of human rights equipmental composition characterizes where and how humanitarian technocrats work on the design and synthesis of human rights equipment. Such a venue is not a neutral scene in which humanitarian technocrats work. Rather, it is a facility. That is to say, when composition is successful, it facilitates rather than obstructs the construction of specific interfaces by providing a venue favorable to redress. Humanitarian technocrats work in the relational field of dignity, by appeal to the worth of archonic beings. Such work requires a venue capable of fast-paced processing of testimonies from the field and organization of emergency missions. It follows that the composition of human rights equipment requires a venue in which vigilance can be translated quickly into action and testimonies re-circulated as indications of human rights violations. Once human rights equipment is successfully synthesized in relation to upstream and downstream design parameters, then of course it has to be put to use. Consideration of the specifics of rights-based NGO venues thus raises the question of how, where, and when the human rights equipmental platform actually will be deployed.

Human practices equipment is composed when the interfaces of human practices modules are designed and synthesized as equipment.

Table 3.37

Human practices equipmental composition analytically consists of the series:
Leveraging, Second Order Participant, Agile Assemblage.

Table 3.38

Figure	Mode of Composition	Specialist	Venue
Human Practices	Leveraging (T,T,R)	Second Order Participant	Agile Assemblage

Table 3.39

3.5.38 What is leveraging as a mode of composition in human practices equipmental composition?

Leveraging as a mode of composition in human practices equipment distinguishes the way in which modules that qualify for human practices equipment are worked on such that their interfaces can be designed and such that they can be synthesized into an equipmental platform. Leveraging is a mode of composition that takes advantage of existing talent, technology, and resources, adjusts their interfaces such that the resulting connections should yield more potent solutions to real world problems than could have been the case had these elements been taken up serially. Leveraging is distinctive in its attention to interfaces as a strategy for increasing capacities. A first set of upstream design parameters in this mode of composition is how to design module interfaces and synthesize them such that the resulting equipment is suited to harmonizing **forms and pathways** according a **metric of flourishing**. Thus, leveraging as a mode of composing human practices equipment should be distinguished from leveraging as a technique of maximizing forces or resources per se. The second set of upstream parameters consists of the challenge of adjusting the interfaces of heterogeneous elements that qualify as equipmental modules in the figure of human practices (i.e., vigorous insistence as a mode of **êthika**, warranted assertions, and assurance), such that these heterogeneous modules are synthesized so as to function in ways that depend on, but cannot be reduced to, individual modules. In other words, the second set of upstream parameters consists of synthesizing modules such that the resulting assemblage is characterized by emergence. Downstream design parameters consist of designing and synthesizing human practices equipment in such a way as to maintain a constantly available level of generality. Modules must be composed in such a way that the resulting composition will function effectively to reconstruct significant problems, and is also plausibly applicable to a range of analogous problems. That is, human practices compositions must be designed and synthesized so that they will be able to function as human practices platforms. Successful leveraging requires a specific type of specialist, i.e. a **second order participant**, with a distinctive skill set, authority, and access to resources.

3.5.39 What is a second order participant as a specialist in a human practices equipmental composition?

A **second order participant** as a specialist in human practices equipmental composition designates the type of actor who leverages pre-existing talent, technology and resources, and designs module interfaces such that these disparate modules can be synthesized into a reconstructed form. Human practices equipment reconstructs emergent forms- pathways through warranted assertions so that conditions of flourishing can be specified and so that forms-pathways can be remediated. Those specialists positioned and trained to accomplish such remediation are **second order participants**. Analytically, it is useful to think of specialists who leverage human practices equipment as second order **technocrats** who can be distinguished from second order **technicians**, in the sense that technocrats are the managers of technicians and technologies, while technicians are charged with the production of the warranted assertions. Said another way, second order participants as technocrats, who are charged with the task of equipmental invention, oversight, and management within the figure of human practices (but not the details of its technical implementation per se), can be called "technicians of general ideas." A challenge for the second order participant is to design interfaces in such a way that the resulting synthesis functions to facilitate activities that contribute to and are appropriate to emergence. The invention, oversight, and management of human practices equipment draw

on, and have an elective affinity with, vigorous insistence as a mode of **êthika** and an affect of assurance. What is the **venue** in which second order participants come to their design and synthesis resolutions? The venue of their composition is **agile assemblages**.

3.5.40 What is an agile assemblage as a venue of human practices equipmental composition?

An **agile assemblage** as a venue of human practices equipmental composition characterizes where and how second order participants work on the design and synthesis of human practices equipment. Unlike governmental venues that are already stabilized or institutionalized, and unlike rights-based NGOs that coincide with the articulation of human rights equipment itself, agile assemblages emerge through the practice of human practices equipmental composition. These assemblages privilege agility and eschew fixity. There are two reasons for this. The first reason is that these emergent assemblages are leveraged in relation to significant contemporary problems. The second reason is that these assemblages are explicitly designed not to become apparatuses.[5] That is to say, the **ethos** of leveraging human practices equipment is neither the construction of long-term governmental venues nor urgent rights-based organizations. Rather, these assemblages are designed to be quickly reassembled in relation to different problems once existing problems have been satisfactorily worked on. Second order participants work in the relational field of flourishing. Such work is encouraged by a venue that itself is emergent and open to reconstruction. It follows that the composition of human practices equipment favors a venue that is flexible and pragmatic. Such a venue is structured by vigorous insistence, generating an assurance that warranted assertions will continue to be produced, tested, and effectively deployed. Once human practices equipment is provisionally synthesized and put to use in relation to upstream and downstream design parameters, then it is ready to be put to use and, when appropriate, remediated. Agile assemblages as venues for the composition of human practices equipment instantiate the challenge of how, where, and why human practices equipmental platform actually will be used.

An equipmental composition ready to use is an equipmental platform.

Table 3.40

Equipmental platforms are analytically composed of the series:
Mode of Jurisdiction, Method, Purpose.

Table 3.41

Figure	**Mode of Jurisdiction**	**Method**	**Purpose**
Biopolitical	Regulation	Modulation	Security
Human Rights	Protection	Emergency Intervention	Restoration
Human Practices	Remediation	Collaboration	Resourceful solutions

Table 3.42

[5] See Paul Rabinow, Anthropos Today: Reflections on Modern Equipment (Princeton: Princeton University Press, 2003).

3.5.41 What is a mode of jurisdiction in an equipmental platform?

A **mode of jurisdiction** distinguishes the way in which an equipmental platform discriminates appropriate (i.e. coherent and co-operable) equipmental activities and the way in which it functions as the basis for the organization of these activities. The kinds of activities it discriminates and organizes are those activities that govern the object (relation) within a relational field. Equipmental platforms function as the basis for the organization of these equipmental activities. Of the possible ways in which an object can be governed, only those modes of jurisdiction qualify for an equipmental platform that can be made to operate according to a specific metric, i.e., adjust an object (relation) according to the standards of a given relational field. How the relation between the qualified mode of jurisdiction and an object (relation) adjusted to a relational field is made ready for use is **method**.

3.5.42 What is method in an equipmental platform?

A **method** in an equipmental platform designates how the relation between a mode of jurisdiction and an object (relation) adjusted to a relational field is made ready for use. In this way, method functions as a primary structural joint between an equipmental platform and a **contemporary figure**. A method establishes a type of jurisdictional relationship. Of the possible jurisdictional relations that can be established, only those will qualify for a specific equipmental platform that support the equipmental platform so as to organize activities that work on objects according to the requirements of a given mode of ontology. The rationale for which one undertakes the organization of activities that method supports is an equipmental platform's **purpose**.

3.5.43 What is purpose in an equipmental platform?

Purpose in an equipmental platform characterizes the specific rationale according to which the platform is composed. If mode of jurisdiction distinguishes the way in which platforms organize governing activities, and if method designates how these governing relations are established, then purpose characterizes that for which equipmental platforms were originally composed. Equipmental platforms function as a pragmatic means of transforming aspects (e.g., blockages, difficulties, disruptions of the play of true and false, etc.) of a broader problematization into concrete problems such that these problems can be taken up as a set of possible solutions.

A biopolitical equipmental composition ready to use is a biopolitical equipmental platform.

Table 3.43

Biopolitical equipmental platforms are analytically composed of the series:
Regulation, Modulation, Security

Table 3.44

Figure	**Mode of Jurisdiction**	**Method**	**Purpose**
Biopolitical	Regulation	Modulation	Security

Table 3.45

3.5.44 What is regulation as a mode of jurisdiction in a biopolitical equipmental platform?

Regulation as a mode of jurisdiction distinguishes the way in which a biopolitical equipmental platform discriminates appropriate equipmental activities and the way in which it functions as the basis for the organization of these activities. The kinds of activities **regulation** distinguishes and organizes are those activities that govern the relation population-body within the relational field of normalization. Of the possible ways in which population-body can be governed, only those modes of regulation qualify for a biopolitical equipmental platform that can be made to operate according to a metric of normalization, i.e., that can calibrate population-body according to the standards of a relational field of normalization. How the relation between regulation and population-body calibrated to a relational field of normalization is made ready for use is a question of **modulation**.

3.5.45 What is modulation as a method in a biopolitical equipmental platform?

As a method in a biopolitical equipmental platform, **modulation** designates how the relation between regulation and population-bodies calibrated to a relational field of normalization is made ready for use. In this way, modulation functions as a primary structural joint between a biopolitical equipmental platform and the **figure of biopower**. Modulation establishes a type of regulatory relationship. Of the possible regulatory relationships that can be established, only those will qualify for a biopolitical equipmental platform that support the platform so as to organize activities that govern population-body according to the requirements of probabilistic series. The rationale for which one undertakes the regulatory activities that modulation supports is the biopolitical equipmental platform's **purpose**. That purpose is **security**.

3.5.46 What is security as the purpose of a biopolitical equipmental platform?

Security in a biopolitical equipmental platform characterizes the specific rationale according to which the biopolitical platform is composed. This characterization consists of two steps: the determination of a problem within a broad field of problematization and the articulation of possible solutions to this problem. Regulation designates the way in which a biopolitical platform operates in a field of normalization so as to introduce determination into an indeterminate field of security. Modulation designates how relations are established between the biopolitical platform and the field of normalization. In a broad sense, security is the problem for which biopolitical equipmental platforms are composed as components of a solution. Through biopolitical equipmental intervention, the general problem-space of security is rendered susceptible to pragmatic intervention. Biopolitical platforms function as a pragmatic means of transforming aspects (e.g., blockages, difficulties, disruptions of the play of true and false, etc.) of a broader problematization of the figure of biopower into concrete problems of security such that a set of possible solutions become available.

A human rights equipmental composition ready to use is a human rights equipmental platform.

Table 3.46

Human rights equipmental platforms are analytically composed of the series:
Protection, Emergency Intervention, Restoration

Table 3.47

Figure	**Mode of Jurisdiction**	**Method**	**Purpose**
Human Rights	Protection	Emergency Intervention	Restoration

Table 3.48

3.5.47 What is protection as a mode of jurisdiction in a human rights equipmental platform?

Protection as a mode of jurisdiction distinguishes the way in which a human rights equipmental platform discriminates appropriate equipmental activities and the way in which it functions as the basis for the organization of these activities. The kinds of activities **protection** distinguishes and organizes are those activities that redress violations or transgressions of humanity-human according to a metric of dignity. Of the possible ways in which the relation humanity- human can be redressed, only those modes of protection qualify for a human rights equipmental platform that are mobilized and directed in the name of dignity. That is to say, dignity constitutes a determination of the way in which human rights equipment operates, i.e., through the protection of humanity-human according to the standard of a relational field of dignity. How the relation between protection and humanity-human as a recognized part of the relational field of dignity is made ready to use is **emergency intervention**.

3.5.48 What is emergency Intervention as a method in a human rights equipmental platform?

As a method in a human rights equipmental platform, **emergency intervention** designates how the relation between protection and humanity-human in a relational field of dignity is made ready for use. In this way, emergency intervention functions as a primary structural joint between a human rights equipmental platform and the **figure of human dignity**. Emergency intervention establishes a type of jurisdictional relationship. Of the possible jurisdictional relationships that can be established, only those will qualify for a human rights equipmental platform that declaim the existence of archonic being instantiated in humanity-humans in such a way that violations can be identified and protective action taken. The purpose for which one protects the relation humanity-human through emergency intervention is **restoration**.

3.5.49 What is restoration as the purpose of a human rights equipmental platform?

Restoration in a human rights equipmental platform characterizes the specific rationale according to which a human rights equipmental platform is composed. This characterization consists of two steps: the determination of a concrete problem within a broad field of problematization and the articulation of possible solutions to this problem. Within the general problematization of the worth of human beings, taken up as a figure of dignity, a series of indeterminations and blockages are framed as a problem of the violation of rights inherent in humanity. That is to say, the object (relation) humanity-human is framed as the bearer of dignity by way of these rights. In this way, human dignity, which as archonic, could not otherwise be worked on, can subsequently be made susceptible to equipmental intervention. The purpose of this intervention is restoration. Restoration as the purpose of the human rights equipmental platform thus frames the challenge of how to address the permanent problem of human rights violations such that it can be managed through protection and emergency intervention. In sum, human rights equipmental platforms function as a pragmatic means of transforming aspects (e.g., blockages, difficulties, disruptions of the play of true and false, etc.) of a broader problematization of the figure of human dignity into concrete problems of the violations of rights such that a set of possible solutions become available.

A human practices equipmental composition ready to use is a human practices equipmental platform.

Table 3.49

Human practices equipmental platforms are analytically composed of the series:
Remediation, Collaboration, Resourceful Solutions.

Table 3.50

Figure	Mode of Jurisdiction	Method	Purpose
Human Practices	Remediation	Collaboration	Resourceful solutions

Table 3.51

3.5.50 What is remediation as a mode of jurisdiction in a human practices equipmental platform?

Remediation as a mode of jurisdiction distinguishes the way in which a human practices equipmental platform discriminates appropriate equipmental activities and the way in which it functions as the basis for the organization of these activities. Remediation entails two integral facets: a change of media and an amelioration, but not perfection, of an object or situation. These facets are interconnected by a metric of flourishing. The kinds of activities remediation distinguishes and organizes are those activities that engage forms-pathways within a field of flourishing. Of the possible ways in which forms-pathways can be engaged, only those activities organized by a mode of remediation qualify for a human practices equipmental platform. This means that remediation as mode of jurisdiction qualifies for a human practices equipmental platform in so far as it contributes practices which adjust forms-pathways according to the standards of a relational field of flourishing. A metric of flourishing engages human practices equipmental platforms through experimenting with changes of media and ameliorative actions. The metric provides a gauge of and for these remedial practices by assessing the extent to which flourishing is encouraged. A human practices equipmental platform thus functions to organize inventive form-making activities in such a way as to encourage flourishing. The way in which such activities are organized is through the remediation of forms-pathways. How the relation between remediation and forms-pathways adjusted to a relational field of flourishing is made ready for use is **collaboration**.

3.5.51 What is collaboration as a method in a human practices equipmental platform?

As a method in a human practices equipmental platform, **collaboration** designates how the relation between remediation and forms-pathways adjusted to a relational field of flourishing is made ready for use. In this way, collaboration functions as a primary structural joint between a human practices equipmental platform and the **figure of synthetic anthropos**. Collaboration establishes relations in a way that can be distinguished from cooperation. A collaborative method proceeds from an interdependent division of labor on shared problems. A cooperative method consists of demarcated work with regular exchange, but does not entail common definition of problems or shared techniques of remediation. Collaboration establishes a type of jurisdictional relationship. Of the possible jurisdictional relations that can be established, only those will qualify for a human practices equipmental platform that promote and contribute to the remediation of forms-pathways in emergent assemblages. The purpose for which one remediates forms-pathways through collaboration is **resourceful solutions** to significant real-world problems.

3.5.52 What are resourceful solutions as the purpose of a human practices equipmental platform?

Resourceful solutions as the purpose in a human practices equipmental platform characterizes the specific rationale according to which the platform is composed. The characterization consists of two steps: the determination of a problem within a broad field of problematization and the articulation of possible solutions to this problem. Resourceful solutions produce determinations in a situation in which what counts as a significant and manageable problem of flourishing is underdetermined. Those problems count as significant

that can be framed as a problem of the remediation of forms-pathways through the leveraging and assembling of existing talent, technology, and resources. Through human practices equipmental intervention, the general problem-space of flourishing is rendered susceptible to pragmatic intervention. Human practices platforms function as a pragmatic means of taking up aspects (e.g., blockages, difficulties, disruptions of the play of true and false, etc.) of a broader problematization of the figure of synthetic anthropos as manageable real world problems. By taking up aspects of the broader problematization in this way, existing resources can be assembled and a range of possible solutions opened up.

Chapter 4

Test Case. Figuring Human Embryonic Stem Cells[1]

A first draft of our diagnostic was completed July 17, 2007. Prior to putting it to work in SynBERC, I ran the diagnostic through its paces, taking as a test case another area of the life sciences in which researchers are currently unsure of their objects, the best venues in which to work on them, and the broader ethical framing of their undertakings: human embryonic stem cell research.

Taking stem cell research as a case for testing the diagnostic seemed appropriate for two reasons. First, it seemed appropriate because, although the science and ethics of stem cell research were more developed than synthetic biology, and though political and experimental blockages more familiar, research remained scientifically indeterminate, ethically discordant, and analytically unsettled. To use our diagnostic terms, the controversy over stem cell research remained a zone within which, despite the expenditure of considerable energy on multiple fronts, processes of **figuration** had not yet settled into stable **figures**, and within which the various equipmental platforms on offer remained highly contested.

Second, stem cell research seemed an appropriate test case in that I had been working quite intensely in this contested domain for several years. Indeed, two colleagues and I were just in the process of completing a book-length analysis of the history, ethics, and politics of stem cell research.[2] From 1998-2002 I served as the research associate of the Ethics Advisory Board at Geron Corporation, which at the time was the predominant biotechnology company working on stem cells and regenerative medicine. The Geron EAB represented a new experiment in ethical practice. University ethicists and theologians consulted with Geron executives before work on human embryonic stem cells began, and through the initial years of experimentation. For all of the difficulties we encountered—accusations of corruption on the part of our academic colleagues, and no official standing and thus no real leverage within the company—we were nonetheless able to conduct ethical inquiry in close proximity to the science and politics of stem cell research as things unfolded. And, to a small degree, were able to contribute to the form of things as they began to ramify.

Despite this relatively privileged position, however, my colleagues and I were frustrated by the polemics, hype, and impasses that characterized the politics and much of the science. More significantly, we were largely blocked in our attempts to develop bio-ethical equipment appropriate to the stakes at hand as we understood them. Even within Geron, where our capacity to influence policy and practice was most direct, our efforts only went so far. Though Geron took our work seriously, we were, in the end, un-invited. We served at the discretion of the Geron executives, after all, and with stock prices sinking and resources strained, the pragmatics of corporate and scientific efficiency won out over the need for further ethical consultation.

As one means of dealing with our frustration with the public debate and blocks to the implementation of ethical practices, we turned to analysis. Surveying our more than ten years of work on stem cell research,

[1] This content is available online at <http://cnx.org/content/m18823/1.1/>.

[2] Ted Peters, Karen Lebacqz, and Gaymon Bennett, **Sacred Cells? Why Christians Should Support Stem Cell Research** (Lanham, MD: Rowman & Littlefield, 2008).

we developed an analysis of the predominant ethical frameworks at play in the stem cell debate, which we designated: **embryo defense**, **human protection**, and **future abundance**.[3] Our goal was to show how, out of the heterogeneous elements at play in the stem cell debate— scientific practices, funding sources, moral discourses, church statements, government policies, and so on—certain elements were being selected out, coordinated, and made coherent. We argued that by limiting the scope of which elements could be taken seriously and by giving form to this limited scope, ethical frameworks worked to produce shared conceptions of what is at stake in stem cell research and which courses of action were licit or illicit. If things were blocked in the science and politics of stem cell research—and they were—we hypothesized that this was due to the relative incommensurability at the level of ethical frameworks.

As of August 2007, my question was: to what extent might a diagnostic initially formulated in response to developments in synthetic biology be useful for expanding or even remediating stem cell materials that had already been the object of considerable analysis? Or, to use Weber's definition of science, how might the categories and relations in our Human Practices diagnostic help establish "the conceptual interconnections of problems" in stem cell research and thereby "open up significant new points of view"?[4] I hypothesized that a shift of analytic focus from ethical frameworks to ethical figures, or, more precisely, to processes of figuration, might help me further characterize connections among problems of varying scale and significance at work in the stem cell debate. This, in turn, might serve to specify why certain courses of action are taken to be uniquely urgent and necessary. The diagnostic, after all, was designed to facilitate the analytic work of showing how figurations bring together and interface veridictional and jurisdictional modes. In the case of stem cell research, such analytic work, it seemed to me, might also facilitate recomposition. If the diagnostic could help specify and decompose elements and relations, it might also facilitate collection, arrangement, and reordering of those elements so as to give form to possible new solutions. Diagnosis is not yet a remedy. But it analytically reworks and synthesizes things such that remedy becomes possible.

In sum, the goal of the test case was to use the categories and elements of the diagnostic to analytically distinguish and test the logic and capacities of the predominant figurations at play in the stem cell debate. The horizon of my analysis was pragmatic. In the first place it would tell us something about the capacity of the diagnostic to open up significant new problems and insights in relation to a relatively well-studied body of materials. In the second place, if one were so inclined, and if one had a venue within which to pursue such work, such de-compositional analysis might facilitate re-compositional proposals for new figurations of stem cell research, adjusted to the strengths and limitations of those currently in play.

4.1 Orientation: The Biology of Embryonic Stem Cell Research and its Ethical Significance

My test case beings with a word of orientation to the biology and ethical significance of stem cell research. In 1981, two independent research teams reported that they had successfully isolated and cultured cell lines from the inner cell mass of the mouse embryo.[5] The cells exhibited uncommon characteristics, distinctive and potentially useful. The cells were **immortal**, that is to say, they were able to achieve multiple population doublings without exhibiting either cell senescence or degradation of the DNA. They were also **pluripotent**; they were able to differentiate into any of the tissues in the mouse's body. As it turned out, work on mouse embryonic stem cells (mES cells) proved immediately useful. They became a vector for the generation of chimeric and transgenic mice. Given that at the level of gene function the mouse is an experimentally favorable analog to humans, mES cells have facilitated the study of human disease.

In addition to facilitating transgenics, it was clear to some researchers that if the techniques used to produce mES cells could be reproduced in human tissues, new domains of cell therapy might be opened up.

[3] Ibid.

[4] Max Weber, "Objectivity in the Social Sciences," online at http://www.ne.jp/asahi/moriyuki/abukuma/weber/method/obje/objectivity_frame.html (<http://www.ne.jp/asahi/moriyuki/abukuma/weber/method/obje/objectivity_frame .html>)

[5] Evans and Kaufman, "Establishment in culture of pluripotent cells from mouse embryos," Nature, 292, 154-156; Martin, "Isolation of a pluripotent cell line form early mouse embryos cultured in medium conditioned by teratocarcinoma stem cells," **Proceedings of the National Academy of Sciences of the USA**, 78: 7634-7638.

It has long been understood that certain organ systems in the adult human body contain populations of stem cells. These adult stem cells serve to renew and replace lost or damaged tissues. Through cultivation and transplant, embryonic stem cells seemed to offer an opportunity to mimic the function of adult stem cells in any organ system. However, if the mouse is a good genetic analog to humans, at relatively greater levels of integrated complexity it is much less so. Mouse embryonic stem cells were derived in 1981. Human embryonic stem cells (hES cells) would not be successfully derived for another seventeen years.

4.1.1 Ethics: the Emergence of Embryonic Stem Cell Research

In the November 6, 1998, issue of the journal **Science**, James Thomson, et al, from University of Wisconsin, announced the successful derivation of hES cells.[6] The scientific announcement was accompanied by two ethically significant pronouncements. The first was that derivation of hES cells represented a revolutionary step in the treatment of degenerative diseases. The cells offered the potential of permanent repair of failing organs—"regenerative medicine," as it was coined. The prospect of regenerative medicine, as one researcher framed it, constitutes "a totally new value paradigm for clinical therapeutics."[7] The second pronouncement came from the U.S. Conference of Catholic Bishops, given as testimony to the U.S. Congress. Because hES cell research entails the destruction of the embryo, the Bishops pronounced the research morally illicit. The therapeutic potential of the research represents a "good end" pursued by way of "an evil means." Embryonic stem cell research must be judged "fundamentally wrong."[8] Ten years later, both pronouncements remain contested. Nevertheless, both indicate the way in which hES cell research has been figured as a matter of ethics from the start.

Among the researchers who recognized the therapeutic potentials of early work on mouse stem cells was Michael West, who, in 1990, founded the Geron Corporation. Geron funded Thomson's breakthrough research, and it held proprietary rights for the use of hES cells in core therapeutic domains. The company and its research portfolio constituted West's response to what he took to be a core set of ethical-theological challenges. West was raised as a Christian Fundamentalist. And though, for quite specific theological reasons, he has distanced himself from Christianity, he continued to frame his scientific vocation in strikingly biblical terms. West took as a scientific calling "the defeat of death." The "highest calling," as he put it, is "to find and control the biological basis of the immortality of life, and to alleviate the suffering of our fellow human beings."[9]

The selection of the name "Geron" reflected West's vocational self-understanding. The name is derived from the Greek, meaning "old man." It is found in the New Testament in the famous passage in John 3:4 in which Jesus is asked by Nicodemus, "How can a man be born again when he is old [geron]?"[10] In the course of Jesus' response, he identifies the spiritual terms on which renewed life is possible. West, moving in quite a different direction, looked to renew life on strictly biological terms. West took these verses to be concerned with immortality. English translations refer to "everlasting life." Stem cell research, in West's view, made such a proposition biologically feasible. It bears noting that a more accurate translation of the biblical passage might read "abundant life" or "fullness of life" rather than "everlasting life." As embryonic stem cell research began to unfold, the question of the extent to which it might contribute to abundant life and not only extended life became a matter of central concern.

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[6] J.A. Thomson, J. Itskovitz-Eldor, S.S. Shapiro, M.A. Waknitz, J.J. Swiegiel, V.S. Marshall, and J.M. Jones, "Embryonic stem cell lines derived from human blastocysts," **Science** 282 (1998) 1145- 1147

[7] Thomas B. Okarma, "Human Embryonic Stem Cells: A Primer on the Technology and Its Medical Applications," in Suzanne Holland, Karen Lebacqz, and Laurie Zoloth, eds. **The Human Embryonic Stem Cell Debate** (Cambridge, MA and London: MIT Press, 2001), 3.

[8] U.S. Council of Catholic Bishops web-archive at: http://www.usccb.org/comm/archives/1998/98- 261.htm

[9] Michael D. West, **The Immortal Cell: One Scientist's Quest to Solve the Mystery of Human Aging** (New York: Random House/Doubleday, 2003), 30.

[10] **Sacred Cells?**, 13.

4.1.2 Pluripotent and Immortal: the Ontology of Stem Cells

In 1996, while seeking venture capital for Geron, West was persuaded to seek the council of ethicists and theologians at the Graduate Theological Union in Berkeley. The motives for doing so centered, no doubt, on his desire to preempt ethical and political fallout concerning the use of embryos in research. His motives, however, are far less significant than the fact that the technical aspects of stem cell research were interfaced with ethical reflection a full two years before Thomson successfully derived his hES cell lines. At the initial meeting of Geron biologists and GTU ethicists, West laid out the basic program for regenerative medicine. That research program remains more or less unchanged, though techniques have certainly been refined. In addition, the ethical problems and opportunities elaborated by the GTU scholars in response to Geron's program have persisted as sites of primary concern. Which is to say that the ontological and ethical elements that would subsequently be taken up and arranged in various figurations were more or less conceptually in place by the time hES cells were derived.[11]

Human embryonic stem cell research is, in the first place, ontologically significant. In the 1850s, Rudolph Virchow articulated a basic biological truism: "All cells come from cells." Developmentally speaking, the cell is a basic organismal unit. All organisms begin as single cells, or the union of single cells, and through the process of cell division, cell differentiation, and cell determination, take complex and multifunctional form. The large majority of the cells in the human body can be described as "highly differentiated" or developmentally "fated." These cells have highly specialized functions within specific systems, limited life spans determined by a certain number of cell divisions, and, with each division, produce two cells with an identical differentiated function.

Stem cells, however, are distinctive in that they have differentiated function, prolonged life spans, and, when they divide, are capable of producing not only more stem cells, but are also cells that are differentially specialized. Stem cells are classed according to degrees of potency and plasticity. First are so-called **adult stem cells**. These cells are found in various organ systems, and function to renew and repair populations of cells in those organs throughout the life of the individual. Adult stem cells are termed **precursor** or **progenitor** cells. Adult stem cells are either **multipotent** or **unipotent**. That is to say, they either give rise to multiple types of specialized cells within the organ system or only one type. A second class of naturally occurring stem cells is **fetal tissue stem cells**. From the time of the earliest specializations of tissues in the developing fetus (approximately after two weeks) until approximately three months, when the organs of the human body form, stem cells can be found in all organ systems. These stem cells generate the tissues for formation of the organs. Fetal tissue stem cells are **multipotent**, only producing cells in a differentiated system. Some of these cells, however, are **pluripotent**.

Unlike these first two classes of cells, **human embryonic stem cells** (hES cells) are not naturally occurring. They are derived from a human zygote, a fertilized egg, **in vitro**. The zygote is allowed to develop for about five days, to the blastocyst stage. At this stage the developing cells of the zygote undergo their first substantial differentiation from one another: the cells from a spherical cavity consisting of two cell types, an outer layer (trophoblast) and an inner cell mass. Human embryonic stem cells are derived by chemically disaggregating the outer layer, manually removing the inner cell mass, and plating the cells of the inner cell mass on fibroblast feeder layers.[12]

Having passed through multiple changes of media and reworked with specified nutrients, the hES cell lines exhibit the distinctive characteristics of mES cells noted above. They do not suffer the mortality and genetic degradation normally associated with cell division. This characteristic is shared with adult stem cells. However, unlike adult stem cells which, **in vivo**, only survive in parallel with the life of the organism, and which, **in vitro**, tend to degrade over a number of population doublings, hES cells exhibit cellular immortality. This means that they are scalable to exponential degrees. A single cell line, given the right nutrients, will reproduce itself indefinitely.[13] In the second place, when given the right growth factor, these

[11] See "From Science to Ethics in a Flash," in **Sacred Cells?**.

[12] Haron Gerecht-Nir and Joseph Itskovitz-Eldor, "Differentiation of human ES cells," in Lena Notarianni and Martin J. Evans, eds., **Embryonic Stem Cells** (Oxford: Oxford University Press, 2006).

[13] James A. Thomson, "Human Embryonic Stem Cells," in Suzanne Holland, Karen Lebacqz, and Laurie Zoloth, eds., **The Human Embryonic Stem Cell Debate** (Cambridge, MA, and London, England: MIT Press, 2001), 19.

cells can be directed to become any tissue type in the body, although effective control of differentiation remains a significant technical hurdle even in mES cells. This pluripotent characteristic is shared with some fetal stem cells. However, unlike fetal stem cells, which, **in vivo**, become fated to specific organ systems relatively early in fetal development, hES cells can be maintained in an undifferentiated state indefinitely.

If hES cells are interesting because they are ontologically distinctive, they have received much more attention because they may be medically useful. The logic of the concept of regenerative medicine has become familiar. It is not thereby less striking in its simplicity and potency. Thomas Okarma has pointed out what may appear to be an obvious biological fact, but which, in light of the derivation of hES cells, becomes rather more interesting. If all cells come from cells, then "the only way to restore cellular function in an organ is literally to replace the lost cells."[14] As noted, organs with populations of adult stem cells do this regularly. If hES cells could be effectively controlled, this function might be reproducible in any organ system by way of cell transplantation. Preliminary animal trials have been promising. Rats with severed spines who received transplantations of neural cells derived from hES cells regained lost mobility in their hindquarters. Injected hES- derived cells migrated to injured tissues and allowed the spinal cords to re- knit themselves.[15]

All the same, the now ten-year-old claims that human embryonic stem cell research would revolutionize medicine have not proven to be true (nor false, for that matter). Significant advances toward therapeutic proof-of-concept have been made, but have been rare. Differentiation is still not understood well enough to be managed. Stem cell transplants still result in cancers more frequently than is safe for regular experimentation in human subjects. And the problem of immune rejection, and its connections to nuclear transfer, remains a blockage point. Reasons of politics are often cited for this slow pace. Perhaps these reasons are accurate. Nevertheless, the revolution has not come. Regenerative medicine remains a provocative and plausible concept, but a concept whose applications have not born benefits equal to the prognostications.

4.1.3 Remediation

Despite this slow pace toward therapeutic application, hES cell research has already proven politically and ethically significant. Within a few short months of their derivation, stem cells were given pride of place alongside abortion and evolution as a political and moral litmus test in US politics. Given the polemics connected to the politics of stem cell research, another less obvious point of significance has often been overlooked. Stem cell research exemplifies the way in which living systems appear to be open to remediation. Recall that in the diagnostic **remediation** has two relevant aspects. First is a change of medium. Second is amelioration—to remedy, to make things better. By removing the inner cell mass cells from the blastocyst and by placing these cells into different media, researchers have been able to reconstruct the signaling pathways that function to direct the vitality and differentiation of the cells. This reworking is such that these cells are given new forms and subsequently new functions. Why is this significant? Ontologically, this means that engineered biological artifacts, placed within new media, media that rework pathways, are given a form that substantially alters the function of these artifacts. In this reconstructed form, the artifacts have been made to contribute the amelioration of biological systems that otherwise would have remained relatively degraded. By refashioning cells—isolating, associating, and reconnecting them—human embryonic stem cell research has demonstrated once again the remediative character and capacity of the evolutionary natural world.

This point of ontological significance bears on the ethical figuration of stem cell research. The remediation of zygotic cells demonstrated, once again, that the function and significance of living organisms is not dependent on pre-given natural forms, with pre-given capacities and **telê**. Thomson and subsequent researchers have shown that zygotic cells, under specified conditions, do in fact have capacities other than developing into fetuses, i.e., they can be made to become embryonic stem cells. That these conditions are cultivated, and not simply given, does not mean stem cells are unnatural. HES cells do not violate nature. Rather, they exemplify its flexibility, context-dependence, and the mutually constitutive relation among pathways, forms, and functions. The question of whether or not these remediated forms contribute to flourishing, however,

[14] Okarma, "Human Embryonic Stem Cells," 4.

[15] Hans S. Keirstead, et al, "Human Embryonic Stem Cell-Derived Oligodendrocyte Progenitor Cell Transplants Remyelinate and Restore Locomotion after Spinal Cord Injury," **The Journal of Neuroscience**, May 2005; 25: 4694 – 4705.

remains unclear. In any case, the extent to which such a question can be satisfactorily resolved—the question of the significance and worth of these ontological capacities—depends on figuration.

Defending the Embryo, A First Figuration

Figuration	**Mode of Veridiction**	**Metric**	**Mode of Ontology**	**Object**	**Mode of Jurisdiction**
Embryo Defense	Demonstration	Dignity	Genetic	The Embryo	Defense

Table 4.1

The first predominant figuration of embryonic stem cell research concerns the status and worth of the embryo, and the question of whether or not such worth calls for defense. Insofar as this way of establishing connections is made stable as a coherent ensemble, it can be thought of as a **figure of embryo defense**. The term defense here means both to protect and to justify. This figuration forms part of the wider problematization of human worth, bioscience, and ethics, which in our diagnostic we characterize as the figure of human dignity. As a figuration of embryonic stem cell research, however, the question of the embryo and its worth is distinct from this wider problematization in a number of salient respects, which need to be specified.

Although this figuration has been elaborated by those interested in promoting hES cell research, it is usually associated with those interested in forestalling research, most notably the Roman Catholic magisterium. Given its relatively long history of thinking about and responding to embryo research, the Catholic magisterium was one of the first organizations to publicly and coherently respond to the announcement of Jamie Thomson's breakthrough. As such, the Vatican position was widely circulated as the "religious" position, per se, and often cited as proof of "warfare" between science and religion.

Along with the Roman Catholic magisterium, others who have contributed to and argued for the coherence and legitimation of this first figuration include certain American Protestant denominations and theologians associated with these denominations. The Southern Baptist Convention and the Lutheran Church, Missouri Synod, are two examples. A number of political advocacy groups such as the "Center for Bioethics and Culture" and "First Do No Harm" also take this as the uniquely legitimate figuration. The Catholic magisterium, however, has developed the most systematic and coherent form of this figuration. Given this, I have elected to focus on the Roman Catholic variation. However, other variations will be noted as well.

4.1.4 Ethical Object: The Embryo

This figuration, like the others, is not simple. That is to say, it consists of multiple elements whose form and connections are characterized by a significance and function not reducible to any single element. Keeping this in mind, however, this first figuration can be usefully summarized as a question of what, ontologically, is at stake in hES research, and how, ethically, practices be ordered. The object that is taken to be at stake, of course, is the embryo. Recall that in our diagnostic, we use the term **object** in a technical sense. An object is the anchor point for a figuration; it works as a relay point to integrate the other elements of which the figuration consists. More pragmatically, an object is that which is taken centrally to be at stake in the figuration, and is therefore that in relation to which truth claims are produced and interventions ordered.

The embryo, as an object, is not identical with the zygote taken up as an object in biology, although the biology of the zygote is certainly considered as an integral element in this figuration. Rather, as an ethical object, the embryo is that which may or may not be the exemplar of the dignity of the human. This means that in the figure of embryo defense, it is the question of the worth and the status of the embryo which counts first and foremost. The question of the therapeutic worth of the stem cells derived from the embryo, along with other questions, is secondary. In short, the question is: to what extent is the embryo constituted by, and to what extent does it exemplify and partake of, those characteristics of incomparability and inviolability associated with the figure of human dignity; and thus, to what extent must the embryo and its integrity be defended against destruction at the hand of stem cell researchers?

4.1.5 Mode of Veridiction: Demonstration

In 2000, the Pontifical Academy for Life published a "Declaration on the Production and the Scientific and Therapeutic Use of Human Embryonic Stem Cells."[16] In the declaration, the authors assert, "The first ethical problem, which is fundamental, can be formulated thus: Is it morally licit to produce and/or use living human embryos for the preparation of ES cells?" The Academy answers in the negative. The question is analytically interesting in that it leaves unanswered a prior question: why is it that the embryo should be taken up as an ethical object? How is it that in the Roman Catholic figuration of embryonic stem cell research the question of the status of the embryo is the "fundamental" ethical problem?

The declaration does not answer this question. It does, however, indicate where one might look for such an answer. The declaration offers three interrelated steps in justifying its rejection of hES cell research. First, it states that "biological analysis" tells us that the human embryo is, from the moment of the union of the gametes, a "human subject" with a defined genetic identity that points to its "coordinated, continuous, and gradual development." The human subject thus has two defining characteristics. It is relational and it is a continuum of potentiality and actuality. Biology, we are told, confirms that the embryo exemplifies these characteristics. Second, it follows for the authors of the declaration that the embryo is a "human individual" with "the right to its own life." Once relationality and potentiality have been confirmed, the individuality of the embryo is asserted, and rights, including rights to life, are claimed. Third, the declaration concludes, it is morally illicit to destroy the human embryo. The ends do not justify the means. Relationality, potentiality, individuality, and integrity are linked.[17]

The logic that brings these four concepts together and attaches them to the embryo can be traced across three documents: **Gaudium et spes**, **Communion and Stewardship**, and **Donum Vitae**. These texts are not only thematically interrelated, but they are also veridictionally interconnected. That is to say, in addition to addressing questions concerning the embryo, the documents are connected and function together by way of a shared mode of veridiction. The shared mode of veridiction is **demonstration**.

What is demonstration as a mode of veridiction? Demonstration, as I am using it here, distinguishes the way in which, in embryo defense figuration, certain speech acts are taken to count in the register of true and false and are thereby authorized. Those speech acts count that are an elaboration of, or that follow from, foundational theological or philosophical principles. For this reason, the embryo defense figuration has a particular relation to the findings of the natural sciences. The claims of the biological sciences do not directly inform a demonstrative mode of veridiction. Rather, these claims are interpreted in such a way as to demonstrate that they follow from, and thereby serve to reinforce or ratify, foundational terms. In short, biological truth claims form part of this figuration only in so far as they are adjusted to demonstration as a mode of veridiction. Biology, as the Vatican's **Donum Vitae** puts it, does grasp the proper meaning the human person, and therefore must be ordered to such meaning by theology and the Church.

Of the theological and philosophical first principles at work in the documents identified above, two are particularly crucial. First is the theological and ontological doctrine of the **imago Dei**—the idea that humans were created in the image of God. Since Vatican II, the doctrine of the image of God has been given significant prominence in magisterial teaching and theological research.[18] Roman Catholic teaching and theology have focused on the challenge of discerning the proper form of human life amidst what the church takes to be the excesses and disorientations of the modern world. This focus has issued in demonstrations of the connection between the nature of God and the nature of humans. The medium of this demonstration has frequently been the doctrine of the **imago Dei**. It is worth noting that the term **imago** not only means "image," as it is usually translated, but "perfect form." The question taken up by the Roman Church is: what does the doctrine of the **imago Dei** tell us about the true or perfect form of human life in the modern world?

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[16] Reprinted as "Appendix A," in Brent Waters and Ronald Cole-Turner, eds., **God and the Embryo: Religious Voices on Stem Cells and Cloning** (Washington D.C.: Georgetown University Press, 2003).

[17] Ibid., 167-168.

[18] Communion and Stewardship, i.1, on line at http://www.vatican.va/roman_curia/congregations/cfaith/cti_documents/rc_con_cfaith_doc_20040723_communion-stewardship_en.html (<http://www.vatican.va/roman_curia/congregations/cfaith/cti_documents/rc_con_cfaith_doc_20040723_communion- stewardship_en.html>)

The second principle at work in these documents is the Thomistic notion of the "unified totality" of the human person as a corporeal body and as a substantive soul. This principle of "natural moral law," as **Donum Vitae** puts it, "lays down the purposes, rights and duties which are based upon the bodily and spiritual nature of the human person."[19] The principle functions to position the church's teachings in two important ways. First, it functions as warrant for the claim that the norms of human life cannot be determined at the biological level, but only at the level of the rational soul. Human life is defined "as a rational order whereby man is called by the Creator to direct and regulate his life and actions and in particular to make use of his own body."[20] Second, given that the rational soul is ordered by nature to a divine telos (beatific communion with God), the terms of that telos not only hold across human life in all its dimensions, but constitute the intent of the Creator. The telos of the rational soul, which is natural and proper to it, can also be taken as a mandate specifying the proper form of human life. Once discerned, such a form must be taken as normative. This means, among other things, that both the origin and goal of the human are genetically united, in the broad sense of genetic as the unfolding of potentialities. This also means that the potentialities of the rational soul as the first principle of life have the same moral worth as actualization of those potentialities.

The veridictional challenge for the magisterium is to show how developments in biology generally, and in stem cell research specifically, either follow or diverge from the doctrine of **imago Dei**, or the principles of natural moral law.

4.1.6 Metric: Dignity

Of the possible demonstrative truth claims that might be produced, only those will form part of the figure of embryo defense which can be ordered and made to operate according to a specific metric or standard: **dignity**. Given that the ethical object of this figuration is the embryo, those truth claims will form part of the figure that can be ordered according to the metric of dignity as it concerns the embryo. The metric thus functions as a structural joint between the embryo defense figuration and the broader contemporary problematization of human dignity. A crucial distinction here is that in the broader problematization the figure of human dignity operates according to a declamatory mode of veridiction. That is to say, according to the figure developed in our diagnostic, dignity is simply declaimed—forcefully declared without explicit appeal to grounds. By contrast, the dignity of the embryo in the figure of embryo defense must be demonstrated.

Dignity became an authoritative standard for contemporary Roman Catholic thought, in part, through the 1965 Vatican II "Pastoral Constitution on the Church in the Contemporary World," or "**Gaudium et spes**."[21] In the Constitution, the Roman Church is described as the "hope of the modern world," in that the church discerns the ends to which technological and political powers in the contemporary world should be ordered. The Council writes: "Though mankind is stricken with wonder at its own discoveries and its power, it often raises anxious questions about the current trend of the world, about the place and role of man in the universe, about the meaning of its individual and collective strivings, and about the ultimate destiny of reality and of humanity."[22] Technological "mankind" on its own is incapable of answering such questions.

The proper meaning of these individual and collective strivings is communion with God. Such communion is anticipated and oriented by human nature itself. What is this nature, the Constitution asks? It is the image of God. Such a "noble destiny" as communion with God is given form as a "Godlike seed" that must be respected as invaluable, inviolable, sacrosanct. The Council argues that this Godlike seed can be discerned in the social character of human nature. The image of God, from the beginning, is "male and female," for when God created the human, "he created them." Interpersonal communion is taken to be the "innermost

[19] **Donum Vitae**, section 3. **Donum Vitae** can be found online at: http://www.vatican.va/roman_curia/congregations/cfaith/documents/rc_con_cfaith_doc_19870222_respect-for-human-life_en.html (<http://www.vatican.va/roman_curia/congregations/cfaith/documents/rc_con_cfaith_doc_19870222_respect-for-human- life_en.html>)

[20] Ibid.

[21] **Gaudium et Specs** can be found online at http://www.vatican.va/archive/hist_councils/ii_vatican_council/documents/vat-ii_cons_19651207_gaudium-et-spes_en.html (<http://www.vatican.va/archive/hist_councils/ii_vatican_council/documents/vat-ii_cons_19651207_gaudium-et- spes_en.html>)

[22] Ibid., preface.

nature" of the human, and "unless he relates himself to others he can neither live nor develop his potential."[23] It bears underscoring that this "innermost nature" is taken to be natural, that is, of human nature. This means, among other things, that it is a principle not only of human "persons" but of human "life." Or, put the other way round, human life is qualified by that nature that makes human persons sacrosanct. Thus, of course, the dignity of persons can be taken up as the sanctity of life.

Since the publication of **Gaudium et spes**, these themes have been elaborated in a number of directions. Most relevant here is that they have been taken up and extended in the context of Roman Catholic reflection on contemporary science and experimentation with the early embryo. The international commission, **Communion and Stewardship** (subtitled **Human Persons Created in the Image of God**) spells this out.[24] The commission starts by reinforcing the connection of the dignity of humans to the **imago Dei**. It then specifies that God's true nature is Trinitarian, and thus, that the human, as the image of God, is by nature a communal being. The commission draws a striking conclusion from this: children are the exemplars of the dignity inherent in the **imago** insofar as children are the biological-spiritual expression of "a man joining with a woman" in a love created by God. Put simply, a child should be thought of as a Trinitarian creation.

This formulation and its connection to the notion of intrinsic dignity have, for several decades, been connected to Catholic thinking on the nature and status of the embryo. This connection was given definitive articulation in the instruction **Donum Vitae**, the **Instruction on Respect for Human Life in Its Origin and on the Dignity of Procreation**. In the instruction, the relational dignity of human life is directly connected with the ontology of the embryo. The embryo is figured as not only participating in human dignity, but as its original and perfect form and thus the initial site of its genetic unfolding —both figuratively and literally.

Donum Vitae asserts that human life is sacrosanct from the event of the joining of the gametes. If the human finds its dignity in the Trinitarian relationality of man-woman-God, that dignity first takes form as the embryo. The embryo, **Donum Vitae** argues, consists of the three contributing elements of human nature—a mother, a father, and a divinely created soul. It further argues that such a view is ratified by contemporary developmental biology. The embryo is produced by the joining of the father's gamete, the mother's gamete, and the soul. Of course, the biological sciences could never confirm the presence of the soul, per se. But what is the soul? It is, in the first place, a matter of self- identity. In the second place, it is a matter of rational self-ordering. Taken together, these two constitute principles of subjectivity, the locus of a subject. The authors of **Donum Vitae** note that when the mother's and father's gametes come together, a novel genome is created. This novel genome can be taken as a marker of what John Paul II referred to as the "absolutely unique singularity" of the human person.[25] What's more, this genome will provide the instructions for the organization of the body of the developing embryo-fetus-child. That is to say, the genome inscribes a continuum of being by way of a principle of self-ordering. The authors of **Donum Vitae** note that the genome cannot be identified with the soul. However, they ask: how can we have such novel identity and an inner principle of self-ordering and not have a human subject? And if we have a human subject how can we not have a potential human person?

A note should be made at this point concerning the biology at play in the Vatican's formations. The first is that since the publication of **Donum Vitae**, somatic cell nuclear transfer— cloning—has become a more or less refined technique for activating an egg such that it functions like a zygote. This technique indicates that it is possible to initiate the embryonic process without the contribution of gametes from a father. This means, among other things, that genomic novelty cannot reasonably be taken as an indication of the presence of a subject (although the fact of identical twins already indicated this). This also means that ordering factors characteristic of a genome are not simply intrinsic per se. Rather, they depend entirely on the cytoplasmic context in which the genome is situated. Second, this insight has not only been reaffirmed and nuanced by post-genomic biology, but is clear in the simple fact that the potential of an embryo to become a baby depends in no small part on being located in a womb. Living organisms, including the embryo, have

[23] Ibid., chapter 1, citing Genesis 1:27

[24] "Introduction," **Communion and Stewardship**

[25] Quoted in **Donum Vitae**, section 2 of the preface.

multiple potentialities, the actualization of which is highly context-dependent. Biologically speaking, there are no natural forms that will genetically unfold according to a pre-given or necessary telos. Genetics simply do not work in the determinative fashion suggested by John Paul II in **Evangelium Vitae**. Nor do the genetic sciences demonstrate "that from the first instant there is established the structure or genetic program of what this living being will be: a man, and indeed this individual man."[26] Rather, post- genomic biology suggests that there are organisms whose pathways are ordered and whose forms are produced by a series of relational factors. The question would thus seem to be not which natural forms need to be defended in the name of what's naturally given, but rather which forms should be favored given the kinds of relations which are worthwhile. This point bears on the second figuration as well.

In any case, the Vatican figuration takes dignity to be inherent and given in the early embryo, a given that can be theologically demonstrated and biologically confirmed. Dignity in this way functions as a metric for specifying which things at play in stem cell research (from biology to public policy) will be picked out as elements in the figure of embryo defense. Following our diagnostic, we can say that those elements that are picked out can then be associated, connected, and coordinated as part of the overall figuration. The kinds of elements included in the figure of embryo defense are, of course, those that are taken to bear on the question of the dignity of the embryo.

4.1.7 Ontological Mode: Genetic

As described in the diagnostic, the elements selected and arranged by a metric in a figure are characterized by a given ontological mode. The elements of a figuration form a single relational field, in part, because they are taken up according to a shared ontology. The modal aspects of this ontology include a particular temporality. The figuration of embryo defense is characterized by a **genetic** ontological.

The term **genetic** is, of course, most immediately associated with the idea of the gene, or with that part of the biological sciences that study the genetic characteristics of an organism. The term, however, has an older and broader meaning. The term refers in the first place to genesis—origin or generative source. Second, the term means "arising from a common origin." A genetic mode of ontology is a mode in which an object's being and significance are taken to be explainable in terms of the unfolding of potentialities latent in its origin.

A genetic mode of ontology is closely related to an **archonic** mode of ontology, which characterizes the second figuration, and which I will explain in more detail there. Ted Peters has distinguished two different and incompatible ontological modes in thinking about the natural world: an **unfolding** view and an **epigenetic** view. The unfolding view he terms the archonic view. As Peters defines it, the archonic view is characterized by a conception of things in which "everything is in one way or another given at the beginning. The universe consists in an unfolding or realization of potentialities already present at the starting point."[27] Peters adds that the archonic is thus an ontological mode in which origins both define and govern. I would like to add a distinction to Peters' analytic categories. Analytically, it is useful to distinguish between an ontological mode in which potentialities present in the origin unfold over time, and an ontological mode in which an **unchanging archon**, as a first or defining principle of things, which may not in fact unfold over time, is definitive. Following this distinction, I want to use the term **genetic** to designate an ontological mode in which a potentiality comes to actuality through historical unfolding, and I want to use **archonic** to define an ontological mode in which an unchanging and defining "nature of things" is determinative. To use a rather imprecise philosophical distinction, the genetic refers to the unfolding of a **telos**, whereas the archonic refers to the **ideal form** of a thing. In both cases there are pre-given and normative forms. However, the temporality of the two is quite distinctive. Borrowing from Peters' definition of the archonic, we might say that in a genetic mode of ontology, "The present and future have been predetermined or at least delimited by the past. All fresh initiative, novelty, or creativeness are effectively banned from the universe."[28]

[26] **Evangelium Vitae**, 60, 468-469, which can be found online at http://www.vatican.va/holy_father/john_paul_ii/encyclicals/documents/hf_jp-ii_enc_25031995_evangelium-vitae_en.html (<http://www.vatican.va/holy_father/john_paul_ii/encyclicals/documents/hf_jp-ii_enc_25031995_evangelium- vitae_en.html>)

[27] Ted Peters, **God— The World's Future**, 2nd edition (Minneapolis: Fortress Press, 2000), 18-19.

[28] Ibid., 19.

The kinds of elements that can be made to appear in a genetic mode are those that can be taken as defined by potentialities inherent in their origins. A genetic mode of ontology brings together the elements of demonstrative philosophy and theology, the metric of dignity, and embryonic stem cell research, and interfaces them such that they become connectable into and as a single genetic object. The object is, of course, the dignified embryo.

4.1.8 Mode of Jurisdiction: Defense

When the embryo as an object is figured through demonstration as a mode of veridiction, aligned by dignity as a metric, and characterized by a genetic mode of ontology, a specific mode of jurisdiction is taken to be both appropriate and necessary. This mode of jurisdiction is **defense**.

Defense, as a mode of jurisdiction, specifies that the activities appropriate to the ordering of embryonic stem cell research are those that protect the embryo from destruction or even manipulation. Given that dignity of the embryo is taken to be identical with its nature and potentiality, it can be neither established nor cultivated. Scientific practices that would destroy the embryo or otherwise disrupt the course of its "natural" development must be blocked. As the Pontifical Academy for Life puts it, regardless of the therapeutic worth of the artifacts derived from the early embryo, destruction of the embryo is morally illicit. Its sacrosanct dignity must be defended. As **Donum Vitae** expresses it: "The inviolability of the innocent human being's right to life 'from the moment of conception until death' is a sign and requirement of the very inviolability of the person to whom the Creator has given the gift of life."[29] Such inviolability is morally ordaining. It orders a mode of defense.

4.1.9 Note: Figural Variation

As noted above, there are several variations of the embryo defense figuration. A good number of these are produced by Roman Catholic theologians who share the demonstrative mode of veridiction and the metric of dignity, but who adjust these to the elements of stem cell research differently. Several Roman Catholic theologians, such as Australian theologian Norman Ford and American Catholic theologian Thomas Shannon, argue that the early embryo does not exhibit the kind of unique individuation asserted in the Vatican figuration. Shannon, for example, argues from Scotus that the early embryo exhibits a human nature but is not yet a human person. Natures have value, persons have dignity. Shannon, following others, argues that the early embryo is not yet individuated and thus does not yet have dignity.[30] Shannon's position recommends a different mode of jurisdiction.

A prominent variation outside of the Catholic church forms the element of the figure of embryo defense according to the so- called "14-day rule." This variation, rather than genetic in its mode of ontology, is developmentalist. That is to say, it asserts that the moral status of the embryo changes as it develops. As with Shannon, the 14-day rule suggests that the rights associated with human dignity cannot be asserted unless one has a human individual; a general human nature is insufficient. At fourteen days, the developing embryo can no longer undergo twinning. Thus, this is taken to represent a threshold at which individuation can be asserted. Note that the 14- day rule also relies on the adjustment of the findings of biology to a demonstrative mode of veridiction. In this case individuation is taken to be a marker of dignity. The task then is to put biology in the service of clarifying individuation. This variation is most prominently associated with the Warnock Report, a report produced to establish oversight rules of embryo research in England.[31]

Note that in the case of both of these variations, a kind of respect or value is extended to the embryo. It is not taken up as a sheer biological artifact per se. However, in both cases, value is not identical with dignity, and certainly not with inherent dignity. Both variations cohere with reasoning put forward by Karen Lebacqz, namely that value and dignity should not be confused or conflated: "First, the embryo or tissue

[29] **Donum Vitae**, section 4.

[30] See Thomas A. Shannon, "From the Micro to the Macro," in Suzanne Holland, Karen Lebacqz, and Laurie Zoloth, eds., **The Human Embryonic Stem Cell Debate** (Cambridge, MA, and London, England: MIT Press, 2001).

[31] The Report can be found online at http://www.bopcris.ac.uk/bop all/ref21165.html (<http://www.bopcris.ac.uk/bopall/ref21165.html>)

must be valued.... To respect the embryo is to affirm that the value of the embryo or tissue is **not** dependent on its value for us or its usefulness to us. Respect sees a value in itself beyond usefulness. [...] Second, such an entity can be used in research and can even be killed. To do so is not in itself disrespectful."[32] Given the archonic logic at work in much of the embryo defense figuration, it is not surprising that Lebacqz's conclusions have been contested.

Protecting Human Nature, A Second Figuration

Figuration	**Mode of Veridiction**	**Metric**	**Mode of Ontology**	**Object**	**Mode of Jurisdiction**
Human Protection	Verification	Dignity	Archonic	'Truly Human'	Protection

Table 4.2

The second predominant figuration of embryonic stem cell research concerns the relations between human nature and the nature of biotechnology. In so far as this way of establishing connections is made stable as a coherent ensemble, it can be thought of as a **figure of human nature protection** or **human protection**. Like the first figuration, the human nature protection figuration forms part of the wider problematization of human worth, bioscience, and ethics that has taken form as the problem of human dignity. However, unlike the embryo defense figuration, the figure of human protection includes elements of the figure of biopower.

Like the first, forms of this second figuration have been elaborated by those interested in promoting as well as those interested in forestalling hES cell research. Though like the first, it is usually associated with the later. On August 9, 2001, George W. Bush gave his first public policy address as the U.S. President. The address focused on stem cells. Of the notable elements of his address, three are relevant here. First, President Bush rhetorically framed human life as fundamentally vulnerable. Second, he linked hES research to the "hatcheries" of Aldus Huxley's **Brave New World**. Third, he announced the formation of the President's Council on Bioethics (PCBE), which would be developed and chaired by University of Chicago Professor Leon Kass. The PCBE's elaborate a figuration of stem cell research that can be characterized as human nature protection. The PCBE's figuration of stem cell research is the most coherent and robust articulation of the second figuration. As such I have selected it as an exemplary case for my analysis.[33]

4.1.10 Ethical Object: Human Nature

This second figuration can be usefully summarized as a question of what, ontologically, is at stake, and how, ethically, practices be ordered in response to such stakes. The question does not center on the nature and moral status of the embryo, although the question of the embryo certainly appear as an element in this figuration. Rather, the question centers on the "nature" of what it means to be human, or "truly human" (as Kass has consistently put it), and the extent to which biotechnology generally, and hES cell research specifically, supports or degrades the truly human. Put as a question: if the human is inherently dignified, what is the nature of that dignity such that, as stem cell research develops it can be evaluated as either coherent with or dangerous to that dignity? In order to respond to the question, obviously, one must suppose that the human is inherently dignified and that this dignity is susceptible to verification in such a way that biotechnological developments could be evaluated and aligned in view of it. Such a supposition of verifiability has been difficult for this figuration maintain.

In this figuration the ethical object is the "naturally given" nature of the human. "Naturally given" here means both "gifted" by nature and free from cultivation. Human nature as "naturally given" functions as an anchor point and relay point which integrates the other elements of which the figuration consists. Human

[32] Karen Lebacqz, "On the Elusive Nature of Respect," in Suzanne Holland, Karen Lebacqz, and Laurie Zoloth, eds., **The Human Embryonic Stem Cell Debate** (Cambridge, MA and London, England: MIT Press, 2001), 159.

[33] **Monitoring the Frontier of Stem Cell Research**, A Report of the President's Council on Bioethics (2004), 185, online at www.bioethics.gov (<http://www.bioethics.gov/>)

nature (used by the President's Council as more or less synonymous with human dignity) is that which is taken centrally to be at stake in biotechnology; it is that in relation to which moral understanding should be oriented and ethical interventions ordered. This figuration has two secondary objects: "biotechnology" and "liberal society." These two are taken to be forces in response to which the question of human nature must be posed. This figuration is not concerned in the first place with the status of the embryo. This figuration is concerned with the question of the extent to which embryonic stem cell research, driven by the interests of "liberal society," might degrade human nature and thereby compromise human dignity.

The most synthetic and concise formulation of the concerns at play in this figuration was offered by Kass at the inaugural meeting of the President's Council. Kass reminded the members that the Council's work would proceed by way of a core mandate: "fundamental inquiry into the human and moral significance in developments in biomedical and behavioral science and technology." The task was to bring things together in such a way as to discern the "fundamentally human" in biotechnical science. He also argued that bioethics conducted in a post-9/11 world should recognize "security" as the principle challenge of biotechnology. Something fundamental has been made insecure; and thus something fundamental must be secured: human nature. Ethics must take seriously not only the question of the extent to which biotechnology contributes to the enhancement of life medically, but whether or not biotechnology enriches us "humanly." In Kass' view, biotechnology risks being a tragic enterprise: in the name of one set of goods (e.g. freedom of inquiry, individualism, health), it may destroy other "truly human" goods, "the worth and defining features" of human life. How such a thing could even be conceivable depends entirely on how biotechnology, freedom, and human nature are figured. This is, of course, the work of the human protection figuration. The object is human nature; the stakes are whether or not biotechnology humanizes or dehumanizes.[34]

4.1.11 Mode of Veridiction: Verification

In his opening address, Kass proposed that the ethics of the PCBE consists of three inquiries. First, the Council should inquire into which features of human life are most worth defending. Second, it then must determine whether or not biotechnology threatens those features. And third, if those features are threatened, the Council must devise equipment for their protection. The first of these three inquiries is determinative of the other two. In the course of the PCBE's work (at least under Kass' chairmanship) this first inquiry established the veridictional mode for the Council's subsequent efforts.

The Council's work operates according to a verificational mode of veridiction, a mode that the Council takes to be appropriate to the objects and developments of the biological sciences. This means that unlike the mode taken up by the Vatican, the findings of the biological sciences are not positioned relative to prior philosophical principles. The fact that the Council takes its mode of reasoning to be appropriate to the biosciences can be obscured by much of the rhetoric mobilized within this figuration. In the Council's early work they frequently articulated fear of a **Brave New World**, the fear that overly technologized approaches to problems of human wellbeing drive toward a future in which human nature will be traded for technological gain, as well as a feat of **playing God**, the fear that technological interventions are an expression of hubris, which will precipitate destructive reactions on the part of nature. In any case, bioscientific truth claims are taken to form part of the register of true and false within which the Council's claims about the defining and worthy features of human life are produced.

Following our diagnostic, recall that as a mode of veridiction verification takes as significant and worthwhile only those truth claims "which can be verified through the reduction of particulars to predictable regularities or patterns." Verification is characteristic of the modern human sciences, and frequently the biological sciences. Verification has two aspects, a hermeneutic aspect and a positivist aspect. First verification means "to substantiate," to make into cases; this is the hermeneutic aspect. Second verification means to "prove the truth of something"; this is the positivist side. Truth claims in a mode of verification thus require "incessant movement between an attempt to verify truth claims through facts on the one hand, and through generalization or theory on the other."

The Council's inquiry into the defining and worthy features of human life is conducted through this shift

[34]See the transcript of Kass' January 17, 2002, address online at www.bioethics.gov (<http://www.bioethics.gov/>)

from particulars to patterns of regularity. At least one of their major publications devotes considerable energy to the task of verifying "human nature" as an ethical object through a hermeneutic and positivist movement. If the attempt fails—and to a large part of the Council's critics it does—this is in part because a verificational mode usually operates within an ever-receding horizon in which the incessant movement between, and adjustment of, accumulated facts and general theories never ends. By contrast, in the figure of human protection, the movement stops when the defining features of the "truly human" are taken to be verified. Nonetheless, the particularities and patterns of "human nature" are articulated in a verificationalist mode, and such a mode is deployed as a source of standards for ethical practice.

4.1.12 Metric: The "Truly Human"

Of the possible verificational claims that might be made about human nature, only those qualify for the figure of human protection that can be ordered and aligned with a specific metric: the **truly human**. The truly human is both a given and an obligation. It is a given in that it is that which is most "naturally" human. It is an obligation in that those forms of life should be avoided in which "we cease to be ourselves." As the Council puts it, "there is something precious in our given human nature."[35]

As a metric, the truly human is closely related to dignity or human dignity. In fact, it could be argued that dignity is the metric of this figuration, both in that the features which count as "truly human" for the Council coincide with their definition of dignity, and in that this figuration forms part of the broader contemporary problematization of human dignity. However, the "truly human" is distinct from the metric of dignity as we developed it in our diagnostic in at least one crucial respect. Dignity, as a metric in much twentieth century political and ethical thought, is characterized by a declamatory mode of veridiction. Dignity is neither demonstrated, nor is it verified. Rather, it is taken as immanent and self-referential. The figure of human protection, however, attempts to substantiate and verify the truth of human dignity, the truly human.

The "truly human" is thus the standard by which verificational claims are selected and ordered. Only those speech acts that can be verified and that bear on the question of the truth of human nature are taken seriously. Of the elements that are specified, associated, and connected by "truly human" as a metric, two are particularly important. The first concerns what the President's Council refers to as "finitude" or "limitation." The second concerns "freedom" or "striving."[36]

The Council orients its verification of the truly human with what it takes to be an anthropological constant: every human life is marked by certain limitations; each life is the way it is and not some other way. Some of life's limitations can be adjusted or even overcome. Teaching, learning, practice, and training represent techniques that humans have long used to deal with limitations. Some limitations, however, appear to be "fixed." These fixed limitations are those that are "naturally given": bodies suffer injuries, contract diseases, wear out and die; capacities are limited, humans fall short of ideals despite cultivation; humans experience depression and anxiety, loneliness, even despair. As Kass has put it, "Nature is fallible and her works are imperfect. Human beings are no exceptions; our bodies decay and perish and our powers are limited."[37] Limits should be respected.

But the Council rightly asks: "Why should natural limits be respected?" Two responses are given. First, nature, though "fallible and imperfect," is also highly complex and delicately balanced, the result of "eons of gradual and exacting evolution."[38] Intervention risks triggering dangerous unintended consequences. Second and more significant, biotechnical interventions risk a temptation to what the Council refers to as "hyper-agency." Hyper-agency is described as the "Promethean aspiration to remake nature, including human nature, to serve our purposes and to satisfy our desires."[39] This aspiration constitutes a "false understanding of" and an "improper disposition toward" the naturally given world, a failure to acknowledge the goodness and

[35] **Beyond Therapy: Technology and the Pursuit of Happiness**, a Report of the President's Council on Bioethics (2007), online at www.bioethics.gov (<http://www.bioethics.gov/>), 289.
[36] Ibid., 306
[37] Kass' address January 17, 2002
[38] **Beyond Therapy**, 287.
[39] Ibid., 288.

giftedness of the world. True understanding and proper disposition consists of the recognition that nature is not fully ours to master, but a gift to be accepted and served with "reverent awe."

The Council recognizes that its appeal to the goodness of "natural gifts" may be unpersuasive. Nature's "gifts" are frequently undesirable—disease, predation, suffering. And where nature's gifts are more desirable—health, physical coordination, metabolic stability—the "distribution" of those gifts appears unequal. Some "naturally given" human limits, it would seem, ought to be opposed by human innovation. Certainly the Council does not think all striving to overcome disease and suffering should be curtailed. The question is: "Which natural limits are good and which ones are not?"

The Council suggests that in order to answer this questions we need to look not to the limits of nature generally, but to those limits characteristic of given **human** nature. Only if there is a given human nature, the PCB argues, a "given humanness, that is also good and worth respecting, either as we find it or as it could be perfected **without ceasing to be itself**, will the 'given' serve as a positive guide for choosing what to alter and what to leave alone." So is there a given human nature? Yes, suggests the Council, it is "limitation." Which limitations? Those on which human goods depend. A key to the Council's position is that limitations serve as the condition for the possibility of the greatest goods of life. Our greatest achievements in life consist in our striving for excellence. Our age and disease-prone bodies limit our life span, thereby encouraging us to form deep attachments and to pursue "the best things in human life." We strive for happiness and joy, according to the Council, because we know pain and loss.[40] The goods of life are inseparably tied to limitations.

It follows, then, for the Council, that if human nature is characterized by limitations, it is equally characterized by "deep dissatisfaction" with those limits and a drive to overcome them. The Council writes that humans have "extraordinary powers, unique among the earth's creatures, to shape our environment and even ourselves according to our wills."[41] This capacity allows us to alter the human estate, relieve suffering, guard against the violence of non-human nature, and so on. However, according to the Council, this impulse toward transcending limitation tends toward the desire for perfection. Our capacity for freedom becomes a tragic flaw built into our very constitution. Whereas limitations are "naturally given" and thereby good, the drive to overcome these limitations is described by the Council as a "native human desire," a native desire in tension with the "wisdom" of nature. This rhetorical shift from nature to native is significant. The desire to overcome limitation can push us to self-destruction.

Humans are finite. Yet humans dream of perfection. Desire to change limitations becomes a drive to escape all limits. This drive to relieve ourselves of our own finitude is nothing less than our desire to relieve ourselves of our own humanity. In the Council's words, not only do we strive to "kill the creature made in God's image," but we seek to "remake ourselves after images of our own devising."[42] The conditions for the possibility of dehumanization are built into our very nature.

In sum, truly human life is one in which limitations are balanced against the drive to overcome these limitations. "Full human flourishing" involves recognizing that the human is a creature whose "limitations are the source of its—our—loftiest aspirations, whose weaknesses are the source of its—our—keenest attachments."[43] This claim is central to the kinds of evaluations of biotechnology that can be made within this figuration. It is also crucial, as I will discuss below, to the modes of intervention that the Council recommends. Limitations are good, insofar as without them humans would not aspire to "lofty" things. Likewise, weaknesses are good insofar as they are the condition for the necessity of forming the "keenest" attachments. Forms of life that cultivate and maintain a balance of limitations and striving can be described as truly human, and thus as humanizing. By contrast, the suppression, disruption, or elimination of either limitation or freedom—the throwing out of balance the relationships between them—would constitute a violation of the truly human and thus would be dehumanizing.

Two notes need to be added here on the nature of "biotechnology" and "liberal society" in relation to the metric of the truly human. First, if the goods of human life are found in balancing naturally given

[40] Ibid., 289.

[41] **Being Human: Reading from the President's Council on Bioethics**, a collection of readings from the President's Council on Bioethics, introduction.

[42] **Beyond Therapy**, 11.

[43] Ibid.

limits against the desire to transcend those limits, contemporary science risks destroying those goods by upsetting that balance. On the Council's account, humans have always been marked by an impulse toward perfectionism. For most of human history, the techniques by which this impulse could make itself felt were limited to "indirect" means of self-transformation: "Until only yesterday, teaching and learning or practice and training exhausted the alternatives for acquiring human excellence, perfecting our natural gifts through our own efforts. But perhaps no longer: biotechnology may be able to do nature one better, even to the point of requiring less teaching, training, or practice to permit an improved nature to shine forth."[44] Through "direct" intervention, advancing biotechnology gives us an increasing capacity to overcome limitations that in the past would have seemed inescapably "given." This capacity not only inflames our appetite to transcend our limitations, it gives us the ability to do so. Such is the Council's concern: biotechnology appears to give us the ability to tip the scales of human nature in favor of freedom over finitude. In doing so, the Council worries, we may sever the necessary connection between limitations and goods and thereby destroy our own humanity.

A second note concerns what the Council refers to as "liberal society." Biotechnology stands in an ambiguous relationship with "liberal society." On the one hand biotechnology appears to cohere with the ideals of liberalism, providing opportunity for the exercise and expansion of individual liberties. On the other hand, biotechnology risks contributing to a "Tragedy of the Commons," a leveling effect wherein the forces of "popular culture" bring about a set of practices that cater only to the most common desires. Through the medium of aggregate pressure, individual desires are shaped, until "uncoerced" private choices produce homogenization. If biotechnology is transformed such that common desires are seen as basic needs which one is entitled to fulfill, the benefits gained by any one individual become outweighed by the aggregate harm of common debasement.

How this all applies to hES cell research has been most forcefully articulated by Kass himself. As Kass explains it, all research on embryos is potentially dangerous. Kass understands sexual reproduction to be a quintessential verification of the tensions characteristic of the "truly human." In sexual reproduction, Kass argues, humans both long to transcend themselves in union with another and also demonstrate their own finitude in that the continuity of the species can only be accomplished by passing life on to another generation. The embryo, in some sense, is thus the production and embodiment of human finitude and striving. Any "society" which is willing to sacrifice the life of the embryo, at the scale of a platform technology, for the sake of medical advance, is a society characterized by a willingness to violate the truly human.[45]

4.1.13 Ontological Mode: The Archonic

The "truly human" as part of the figuration of human nature protection is characterized by an archonic mode of ontology. The term archonic combines the Greek **arche** and **archon**. Arche means "beginning," "origin," or "first principle." Archon means "ruler" or "governor." Taken together, the archonic refers an ontological mode in which the origin of a thing governs its present and future. In this figuration, the archonic characterizes the way in which the "naturally given" elements of the truly human exist and are taken up. Given the distinction I introduced between the genetic and the archonic, I want to underscore the element of "first principle" in the meaning of archonic. The archonic as I am using it here is an ontological mode in which an unchanging ideal, or essential principle, of being governs the significance and true form of the elements in a figure.

The figure of human protection does not involve the unfolding of a potentiality. The nature of truly human life is figured by the PCBE as a basically unchanging way of being. The balance of limitation and striving may be precarious, but it is nevertheless a first principle of who the human is and must continue to be. For this reason, the fact that biotechnology increases capacities means that biotechnology also intensifies the danger of dehumanization. To inflect slightly the quote used above to define the genetic mode of ontology, the PCBE's figuration of embryonic stem cell research is characterized by an archonic ontology in which the present and future are determined and delimited by a natural order of things. All fresh initiative, novelty,

[44] Ibid., 288.

[45] Leon Kass, "Cloning and the Post-Human Future," in **Life Liberty and the Pursuit of Dignity: The Challenge for Bioethics** (San Francisco: Encounter Books, 2002).

or creativeness that moves beyond the "naturally given," are effectively banned as dangerous and potentially dehumanizing.

4.1.14 Mode of Jurisdiction: Protection

The Council asks: "Does our ability to flourish as human beings depend on our ability to improve the human form or function? Or might the contrary be true: does our flourishing depend on accepting—even celebrating—our natural limitations?"[46] When human nature as an ethical object is figured through verification, aligned by the truly human as a metric, and characterized by an archonic mode of ontology, a specific mode of jurisdiction can be taken as necessary and even urgent: protection.

Protection, as a mode of jurisdiction, specifies that the activities appropriate to the ordering of embryonic stem cell research are those that function to vigilantly guard against biotechnological practices that, in the name of amelioration or freedom, might, through compounded effects, tip the human toward a non-human future. Given that the truly human is archonic and thus cannot be cultivated per se (though it can compromised or lost) practices that would upset the balance of limitation and striving must be blocked. Insofar as embryonic stem cell research is taken to indicate a willingness to instrumentalize nascent human life in the name of increasing other goods, and insofar as such instrumentalization might easily be made widespread in a liberal society, hES cell research is taken as dangerous. Stem cell research does not contribute to humanizing work of balancing limitations and striving.

4.2 Remediating the Future, a Third Figuration

Figuration	Mode of Veridiction	Metric	Mode of Ontology	Object	Mode of Jurisdiction
Future Abundance	Reconstruction	Abundance	Emergent	The Person	Remediation

Table 4.3

A third predominant figuration concerns the question of the embryonic stem cell research's potential therapeutic worth and the priority of possible future wholeness in the formulation of ethical practices. In so far as this way of establishing connections among elements is made stable as a coherent ensemble, it can be thought of as a **figure of future abundance**. This figuration is distinct from the other two in that its mode of veridiction and mode of jurisdiction are most directly informed, and most directly form, the ethos within which stem cell research initially emerged and has subsequently developed.

As has been noted in connection to the first two figurations, forms of this third figuration have been elaborated by those interested in promoting, as well as those interested in forestalling, hES cell research. Unlike the first two, however, this figuration is most associated with those who promote the research. Those who reject this figuration take its elements and logic of composition to be utilitarian. Moreover, it is presumed that this figuration represents a kind of moral orthodoxy in the biological research community. In other words, to use our diagnostic terms, this figuration might easily be diagnosed as a matter of biopower.

The connection to utilitarianism does not hold. This figuration is neither calibrated to a consequentialist logic, though consequences are important, nor is it simply a matter of maximizing the good of the population. The frequent association of this figuration with the research community is more plausible; many in the research community do advocate for hES research, and do so through widely circulated media. From the derivation of the first cell lines, these advocates offered prophesy of medical revolution. This rhetoric has, at times, formed part of the future wholeness figuration. However, the figuration itself has not actually been produced by these scientifically authorized spokespersons. Rather, it was elaborated by various theologians and theological communities in the first place, and in the second place by these communities in partnership

[46] **Beyond Therapy**, 300

with secular philosophers in the research community. A crucial feature of this figuration is that it not only endorses the therapeutic potential of stem cell research, but also supports such potential as part of a wider vision of human flourishing.

There is no single form of this figuration which is dominant. Certainly there are consistent elements across multiple forms. There is no official body or organization, however, which has generated the kind of political profile characteristic of the Vatican figurations and the figuration produced by the President's Council. That said, this third figuration is certainly pervasive. Its forms, however, are variable and its elements case- specific. These factors are due, in part, to its temporality, which I analyze below. Here it suffices to note that this figure works in a temporal mode that involves insistent work on, and adjustment to and of, the emerging future. Such insistent work reflects the fact that the elements of this third figuration are relatively dynamic and unfixed.

The categorical elements of which this figuration is composed can, nevertheless, be specified and analyzed. In conducting such an analysis I will focus on the work of Christian theologians Peters et al.[47] I will note the variation of this figuration produced by Jewish organizations and ethicists as well. Others who contribute to this figuration include mainline Protestant denominations and patient advocacy groups.

4.2.1 Ethical Object: Persons

This figuration, like the others, can be usefully summarized as a question of what, ontologically, is at stake, and how, ethically, practices should be ordered. The question is: to what extent does embryonic stem cell research in its current and future forms contribute to or degrade human abundance or flourishing? In order to respond to the question, obviously, one must suppose that the terms of human flourishing are susceptible to being distinguished and specified, that human flourishing is such that it can be ameliorated or degraded, and that embryonic stem cell research is such that it can affect such amelioration or degradation. The ontological-ethical question is: to what extent is stem cell research likely to enrich the lives of persons whose opportunities for abundance have been affected by degenerative disease and what should be done in light of this?

The ethical object in this figuration is **persons** whose opportunities for abundance have been affected, directly or indirectly, by degenerative diseases. The terms **abundance, degenerative diseases**, and **persons** have quite specific and integrally connected meanings in this figuration of hES cell research, which I will attend to. As the anchor point for this figuration, persons function as a relay point through which the other elements of the figuration are integrated.

How it is that the term **person** is defined by this figuration, and how the relation of degenerative disease and abundance is framed, requires specification. Recall that an object is not just a thing in the world, per se. Rather, an object is produced, in part, by the fashioning of the elements at work in the figuration. Elements are aspects of things—events, actors, discourses, etc.—that are specified, associated, coordinated, and connected according to a given metric. It follows that the terms "person" and "degenerative disease" do not refer to things in the world, per se, though they cannot be dissociated from such things. Rather, together they constitute an object that is produced, in part, by the way in which the elements are composed. That is to say, of all the things in the world that could be specified and connected as elements within the figure of future abundance, only specific elements qualify. These elements contribute to the fashioning of the figuration's anchor point.

The term **person** is freighted with a long and contested history of meanings. In the case of this third figuration, two relevant aspects are relevant. The first aspect is drawn from recent efforts to rework Kantian suppositions about persons as autonomous subjects. This reworking asserts that personhood is produced through the dynamic interaction, individuation, and participation within a social-cultural venue. Personhood is thus not a property attached to the capacity for reasoning, although the fostering of such capacities might be an aim of the work of personalization. Personhood, rather, is a form of life produced through the vector of individuation and participation within a social-cultural venue.[48] One example of this rethinking of

[47] **Sacred Cells?**

[48] Ted Peters, "Cells, Souls, and Dignity: A Theological Assessment," unpublished paper, 4.

personhood is Ted Peters' reconsideration of Paul Tillich's definition of persons. In this example, the vector of individuation and participation must be fostered as a responsibility of ethical subjectivity. Tillich expressed this responsibility in the Christian notion of **caritas**. Caritas demands that those who are otherwise excluded from the dynamics of personalization—i.e., excluded from the processes of individuation and participation—must be included and thereby cared for. Such responsibility for individuation and participation thus requires work on one's own subjectivity as part of the dynamic of working on and caring for persons.

The second relevant aspect of the term person is connected to the first. The venues within which the productive dynamics of individuation and participation take form are connected to and constituted by an **ethos**. **Ethos**, like personhood, is a complex term. Two aspects, which have been highlighted in Paul Rabinow's work, are relevant here. First, **ethos** refers both to a "place of habits" or "an accustomed or cultivated venue." Second, **ethos** refers to "ethical competence" or "capable ethical practices." Taken together, **ethos** is "a space of practice at the interface of ethics and a cultural venue."[49] Persons are produced in a space at the interface of ethics and a cultural venue. Thus, in addition to work on and care for the self and others, the fostering of personhood requires work on and care for an ethical venue.

As with the term "person," a word needs to be offered about the term "degenerative disease" and its relation to the notion of abundance in this figuration. I note here that the metric at work in a figuration of medical benefits is **abundant** or **flourishing** life, which will be examined in a moment. A significant aspect of an **ethos** is that it is a space of practice within which difficulties and blockages can be identified as problems. That is to say, as the interface of ethics and a venue, **ethos** informs the way in which problematic situations are specified as concrete problems, and thus made available to intervention. This means that the concrete terms of what does, and what does not, constitute an abundant or flourishing life are, in part, informed by an **ethos**. Conversely, this also means that an **ethos** is a space of practice in which the concrete terms of what blocks or facilitates an abundant form of life are also determined.

The figuration of future abundance forms part of, and is constituted by, an **ethos** wherein degenerative diseases are taken to constitute a problem relative to the notion of an abundant life. Degenerative, after all, denotes a trajectory of deterioration. Put another way, in this figuration degenerative diseases are taken to negatively affect opportunities for flourishing. No doubt, such a determination could also be made in other spaces of ethical practice. And it is certainly the case that many with degenerative diseases live abundant lives despite or even in consonance with their medical situation. The determination that degenerative disease is a problem relative to abundance, however, is figured in light of the hope of regenerative medicine through stem cell research. In relation to stem cell research, degenerative diseases can be conceived not only as conditions susceptible to therapeutic retardation or management, but amenable to amelioration and possible eradication. A persistent and often overlooked challenge of the figuration of future abundance is to specify the conditions under which hES cell research can be made part of an abundant life.

In sum, persons whose opportunities for abundance are affected by degenerative disease constitute the ethical object of the figure of future abundance. Such persons are the anchor point, functioning to integrate the other elements of the figuration. Given this, those who elaborate this figuration often raise the question of the moral culpability of others attempting to block stem cell research; such impediment constitutes a failure to take persons affected by degenerative disease as a principle object of ethical concern.

It bears noting that the question of how stem cell research might contribute to the abundance of persons affected by degenerative disease is open. It is not at all obvious that mere medical intervention would constitute an abundant life, as others have pointed out. The concrete terms of how such abundance might be realized cannot be known in advance, though a vision of an abundant future certainly can be anticipated. This means that for those working with this figuration, the terms of abundance cannot be settled in either a universal or relativistic manner. Rather, the terms of abundance can only be specified and worked on under specific arrangements. In short, the ethical practices called for in this figuration consist, in part, of the formulation of what Peters, working from Ricoeur, refers to as middle axioms: sites of conceptual mediation.

[49] See Paul Rabinow, **Anthropos Today: Reflections on Modern Equipment** (Princeton and Oxford: Princeton University Press, 2003), 3.

4.2.2 Mode of Veridiction: Reconstruction

In our diagnostic, we propose that, within particular emergent zones, the biosciences, the human sciences, and ethics are beginning to operate together in a reconstructive mode of veridiction. **Reconstruction** is the mode of veridiction at work in the future abundance figuration.

Reconstruction, following the diagnostic, has a specific technical meaning, similar to that put forward by John Dewey. Dewey wrote: "Reconstruction can be nothing less than the work of developing, of forming, of producing (in the literal sense of that word) the intellectual instrumentalities which will progressively direct inquiry into the deeply and inclusively human—that is to say moral—facts of the present scene and situation."[50] The conception of the relation of thinking, ethics, and a scene or situation put forward by Dewey here indicates a metric or standard by which veridiction ("intellectual instrumentalities") is ordered. Such a metric entails a specific ethical mode and temporality. In Dewey the ethical mode is indicated as "the deeply and inclusively human" and the temporality is "the present." However, as I will show, other ethics and temporalities can equally interface with a reconstructive mode.

Quoting from the diagnostic, we can say that reconstruction, in a figuration of hES cell research, distinguishes a mode of veridiction in which those speech acts are taken to count in the register of true and false that can be "put to the test in problematic, experimental, and pragmatic situations and subsequently can be reused in reworked form." What is crucial about this mode is that the factors which condition and constitute these situations as problematic, experimental, and pragmatic are more than technical or bioscientific, per se, although such technical expertise is included. Rather, these situations are constituted by complex extra-scientific problems, problems taken by researchers, investors, ethicists, or other participants in bioscientific enterprises to be of primary significance. In other words, the parameters that define what counts as a serious speech act in this mode of veridiction are constituted by an **ethos**. As such, it is reasonable to conclude that a reconstructive mode of veridiction is appropriate to the ethical object in play in the figure of future abundance.

Again, following the diagnostic: reconstructive thinking operates within a problem-space in which work on the problem-space depends not only on an understanding of prior conditions and results, but equally on an orientation to the near future. Indeed, as will be discussed below, the near future constitutes a principal site of ethical work. In addition, within this figuration, the problem-space within which thinking takes place is also oriented by an anticipated eschatological future, although it bears underscoring that such an eschatological orientation may **not** be characteristic of a reconstructive mode of veridiction in other figures. An eschatological orientation is a key element of this figuration in part because the figuration has been articulated through both Christian and Jewish moral theologies. The role of the eschatological, however, is complex, and does not consist of a simple appeal to familiar biblical or secular views of history. In any case, the point here is that the orientation of thinking in the figure of future abundance requires more than technical virtuosity, verifications of nature, or demonstration of first principles. Rather, orientation requires a mode of veridiction in which the technical and the ethical are brought together, interfaced, and synthesized in view of the recent past and near future. Such a view provides an ordering insofar as it is structured by a specific metric, which, in the case of the figure of medical benefits, is a metric of abundance.

4.2.3 Metric: Abundance

Claims of an imminent medical revolution accompanied announcements of the successful derivation of human embryonic stem cells. On one level the claims were not surprising or unfamiliar, as they have formed part of other announcements of biotechnical breakthroughs. Given these claims about the promise of regenerative medicine, one might suppose that only those reconstructive speech acts would qualify for the future abundance figuration that could be ordered by a metric of medical therapeutics. The therapeutic potential of stem cell research, of course, is a prominent element within this figuration. Medical therapeutics, however, is not the metric, and the spokespersons for the revolution of regenerative medicine do not determine the terms of this figuration. If anything, these spokespersons have contributed to the embryo protection figuration, in

[50] John Dewey, **Reconstruction in Philosophy** (Boston: Beacon Press, 1971).

so far as they have operated in a largely reactive mode, countering claims about the inherent dignity of the embryo with arguments favoring developmentalist theories of the embryo's worth.

As I have already noted, in this third figuration the metric is **abundance**, or abundant life. This metric is often connected to other terms such as flourishing and wholeness. I am focusing on **abundance** because it appears explicitly in the variation of the figuration I will be considering below. Abundance designates the standard by which reconstructive speech acts within this figuration are ordered. This standard operates within a specific **ethos**. It bears repeating what was explained above, namely that, concretely speaking, the terms of abundance are neither universal, nor are they relativistic. Although, in the figuration of human abundance, what counts as abundance is, in fact, connected to, and to a certain extent oriented by, universals. (It is also the case, as I will explain, that universals are oriented to the concrete terms of abundance.) This means that, within this figure, the conditions of abundance must be specified in a form that is amenable to intervention and amelioration under concrete arrangements.

In this figuration, the metric of abundance applies in the first place to the amelioration of degenerative diseases. Abundance, however, does not simply consist of technical therapeutic advance, though such advances are clearly vital to this figuration. Rather, abundance is a metric that takes up degenerative diseases and interventions into them as part of a broader concern for and commitment to both an anticipated far-future of wholeness on the one hand, and a near-future of ameliorated flourishing on the other. The intricate relation between these two temporalities, as they've been connected in this figuration, will be spelled out in more detail below when the question of ontological mode is considered.

Abundance functions as a metric of the future abundance figuration in the work of Peters, Lebacqz, and Bennett. This draws on New Testament notions of future abundance and interfaces them with developments in stem cell research. Peters et al cite several New Testament passages which assert that "God intends 'abundance' or 'fullness' of life for all." Johannine passages are given particular attention. As mentioned above, John 3:16, for example, is often translated using the phrase "eternal life." Peters et al argue that it would be better translated "abundant life," a translation that emphasizes fullness of life within a historical and not just extra-historical register. Such an emphasis operates in the figuration of future abundance to select out and connect those aspects of things that potentially contribute to the amelioration of degenerative diseases as one means of actualizing future abundance. As Peters et al put it: "If science in the form of regenerative medical research can give expression to our compassion for those who suffer and can serve human well-being and flourishing, then it ought to do so."[51]

Abundant life in this figuration has an eschatological dimension. Topically speaking, eschatology is that aspect of philosophy or theology which deals with ultimate or final things. Thematically, eschatology concerns such matters as the fulfillment of things, notions of wholeness or completion, and the **sunnum bonum** or the highest good. The eschatological aspect of abundance in this figuration of stem cell research has two aspects. The first aspect is temporal, but not historical. Eschatological wholeness stands as a kind of permanent future horizon, which functions as a point of critical judgment on present conditions and as a reorienting norm. As a critical horizon, the eschatological throws into relief a spectrum of differences between the abundant and the degraded. Framing the eschatological in ethical-political terms, Peters writes, "the future kingdom of God" functions to remind us of present "limits and responsibilities."[52] Working in connection with the critical and orienting vision of a future wholeness, present degeneration is framed as unacceptable. "The biomedical sciences become a means by which one strives to realize that future vision during the present era."[53]

The eschatological aspect of abundance has a second aspect. Where the first is temporal, this aspect is, more strictly speaking, historical. Following Wolfhart Pannenberg, Peters argues that the eschatological wholeness anticipated in Christian theology is nothing other than the wholeness, completion, or full abundance of the concrete arrangements of history. Peters suggests that this transformation of the concrete flux of history is entailed in the biblical concept of New Creation. Ontologically and ethically, such an argument brings into view a nonlinear and a mutually determinative pathway between the future and the present. If

[51] **Sacred Cells?**, 55.
[52] Peters, **God—The World's Future**, 377.
[53] **Sacred Cells?** , 55.

the eschatological future is renewal of the concrete arrangements of history, and if this history is contingent and emergent (as Peters argues), then the form and significance of a perfected or completed future is directly dependent on the form of the present. Ethical practice that consists of intervention into, and reformation of, the present bears on the form of the eschaton. On the other hand, if the eschatological future constitutes the wholeness and integration of an otherwise fragmented history, and if it is the case that such an integrated whole will be definitive of the elements that make that whole, then the eschaton also functions as a point of ontological signification for the present. What things truly are in the present is what they will be in an abundant future.

It bears mentioning that eschatology in this figuration, though at base biblical, is taken up in a way that adjusts the biblical precedence. In the case of both Protestant and Jewish thinkers, for example, the theological notion of eschatology is taken up as an ethical mandate. Eschatology as ethics has resonance with a kind of modern eschatology of human achievement, although unlike many modern philosophies of history, such an ethic does not postulate that an eschaton will be actualized through human achievement.[54] In any case, this way of figuring and of using eschatology in connection to stem cell research both **is**, and **is not**, otherworldly. It is not otherworldly in that such figuring makes reference to no other world than the concrete arrangements of history. It is otherworldly, however, in that it calls for work on the concrete arrangements of history such that, where appropriate according to the metric of abundance, the world is made to be other than it is. It follows that a principle ethical challenge is to both work on the present such that it is oriented to an abundant future, and to find ways of making the abundant future a constitutive part of the present.

In the future abundance figuration, this retroactive ontology, as it were, is taken up as normative. Abundance as a metric designates which aspects of things count as significant and of concern. For those whose lives are affected by degenerative diseases, the diseases and their affects count as significant. Degenerative disease, however, is not definitive. Rather, persons affected by degenerative diseases are defined according to a possible future abundance, and cared for in the name of such a future. It is important to note that, according to this figuration, the form of such a future is constituted by work done in the present. Such work, in turn, must be continually recalibrated and the demands of the metric of abundance reassessed.

Such a figuration of embryonic stem cell research could not be appropriately characterized by a genetic or an archonic mode of ontology. Abundance, as understood here, is not characterized by pre- given or fixed forms, by pre-given or fixed ends. Rather, the terms of abundance are emergent.

4.2.4 Ontological Mode: Emergence

The logic and form of the future abundance figuration as developed by Peters et al includes and draws on Peters' previous work on "proleptic ethics." Proleptic ethics, in turn, is the correlative of Peters' conception of eschatology as retroactive ontology. As such, the mode of ontology that works to connect and consolidate the ensemble elements of the figure of medical benefits is complex and non-obvious. It is complex in that it involves relations among multiple elements; it is non-obvious in that it constructs unfamiliar and unexpected pathways.

Recall that in figuration as a way of establishing connections, the temporal aspect of the mode of ontology is crucial to the way in which the elements are integrated. Given the emphasis on the eschatological in Peters' ethic, it would seem to follow that the elements in the medical benefits figuration would be connected up in part by an eschatological temporality. This is true, but only in a very specific sense. Abundance in Peters' ethic is characterized by and oriented to a future abundance. That abundance, however, is conceived as proleptically present.

Peters' ethic not only emphasizes future wholeness; it also emphasizes the contingent and open character of history. The concrete arrangements and forms of history can be characterized, in his words, as "new, as self-organizing, as opening up new paths and rendering possible new choices, as creating freedom for the future, and in a very real sense as breaking the bondage of the past and its fixed predeterminations."[55]

[54] Thanks to James Faubion for clarification on this point.

[55] Peters, **God—The World's Future**, 19.

This contingency and openness have significant implications for the kinds of problem-spaces within which ethical work is conducted and the kinds of conceptual tools one needs to conduct ethical work. Given that situations are concrete, specific, contingent, and sometimes new, ethical equipment must be designed to make concrete solutions available to concrete problems. Such equipment cannot be based on "some immutable set of precepts or rules. Because of the continuing creation, the rules must change too."[56]

The site of ethical work that Peters' describes, and which functions as the concrete site of work within the human abundance figuration, can accurately be characterized as the **contemporary**. As described in the orientation to our diagnostic, the conception of the contemporary has been developed by Paul Rabinow for inquiry into emergent and contingent problem-spaces, such as the figurations of stem cell research. Rabinow reminds us that in familiar usage the contemporary has two meanings. The first is: "existing at the same time as something else." This first meaning is less significant for an analysis of figuration. Temporal coincidence does not connect elements as a single figure; at most it makes them available for connection. The second meaning is "distinctively modern in style." This second meaning carries both temporal and historical connotations that are useful for connecting the contemporary to, and distinguishing it from, the modern. Rabinow argues that the modern is not just a period but an **ethos**, an **ethos** which pairs tradition and modernity as a moving ratio. Similarly, the contemporary can be thought of not just as a period but as an ethos as well. As an ethos, the contemporary is a moving ratio of the recent past and the near future.[57] The ethical work-space for the future abundance figuration is not, in fact, eschatological. Rather, the temporality is the contemporary. In the name of opening up the possibility of future abundance in response to degenerative diseases, the recent past needs to be analyzed and diagnosed such that the near future can be remedied.

If the temporality ethical work-space of the future abundance framework is the contemporary, it is the contemporary constituted in such a way that it incorporates the eschatological. Peters writes that his ethical mode "begins with the future and works back to the present... begins with eschatology and works back to ethics."[58] If the future here is eschatological and the work-space of ethics is the contemporary, we can ask: how are these two connected such that they both function as part of the same figuration? The answer is twofold. The first concerns a mode of ontology. The second concerns a method. The mode of ontology is **emergence**. The method is prolepsis.

The term **emergence** designates an ensemble of elements composed of both old and new elements and their interactions. While some of these elements are familiar, the specific form of the composition, its function and its significance, can only be determined when it emerges and thus cannot be reduced to prior states or relations. The elements certainly play a constraining role. However, emergence characterizes a way in which ensembles exist and are taken up such that the history of the significance of the ensemble can only be sufficiently specified retroactively. For this reason, an emergent mode of ontology can be made to cohere with and is correlative of both the eschatological (as understood in this figuration) and the contemporary.

As a concept in the future abundance figuration, prolepsis designates a method of establishing a relation between a possible future and the recent past such that the possible future is made actual in and to the present. In Peters' theology and ethics, the concept of prolepsis as a way of establishing relations is central. In the first place, the concept is used to describe the resurrection of Jesus. By way of bodily resurrection, Jesus constitutes a breaking in of a future reality in the present world. This is signified by the fact that such a resurrection could not have been caused by a prior set of conditions. In this figuration of stem cell research, the concept of prolepsis is taken up in a more general way to designate the way in which through ethical practice an anticipated future is made present. The anticipated future is connected to the contemporary as a defining and orienting element within present arrangements. Although the concrete terms of abundance can only be formulated as part of a given situation and a given ethos, one of the normative factors of such an ethos for this figuration is the possibility of an abundant and flourishing future.

[56] Ibid., 374.
[57] Rabinow, **Marking Time**, 1-2.
[58] Peters, **God—The World's Future**, 378.

4.2.5 Mode of Jurisdiction: Remediation

A mode of jurisdiction functions to discriminate what kind of activities are appropriate to the ethical ordering of an object, and functions as the basis for the organization of such. The ethical object in the medical benefits figuration is the person whose life is degraded by degenerative diseases. The kind of truth claims by which this object is understood are reconstructive—capable of operating within problematic and pragmatic parameters set by an ethos. Of these truth claims, those qualify for the figure of medical benefits that can contribute to abundance, not as genetic unfolding or an archonic essence, but as emergent. Given all this, the kind of jurisdictional activities appropriate to the future abundance figuration are neither those that defend nor those that protect. Rather, they are those that contribute to abundance by working to produce its conditions of actuality. **Remediation** as a mode of jurisdiction functions to discriminate and organize such activities.

If the remediation means both a change of medium and to make things better, the question is: what changes of medium and what remedies are called for within the future abundance figuration? In terms of a change of medium, the anticipated future must be taken up and constituted in such a way that it can become a functional and orienting part of a contemporary ethos. That is to say, the mediating work of prolepsis must be undertaken. In terms of remedy, present conditions that affect persons with degenerative diseases must be worked over and ameliorated according to the metric of abundance. The site for both this mediatory and remedying work is the near future. In the figure of future abundance, the challenge is to render the near future as a site of ethical work in which such remediation can become possible.

Conceptually, such remediatory work requires something like Peters' notion of middle axioms. An axiom is a speech act that is taken to be true. The speech acts needed for remediation in the future abundance figuration are not only those that are consonant with an abundant future, but also pragmatically useful under the problematic and experimental conditions of an ethos. Such consonant and pragmatic conceptual renderings might be thought of as mediating conceptions—concepts that facilitate the work of mediation.

Such concepts cannot be constituted by a fixed or pre-given form. If they were, they would neither be appropriate to the emergent nor would they be useful in the work of remedying. These conceptions must be dynamic and adjustable, calibrated to actual conditions under which the terms of abundance can be concretely specified. This means that they must be produced through incessant interaction with, and reworking of, the problem-space within which an ethical object is situated. Put substantively, in this third figuration of stem cell research, forms of abundant life must be produced through ongoing technical work on degenerative diseases, the careful work of personalizing those whose lives can be made more abundant by such work, and through work on oneself and on an ethos as factors contributing to the form of the near future. Needless to say, such remediation could never be ordered according to a programmed genetic unfolding or by appeal to a fixed archon.

4.2.6 Note: Figural Variation

Multiple Jewish thinkers and organizations have produced variations of the future abundance figuration. Given the significance of these variations in contemporary discourse, a short note is in order. While there is obviously no unified authority mandated to speak for the entire tradition, Jewish thinkers have widely agreed that the most critical consideration when responding to biomedical research generally, stem cell research in particular, is the duty to heal. In a joint statement, Rabbis of the Union of Orthodox Jewish Congregations of America and the Rabbinical Council of America write, "The Torah commands us to treat and cure the ill and to defeat disease wherever possible; to do this is to be the Creator's partner in safeguarding the created."[59] Two principles are crucial. The first is the principle of **pikuach nefesh**, the moral obligation to save human life whenever possible. This obligation is binding to the point that "Even biblical law is superseded by the duty to save lives, except for the three cardinal sins of adultery, idolatry, and murder."[60] The second

[59] Cloning Research, "Jewish Tradition and Pubic Policy: A Joint statement by the Union of Orthodox Jewish Congregations of America and the Rabbinical Council of America," reprinted in **God and the Embryo**.

[60] Moshe Dovid Tendler, "Stem Cell Research and Therapy: A Judeo- Biblical Perspective," testimony to the U.S. National Bioethics Advisory Council, in **Ethical Issues in Human Stem Cell Research, vol. III Religious Perspectives** (Rockville, MD: National Bioethics Advisory Council, 2000), H-4.

principle is **tikkun olam**—the responsibility to join God in repairing and transforming an incomplete or broken world. Given that stem cell research might constitute one means of repairing the world, to not pursue the research is itself taken to be ethically suspect.

4.3 Figuration, Ontology, Remediation

I close this test case by recapitulating a number of points in something of a summary fashion. Figurations, as I have analyzed them, designate a process of establishing relations in which elements of things that otherwise might not have been associated are brought together and connected. Importantly, they are connected in such a way that the significance and function of the resulting ensemble, as well as the elements within the ensemble, depend on the overall form produced by the connections. I have tried to show how such ordering is constituted in significant part by the ontological mode at work within a given figuration. And I have tried to show that these ontological modes are made to cohere and cooperate with particular equipmental platforms. Through such mutual reinforcement and synthetic unity, a figuration functions to produce conceptual interconnections among problems. In particular, it connects problems of what, ontologically, is at stake, and what, ethically, can and should be done. Figurations thereby indicate appropriate courses of action, and open the way to new practical activities.

It is a curious feature of the debate over stem cell research that among the elements associated and connected in the predominant figurations, the ontology of hES cells themselves is often left out. Such exclusion strikes me as consequential. To repeat a point I've already made: the remediation of zygotic cells has demonstrated that the function and significance of living organisms is not dependent on pre-given natural forms, with pre-given **telê**, and capacities. James Thomson and subsequent researchers have demonstrated that, given specified conditions, zygotic cells have capacities other than developing into fetuses, i.e., they can be made to become embryonic stem cells.

To recapitulate another point, it is critical to note that such capacities can be considered altogether natural, if the "natural" is taken to consist of relations among pathways, forms, and functions in living systems. It is certainly the case that, so far as we know, prior to 1997 biological systems were never characterized by conditions under which human embryonic cells became disaggregated, mediated, and made into immortal and pluripotent tissues. However, researchers have now produced such conditions. That these conditions were engineered does not diminish the fact that under them, new natural capacities emerge that would not have otherwise. These capacities do not violate living systems. Rather they demonstrate once again the flexibility and the mutually constitutive relations of which living systems are composed.

The question of whether or not these remediated forms constitute a contribution to an abundant life certainly remains contested. And the extent to which that question can be satisfactorily addressed will depend in large part on ethical figurations in play. It is the case that neither a genetic nor an archonic mode of ontology coheres with the reconstructive situation within which hES cell research is emerging, nor do they cohere with the ontological breakthroughs of the research. As such, the remediatory character of hES cell research is likely to appear less significant and even dangerous within the embryo defense and human protection figurations.

It is the case, as **Donum Vitae** points out, that "what is technically possible is not for that very reason morally admissible." It would also seem to be the case, however, that the terms of what is admissible cannot be settled by appeal to the pre- given, the original, or the archonic. Figurations must not be arbitrary and their ontological assertions and ethical metrics must be tested and found sound. "Rational reflection," however, to adjust a phrase from **Donum Vitae**, is not only needed "on the fundamental value of life," but on the figurations within which such values are brought into connection with other relevant matters.

If the technical challenges of differentiation and histocompatibility are overcome, and human embryonic stem cell research is converted from a research project into a platform for therapeutics, we may indeed see something like the hoped-for "paradigmatic revolution" in regenerative medicine. And if this can be accomplished by using stem cells created through methods that do not require the destruction of zygotes, then the challenges of the embryo defense figuration will recede from the ethical and political foreground. When and if such events occur, however, the question of the ontology and the ethics of stem cell research will not go

away. Stem cell research will remain part of a reconstructed situation, and the technical capacities and ethical equipment developed at this new stage in stem cell research will need to be taken up and worked through in order to address the problems and opportunities that emerge in the contexts of therapeutic application. Pathways and forms will once again need to be remediated. These pathways and forms may no longer be cellular or even biological per se. Rather, they may involve the ways in which stem cell technologies, and the life sciences more generally, contribute to the form of human life today. Connections among and between biotechnology companies, regulatory apparatuses, university researchers, patient advocates, questions of the distribution of goods, and the like will need to be taken up, analyzed, and given diagnostic form. And the question of the contribution of the life sciences to a flourishing life will need to be posed and reposed.

Chapter 5

Prelude. Framing an Experiment[1]

Working on the diagnostic unleashed extraordinary energy. We worked intensively for three months, morning and afternoon, in an atmosphere self-consciously cloistered from the constant demand that we justify our mode of work and our place in the overall enterprise. During this period of collaborative work we felt we were finally getting clearer about the problem- space in which we had been operating. A good deal of the work could be characterized as having been conducted in a pedagogic mode: we took up this work so as to traverse an impasse, but found ourselves engaged in a much more enriching experience. Rather than simply clarifying what we thought we already knew, we discovered that the best mode of work entailed questions, tentative answers, elaborations, clarifications, and finally a degree of formalization. In retrospect, we had created a micro-venue capable of facilitating conceptual experimentation. This period was extraordinary, exhilarating and exhausting—the form of the diagnostic seemed to emerge by itself. In fact, this period of intense collaborative work was itself a prime experience of scientific, ethical, and personal flourishing in the sense hoped to contribute to in our Human Practices work more broadly.

Of course the question remained: how the diagnostic would stand up to empirical testing and facilitate practice. We thought that the diagnostic might facilitate a re-engagement with the work of developing the equipment that we knew was lacking in SynBERC. In that light we began to put it to work. The chapters that follow in this section can be taken as cases situated conjuncturally in this effort. They can be read as a series of experimental results over the course of several months, as our work began to unfold. They were produced at significant junctures of diagnosis and reorientation, from October 2006 to December 2007. We present them basically as they were written at the time. Although some minor adjustments have been made to the text so as to minimize redundancy, we have explicitly resisted rectifying differences and duplications so as to preserve the temporality of these interventions. Our purpose is to provide a kind of archive and chronicle of shifts in temperament, expectation, conceptualization, as well as scientific and ethical capacity. At each of these junctures we faced the challenge of assessing, in real time, how our experiment was ramifying, as well as addressing the challenge of remediating our designs for human practices so as to proceed to the next phase of the experiment. The essays provide an account of our growing awareness of the analytic strength of the diagnostic itself, as well as the organizational blockages to putting it into practice in SynBERC. We address the latter problems directly in Section III.

During the fall of 2007, we distributed the diagnostic to the twelve members of a Berkeley graduate seminar. The members organized themselves into three collaborative groups putting the diagnostic categories to work in a variety of empirically diverse cases. The results while preliminary were very encouraging. The experience demonstrated that collaboration across disciplinary specializations was possible given good will and honest effort. They also demonstrated, somewhat to our surprise, that the core categories, pathways, and forms of the diagnostic stood up quite well to a wide range of case materials.

We open Section II with a Manifesto we composed in 2006. It preceded the diagnostic. Like other manifestos in SynBERC, it contained a good deal of hope, some clarity, and only the sketchiest strategies

[1]This content is available online at <http://cnx.org/content/m18818/1.1/>.

for equipmental design and composition. Again, surprising to us, the basic orientation and topics of the manifesto have stood the test of our experiences and conceptualizations. What follows is an account of conceptual and ethical milestones, and attempts to organize, orient, and evaluate the Human Practices work that was underway. These accounts were occasioned by a range of specific circumstances and requests, as indicated in the chapters. In our analysis we downplay the frustrations occasioned by the quirkiness and dispositions of individual personalities and events, although the ramifications were real enough. In the face of such encumberments, we attempted to constantly reintroduce a second-order orientation both as a way of buffeting us against pettiness and impediments and as a scientific and ethical imperative to conceptualize the blockages we were encountering.

Given our commitment to second-order participation, we asked: What objects, relations, and forms were being produced through the various research programs? What modes of Human Practice engagement were adequate to these new objects, as well as to the goal of contributing to flourishing? In what ways does existing equipment need to be reworked? To what degree does such reworking require the simultaneous reconstitution of research venues to be successful? In our darker moments we wondered, was this an impossible task? Or, as we finally concluded, was the venue inadequate for the purposes we were mandated to pursue by the National Science Foundation?

Chapter 6

Manifesto 2006. From Bio-ethics to Human Practices[1]

The various genome sequencing projects of the 1990s were significant in providing a first approximation of the core molecular information about the genome. They were no less significant for the ways in which they contributed to a reconfigured moral imagination and thereby to altering relations among and between biology, ethics, and anthropology.[2] From the outset, the genome projects and the bio-ethics programs affiliated with them traded on the notion that the genome contained the determinative essence of human identity. The run-up to the announcement of the mapping and eventual sequencing of the human genome was replete with the rhetoric of revelation: in reading our DNA, genomic scientists were uncovering the "blueprint" of life, the "holy grail" of biology. Of course, from the outset, such rhetoric provoked contestation and rebuttal, but even then it was taken seriously and its proponents succeeded in setting the points of debate and communication.[3] As such, a good deal of anthropological and ethical energy was spent working to imagine, understand, and critically evaluate the supposed capacities and threats introduced by massive genomic sequencing projects.

6.1 Ethics: Technology and Equipment

In a major innovation, federal funds – "the largest ethics project in human history,"[4] as one actor put it – were devoted to the design and implementation of legal and cultural methods, procedures, and practices adequate to the challenges posed by the sequencing projects. Like the molecular technologies under consideration, these legal and cultural interventions were designed to achieve specified ends.[5] We call the specific mode of intervention and its standardization "**equipment**." Equipment connects a set of **truth claims**, **affects**, and **ethical orientations** into a set of practices. These practices, which have taken different forms historically, are productive responses to changing conditions brought about by specific problems, events and general reconfigurations. The first National Commission, for example, was established in part as response to the abuse of research subjects of medical research. The Commission was mandated to develop practices by which research subjects could be protected. The form these practices took was guided by the following

[1] This content is available online at <http://cnx.org/content/m18816/1.1/>.

[2] Thanks to NSF # for funding. To Drew Endy and Jay Keasling. And to all the readers and ARC members.

[3] This rhetoric still circulates. A summary statement of the significance of the Human Genome Project found on the U.S. National Genome Research Institute website reads, "Completed in April 2003, the HGP gave us the ability to, for the first time, to read nature's complete genetic blueprint for building a human being." http://www.genome.gov/10001772 (<http://www.genome.gov/10001772>)

[4] Eric Juengst.

[5] On the concept equipment: Michel Foucault 1977-8 and 1981-2 courses. Paul Rabinow **French Modern: Norms and Forms of Modern Equipment**, Chicago: University of Chicago Press, 1989. For more on the technical meaning of "equipment" in ethics, see the Anthropology of the Contemporary Research Collaboratory at www.anthropos- lab.net (<http://www.anthropos-lab.net/>).

considerations: a **truth claim** (human beings are subjects whose autonomy must be respected), an **affect** (outrage at the abuse of such infamous research projects as the Tuskegee experiments), and an **ethical orientation** (human subjects must be protected from such abuse in future through the guarantee of their free and informed consent). With genomics more than the autonomy of subjects appeared to be at stake. For many, human nature as well as the integrity of nature more generally seemed threatened. Thus the sequencing projects contributed to a growing sense that bio-ethics urgently needed new means, designed to protect human beings from violations of their nature. Neither the affect of concern nor the desire to restrict genetic interventions was new, to be sure. What was new, however, was a growing sense that bio-ethics as it functioned in authorized spaces, such as government commissions, needed to be recalibrated to meet these new conditions. The means of that re-calibration are what we are calling "equipment."

Whereas the protection of research subjects involved the development of regulations "upstream" from research in the form of Institutional Review Boards and protocols for obtaining informed consent, human genomics appeared to require the design of a set of "downstream" practices. The objective of this equipment, this pragmatic mode of intervention and regulation, was to mitigate "social consequences" by restricting those directions and applications of research thought to pose a threat to the dignity of human beings. In the U.S., equipment of this kind began to be elaborated as part of the Human Genome Initiative ELSI project (ethical, legal, and social implications); it has been most thoroughly conceptualized and developed by the current President's Council on Bioethics. The architect and first chair of that Council, Prof. Leon Kass, proposed a truth claim, an affect, and an ethical orientation for the construction of such equipment: 1) bio-ethics matters precisely because what is at stake in biotechnology is humanization or dehumanization, that is to say, the essence of human being is on the line; 2) this state of affairs should inspire a measure of fear and vigilance, for in the face of scientific advance the "truly" human might be sacrificed; and 3) given the risk of dehumanization, the task of the ethicist is to discover what is truly valuable about human life in advance of any particular scientific endeavor and secure it against scientific excess.[6]

At the beginning of the twenty-first century, after two decades of genomics, it is now clear that the significance of biology for the formation of human life is more than molecular; today we are faced with new forms of the challenge of understanding living organisms and their milieus. New developments in the bio-sciences must be accompanied by the invention of new ethical and anthropological analysis and equipment. Focusing on a new synthetic biology engineering center with which we are associated, SynBERC, we argue that contemporary developments call for new forms of collaboration among ethics, anthropology, and biology. Collaboration is a form of engagement appropriate to the shared stakes of biological research and the broad assemblages within which such research is situated. It is animated by the recognition that ethicists, anthropologists, and biologists are working in a shared field of problems. Collaboration therefore requires more than observation and advice, and more than submission to oversight. Collaboration requires a reflection on and adjustment of basic work habits. In this article we propose the initial steps in that direction.

6.2 Post Genomics: Human Practices

Under the leadership of Professor Kass, the President's Council was oriented by the view that bio-ethics must begin its work by identifying the "defining and worthy features of human life" so as to determine whether or not those features are put at risk by innovations in bio- medical technology. Several characteristics of this orientation are noteworthy. First, these features of human life are universal and a-historical—that is, they obtain regardless of context or situation. Second, this means that they can be identified without reference to scientific developments. Third, as such, the defining features of human life serve as criteria by which particular scientific programs can be judged as threatening or not to "truly human" life.[7]

When the design of equipment starts with the supposition that science can only pose threats to the integrity of human nature, it is difficult for ethical understandings of **anthropos** to take into account the knowledge produced by contemporary molecular biology or anthropology. Ethics thereby would be positioned

[6] See http://www.b ioethics.gov/transcripts/jan02/jan17session1.html (<http://www.bioethics.gov/transcripts/jan02/jan17session1.html>)
[7] Find at www.bioethics.gov (<http://www.bioethics.gov/>)

exterior to both biological and human sciences. Such positioning makes it more difficult to incorporate scientific knowledge in formulating the stakes and significance of contemporary human practices. Rather than excluding continuing scientific insight from our understanding of the human, it seems imperative to engage molecular biology and other sciences in order to learn what they can tell us about living beings. If one accepts this dialogic and contingent form of engagement, then scientific developments themselves prompt the question: are contemporary forms of ethical equipment required today? And what critical stance – in the sense of assessing legitimate limits and forms – is appropriate toward and within it?

Molecular biology demonstrated that DNA is shared by all forms of life and is a remarkably pliable molecule. This means on the one hand that if there are questions to be posed about qualitative distinctiveness of living beings – and there are – such questions must be posed at a different level than the molecular. On the other hand, it suggests that DNA can be manipulated without violating any laws of nature or deep ethical principles per se. Longer and longer DNA sequences are being constructed ever more efficiently and economically each year. Sequences are being inserted with increasingly precision and forethought into organisms; knowledge and know-how are accumulating about ways to make these organisms function predictably. What is at issue for the science, the ethics, and the anthropology is not the metaphysical purity of nature but the biological function of DNA sequences, the extent to which these sequences can be successfully redesigned, and ways in which these redesigns contribute to – or are nefarious to – well-being understood as a biological, anthropological and ethical question.

Living beings are complex in part because of their evolutionary history; they survived or perished under specific selective pressure in particular environments. Although the products of natural selection demonstrate fitness, this does not mean that this is the only way that the organism can function. Quite the contrary, while evolution certainly contains lessons about organic functionality, for contemporary biologists there is nothing sacred about the evolutionary paths followed to arrive at the functionality. Furthermore, the specific functions themselves are neither inviolable nor immutable. For biologists, there is no ontological or theological reason per se why specific functions – whatever their history – cannot be redesigned. Biologists indeed are making new things. And while this may not violate any sacrosanct ontology of nature, it does not mean that anything goes. It is precisely because we do not think that nature is by essence immutable that these practices and the objects they produce must be carefully examined. The effects of redesign do contribute to a problematization of things (ontology) that must be taken up, thought about, and engaged (ethics and anthropology).

In 2007, not only are genomes sequenced with regularity and a steady flow of genes inventoried and annotated, but an array of other active biological parts and functions is being identified and catalogued. All of this science and technology proceeds on the basis of a tacit faith in a principle of an economy of nature. That is to say that nature must consist in isolatable and describable units and functions. Many biological functions appear to be irreducibly complex in part because the capacities to analyze them, to break them down into parts, do not yet exist. One strategy to address this impasse is to invent the skills necessary to reconstruct those parts and make them function. It is that path – of analysis and synthesis – that is currently being grouped under the rubric "synthetic biology" and which concerns us here.

Today, in the early years of post-genomic science, the insufficiency of what has been called "the gene-myth" is now clearer. It has not been as frequently recognized, however, that the sufficiency of the standard bio-ethical models that arose alongside the discourse of molecularization must itself be exposed to renewed questioning and reformulation. Questioning and reformulation does not mean jettisoning; much of existing bio-ethical equipment continues to serve a necessary function. It is simply prudent and consistent with our principles for those of us inventing new ethical forms based in **phronêsis** to learn from the strengths and limits of previous practices. Limiting the intersection among ethics, science, and anthropology, however, to either upstream bureaucratic review or downstream impact regulation now appears poorly adjusted to the current situation of dynamic contingency and critical exploration in the biological and human sciences. In sum, loyalty to past practices can inhibit an ability to identify and analyze new challenges. We must take seriously the ways in which current transformations in scientific research modulate past problems as well as the equipment that had been invented to handle them.

Ethical equipment like that developed by the President's Council remains in an ambivalent relation

to bio-scientific innovations. Strikingly absent from the development of this equipment is any attempt to incorporate the insights of contemporary science into definitions of what it means to be human. We hold that bio-ethics, as currently practiced in official settings, tends to undervalue the extent to which ethics and science can play a mutually formative role. More significant, it undervalues the extent to which science and ethics can collaboratively contribute to and constitute a "flourishing existence." As a place-holder, we note here that flourishing is a translation of a classical term (**eudaemonia**) and as such a range of other possible words could be used: thriving, the good life, happiness, fulfillment, felicity, abundance, and the like.[8] Above all, **eudaemonia** should not be confused with technical optimization, as we hold that our capacities are not already known and that we do not understand flourishing to be uncontrolled growth or the undirected maximization of existing capacities. Here we are merely insisting that the question of what constitutes a good life today, and the contribution of the bio- sciences to that form of life must be vigilantly posed and re-posed. Which norms are actually in play and how they function must be observed, chronicled, and evaluated in an ongoing fashion. It is plausible that engaged observation stands a chance of contributing positively to emergent scientific formations. It is worth seeing if such observation can be effectively realized by conducting ethical inquiry in direct and ongoing collaboration with scientists, policy makers, and other stakeholders. We are persuaded that within such collaborative structures, biology, ethics and anthropology can orient practice to the flourishing as both telos and mode of operation.

6.3 Synthetic Biology

The challenges of functional redesign presented by innovations in molecular biology are being addressed by a next generation of "post-genomic" projects. One such project is synthetic biology. Synthetic biology began as a visionary but minimally defined project:[9]

> *Synthetic Biology is focused on the intentional design of artificial biological systems, rather than on the understanding of natural biology. It builds on our current understanding while simplifying some of the complex interactions characteristic of natural biology." "Those working to (i) design and build biological parts, devices and integrated biological systems, (ii) develop technologies that enable such work, and (iii) place the scientific and engineering research within its current and future social context.*

At the outset, the name was basically a placeholder, or as some of its critics hold, a hoped-for brand. Since its chief architects, however, understand synthetic biology as a process of modularization and standardization, it appears to us to be developing in and renovating a tradition nicely labeled the "Engineering Ideal in American Culture."[10] Unlike the visionaries of the sequencing projects and their prophecies of the molecular as the "code of codes," synthetic biologists clearly have a feeling for the organism.[11]

Synthetic biology aims at nothing less than the (eventual) regulation of living organisms in a precise and standardized fashion according to instrumental norms. There is a feeling of palpable excitement that biological engineering has the capacity to make better living things, although what that would mean beyond efficiency and specification opens up new horizons of inquiry and deliberation.

Today, the engineering project of building parts that either embody or produce specific biological functions and inserting them in living organisms is at the stage of moving from proposal to concept. The concept is being synergistically linked to an ever-expanding set of technologies and to increasingly sophisticated experimental systems. There is agreement within the synthetic biology community that a necessary if not sufficient initial step required to further this project is to conceive of, experiment with, organize, and reach broad consensus on standardized measures and processes. The very qualities of living systems that make them interesting to engineering—that they are robust, complex, and malleable—also make them extremely

[8] We will address these issues at more length in another article.

[9] http://conference.syntheticbiology .org (<http://conference.syntheticbiology.org/>):

[10] The phrase is from

[11] Hood and Kevles, **The Code of Codes** (Cambridge, MA: Harvard University Press, 1993); Evelyn Fox-Keller, **A Feeling for the Organism** (New York: MacMillan, 1984).

difficult to work with. The extent to which these difficulties can be productively managed remains to be seen. In any case, at present, hoped-for standards are recognized to be initially crude and will certainly have to be reworked in an ongoing manner, but the important step is to begin to create them and to instill an awareness and sensitivity among practitioners as to their importance.

Synthetic biology arose once genome mapping became standard, once new abilities to synthesize DNA expanded, and once it became plausible to direct the functioning of cells. Its initial projects address a part of the global crisis in public health—malaria. At the same time, the first ethical concerns that it has to deal with arise from the risk of bio-terrorism (see below). The synthetic biology community is obliged to bring these heterogeneous elements into a common configuration. Put schematically, synthetic biology can be understood as arising from, and as a response to, new capacities, new demands, and new difficulties that oblige, in an urgent manner, contemporary ways of thinking and experimenting with vitality, health, and the functioning of living systems. Those investing in the development of synthetic biology expect that it will play a formative role in medicine, security, economics, and energy, and thereby contribute to human flourishing. Questions about what constitutes flourishing and the extent to which synthetic biology can indeed contribute to it are basic, and, more importantly, remain unanswered.

6.4 SynBERC

In 2006, a group of researchers and engineers from an array of scientific disciplines proposed a five-year project to achieve such standardization, with the aim thereby of rendering synthetic biology a full- fledged engineering discipline. Representing five major research universities—UC Berkeley, MIT, Harvard, UC San Francisco, and Prairie View A&M—the participants proposed to coordinate their research efforts through the development of a collaborative research center: the Synthetic Biology Engineering Research Center, or, SynBERC (www.synberc.org[12]). SynBERC is highly unusual on a number of counts. In addition to its far-reaching research and technology objectives, it represents an innovative assemblage of multiple scientific sub- disciplines, diverse forms of funding, complex institutional collaborations, an orientation to the near-future looking, intensive work with governmental and non-governmental agencies, focused legal innovation, and imaginative use of media. More unusual still, from the start SynBERC has built in ethics as an integral and co-equal, if distinctive, component.

The SynBERC initiative is designed around four core thrusts: Parts, Devices, Chasses, and Human Practices. These thrusts, in turn, are designed to meet specified goals. Thrusts 1 through 3 link evolved systems and designed systems, with emphasis on organizing and refining elements of biology through design rules. Thrust 4 examines synthetic biology within a frame of human practices. It attends to the ways that synthetic biology may significantly inform human well-being through its contributions to medicine, security, energy, and the environment.[13] Critical examination of how synthetic biology will inform these domains constitutes a central concern of Thrust 4.

Several core synthetic biology projects were well under way prior to the organization of SynBERC. Two of these were particularly important for the development of Thrusts 1-3. The first is a project at Berkeley, led by SynBERC Director Jay Keasling. The project's goal is to take a molecule, artemesinin, that is found in the bark of a Chinese tree, and which is one of a small group of molecules that remain effective against malaria, and to engineer a system in which the molecule can be produced at a cost that is many times less than the extraction from the tree. This basic work has been accomplished – it is grown in yeast or **e. coli** through a re-engineering of the pathways of these common single-celled organisms. So, synthetic biology, at least in this form, exists and it works. The major criticisms of the project come from those who have the legitimate concern that too much hope is being invested in a combination therapy based on a synthetic version of artemesinin that is likely to lead to its potential over-use and the consequent acceleration of resistance to it, with tragic results. That is a valid public health argument and those holding this position do not advocate eliminating this source, only thinking about consequences.

[12] http://www.synberc.org/

[13] For more details see www.synberc.org (<http://www.synberc.org/>).

The partner chosen to take Keasling's work out of the lab and into those regions of the world where it most urgently needed is another distinctive NGO, **One World Health**. The concept around which this NGO is organized is that hundreds of millions of dollars have been spent in research and development in the pharmaceutical and biotechnology industries that have yielded scientific insight, technical improvements, but often no commercially viable product. Their strategy has been to acquire (at the lowest possible cost) the intellectual property generated by this investment and work to transfer it to countries like India, where it can be adapted to local circumstances. The goal is to make available therapeutic advances that might be effective but are deemed to be not profitable enough for multi-national pharmaceutical companies. The quid pro quo is for those receiving the intellectual property not to compete in the same markets.

Although it is hard to imagine how one could argue that one should not encourage the development of new anti-malaria drugs in a world in which several hundred thousand people die each year from the parasite simply because the molecule to be used in therapy would be produced by re- engineering pathways in yeast or **e. coli**, this does not mean that no critical questioning should go on. But critical questioning requires knowledge and understanding. Hence, it is valid to argue that an over- abrupt use of a mono-therapy in a situation where the pathogen is highly adaptive is not a prudent strategy. And the synthetic biologists accept that criticism and are seeking to build the molecule so that poly-therapies that will reduce the likelihood of swift resistance can be built into the design (artificial, organic, natural, and emergent). Surely, changing the genome of yeast to produce artemesinin seems prudent and urgent, knowing full well that it is being designed to be introduced into the bodies of human beings and will thereby change both their internal milieu which already consists of multiple genomes (both contemporary and archaic) as well as the external milieu in which they live.

So, perhaps unique attention to the question of existing cultural understandings of nature and science at times can obscure other potentially more significant problems and questions. For example, what is perhaps most distinctive about this project is its funding and institutional setting. There is government research money, there is venture capital funding, there is university support, and the artemesinin project is funded in large part by the Bill and Melinda Gates Foundation. This foundation—with the gift of massive funding by financier Warren Buffet—has the largest endowment of any philanthropy in the world. It, like a few other new foundations—Google now has a for-profit foundation—are seeking to assemble health, science, policy, accountability, profit, delivery systems, management styles, scope, and timing in a distinctive fashion. Here is a very American assemblage with global reach. Its norms of productivity and accountability differ from those of the WHO or other such organizations in which national and international politics play such a distinctive part. This assemblage would certainly seem to be making a difference. And that diagnosis implies that we are obliged to think about its significance.

A second important project that was underway prior to SynBERC is located at MIT. It is devoted to building, or learning how to build, or to find out to what it extent it is possible to build, standardized biological parts, devices, and platforms. Its goal is to have a directory of such functional units available for order online—www.parts.mit.edu[14] —and to make them available worldwide on the basis of an open source license developed by a non- profit called Creative Commons. The core concept and initial work has taken place at MIT under the leadership of Professors Drew Endy and Tom Knight, integral members of the SynBERC initiative. One original organizational contribution, led by Randy Rettberg, has been to organize an international student competition, iGEM (genetically engineered machines) that has grown exponentially over the last three years to include the participation of over a hundred teams.[15]

Whereas one set of ethical and policy problems were raised by the Keasling project, the work at MIT poses a different order of challenge. Recent innovations in synthesis technology vastly expand the capacity to produce ever-larger specified sequences of DNA more rapidly, at lower cost, and with greater accuracy. These innovations raise the stakes of the so-called "dual-use" problem (the idea that technologies can be used both constructively and destructively), expanding existing fields of danger and risk. The relation between technical innovation and the expansion of danger has long been identified in the world of genetic engineering. Previously, these trends have been framed as issues of safety, which can be addressed through

[14] http://www.parts.mit.edu/

[15] See http://parts2.mit.edu/wiki/i ndex.php/Jamboree (<http://parts2.mit.edu/wiki/index.php/Jamboree>).

technical solutions. To date, a number of reports focusing on the governance of synthetic biology have adopted this framing.[16]

It has become clear, however, that not all challenges associated with synthetic biology can be dealt with through technical safeguards. For instance, changes associated with contemporary political environments, particularly new potential malicious users and uses (i.e. terrorists/terrorism), and increased access to know-how through the Internet exceed technical questions of safety. Such challenges cannot be adequately addressed using existing models of nation-specific regulation. New political milieus produce qualitatively new problems that require qualitatively new solutions. In addition, we must confront the challenge of uncertainty characteristic of all scientific research. Although some risks are presently understood, we lack frameworks for confronting a range of new risks which fall outside of previous categories. Such frameworks would need to be characterized by vigilant observation, forward thinking, and adaptation.

Given these conditions, synthetic biology calls for a richer and more sustained inquiry and reflection than is possible in a study commission model of collaboration, wherein formal interaction ceases with publication of a report. To date, work in bio-ethics has largely consisted either of intensive, short-term meetings aimed at producing guidelines or regulations, or standing committees whose purpose is limited to protocol review or rule enforcement. By contrast, we are committed to an approach that fosters ongoing collaboration among disciplines and perspectives from the outset. The principle goal of SynBERC's Human Practices thrust is to design such collaboration. This enterprise aims at giving form to real-time reflection on the significance of research developments as they unfold and the environments within which research is unfolding. The aim of such collaborative reflection would be to identify challenges and opportunities in real time, and to redirect scientific, political, ethical, and economic practices in ways that would, hopefully, mitigate future problems and contribute to human flourishing.

6.4.1 Human Practices: Principles of Design

Within collaborative structures, practice can be oriented and re-oriented as it unfolds. This work is accomplished not through the prescription of moral codes, but through mutual reflection on the practices and relationships at work in scientific engagement and how these practices and relationships allow for the realization of specified ends. Straightforwardly: ethics and anthropology can be designed so as to help us pause, inquire into what is going on, and evaluate projects and strategies. The goal of the Human Practices Thrust is to design, develop and sustain this mode of collaboration. Given that goal, our wager is that the primary challenge for the Human Practices Thrust is the invention of diverse forms of equipment requisite for the task. If the scientific aims of synthetic biology can be summarized as the effort to make living things better and to make better living things, then the principle question that orients our efforts to invent contemporary ethical equipment is this: **How should complex assemblages bringing together a broad range of diverse actors be ordered so as to make it more rather than less likely that flourishing will be enhanced?**

We do not yet know what form contemporary equipment will take. At this early stage of our work, however, three fundamental design principles appear worthy of elaboration and testing: **emergence**, **flourishing**, and **remediation**. In initial experimentation, these design principles appear to be both pertinent and robust. They are pertinent in that they form part of the research strategies of the biologists and characterize the assemblage of relations within which the research is developing. Initial indications have shown them to be robust in closely related domains (e.g. bio- security). In these domains they have made visible unanticipated problems and interconnections, thereby opening up new and more appropriate modes of intervention and reflection. One of our initial aims is to test the robustness of these principles in synthetic biology.

Research in human practices is underdetermined. Past bio-ethical practices often operated as though the most significant challenges and problems could be known in advance of the scientific work with which these challenges and problems were to be associated. Our hypothesis is that such practices are not sufficient for

[16] See the Sloan report on synthetic biology at http://www.jcvi.org/cms/fileadmin/site/research/projects/synthetic-genomics-report/synthetic-genomics-report.pdf, and the Fink report on dual-use, http://www.fas.org/sgp/crs/natsec/RL33342.pdf.

characterizing the contemporary assemblage within which synthetic biology is embedded. This assemblage is a contemporary one: it is composed of both old and new elements and their interactions. While some of these elements are familiar, the specific form of the assemblage itself, and the effects of this form, can only be known as it emerges. We understand **emergence** to refer to a state in which multiple elements combine to produce an assemblage, whose significance cannot be reduced to prior elements and relations. As such, the problems and their solutions associated with synthetic biology cannot be identified and addressed until they unfold. Questions concerning what it means to make life different, what it means to make living beings better, and what metrics and practices are appropriate to these tasks can best be addressed in real time as challenges arise and breakdowns happen. The knowledge needed to move toward the desired near-future will be developed in a space of relative uncertainty and contingency. Adopting a vigilant disposition that is attentive to a mode of emergence is at the core of our work. In sum our equipment must be designed such that it generates knowledge appropriate to states of emergence.

In the 1990s, bio-ethical equipment was designed to protect human dignity, understood as a primordial and vulnerable quality. Hence its protocols and principles were limited to establishing and enforcing moral bright lines indicating which areas of scientific research were forbidden. A different orientation, one that follows within a long tradition but seeks to transform it, takes ethics to be principally concerned with the care of others, the world, things, and ourselves. Such care is pursued through practices, relationships, and experiences that contribute to and constitute a **flourishing** existence. Understood most broadly, flourishing ranges over physical and spiritual well-being, courage, dignity, friendship, and justice, although the meaning of each of these terms must be re-worked and re- thought according to contemporary conditions. The question of what constitutes a flourishing existence, and the place of science in that form of life, how it contributes to or disrupts it, must be constantly posed and re-posed in such a form that its realization becomes more rather than less likely. In sum, the equipment we are developing must be oriented to cultivating forms of care of others, the world, things, and of ourselves in such a way that flourishing becomes the mode and the telos of both scientific and ethical practice.

The third design challenge is to develop equipment that operates in a mode of **remediation**. The term remediation has two relevant facets. First, it means to remedy, to make something better. Second, remediation entails a change of medium. Together, these two facets provide the specification of a specific mode of equipment. When synthetic biology is confronted by difficulties (conceptual breakdowns, unfamiliarity, technical blockages, and the like), ethical practice must be able to render these difficulties in the form of coherent problems that can be reflected on and attended to. That is to say, ethical practice remediates difficulties such that a range of possible solutions become available. In sum, our challenge is to design contemporary equipment that will operate in a mode of remediation. This equipment must be calibrated to knowledge of that which is emergent, and enable practices of care which lead to flourishing.

We do not presume to know in advance of its actual scientific work how synthetic biology will inform human life. We are persuaded, however, that ethical observation and anthropological analysis is capable of contributing positively to the overall formation of synthetic biology. We think that our contribution can only be effectively realized if this work is conducted in direct collaboration with scientists, policy makers, and other stake holders. Standard approaches have sought to anticipate how new scientific developments will impact "society" and "nature," positioning themselves external to, and "downstream" of, the scientific work per se. The value of collaboration is that it constitutes a synergistic and recursive structure within which significant challenges, problems, and achievements are more likely to be clearly formulated, successfully evaluated, and changed. Following our design principles, our goal is to invent new sets of contemporary equipment, put it into practice, and remediate things as they unfold.

Chapter 7

Human Practices 2007. Interfacing Three Modes of Collaboration[1]

A congeries of "post-genomic" projects have defined their challenge as taking up the functional redesign of biological systems. One strategy devised to meet this goal is actually a heterogeneous collection of enterprises deploying diverse tactics loosely grouped under the compelling label of synthetic biology. Synthetic biology began as a visionary if minimally defined project whose goals were nothing if not audacious.

As of 2007, there are at least four strategic tendencies that self-identify as synthetic biology. There are two whose goal is to engineer whole cells. One seeks to do this from the "top down" by simplifying existing organisms and then engineering whole genomes or chromosomes, inserting them into the existing cellular machinery so as to orient them to function in a specified manner.[2] Another, "bottom up" approach, following in the line of earlier efforts at creating synthetic life- forms, attempts to build proto-cells from the amino acids up.[3] The two other variants are the ones we are working most closely with. The distinction between these two variants is an analytic one that we draw from our observations. It is not a stated or otherwise formalized distinction. The first has been developed primarily by a group of researchers at MIT. It consists of the attempt to engineer, modularize, and standardize working parts on the analogy of industry and prior developments in engineering. The goal of the MIT researchers is to make synthetic biology an engineering discipline in the formal sense.[4] The second is a variant of this approach, one that works in conjunction with the MIT model. It is characteristic of researchers at Berkeley, where there is a stated openness to the goal of standardizing synthetic biology as an engineering discipline, but where actual work focuses more on specific functional problems. This approach seeks to develop and use synthetically engineered parts not as a goal in themselves or as the demonstration of the power of the sub-discipline. Rather, techniques and work of standardization are taken up insofar as they can be made to contribute to work on specified bio-engineering projects. Such projects are not, strictly speaking, limited by the label of synthetic biology.

7.1 SynBERC

SynBERC was designed, proposed, and funded as an effort to invent new venues and research strategies capable of producing resourceful solutions to real world problems where existing venues and strategies appeared to be insufficient. As the website puts it with the typical bravado of an early-stage undertaking:

> *The richness and versatility of biological systems make them ideally suited to solve some of the world's most significant challenges, such as converting cheap, renewable resources into energy-rich*

[1] This content is available online at <http://cnx.org/content/m18811/1.1/>.

[2] See the Venter Institute's Lartigue et al.Genome "Transplantation in Bacteria: Changing One Species to Another," **Science** 3 August 2007: 632-638

[3] See http://www.protolife.net/ (<http://www.protolife.net/>)

[4] See www.biobricks.org (<http://www.biobricks.org/>)

molecules; producing high-quality, inexpensive drugs to fight disease; detecting and destroying chemical or biological agents; and remediating polluted sites.

This undertaking, recall, is designed around four core Thrusts. For its part, Thrust 4 examines synthetic biology within a frame of human practices. The name "Human Practices" was coined to differentiate the goals and strategies of this component from previous attempts to bring "science and society" together into one frame so as to anticipate and ameliorate science's "social consequences." The task of Human Practices is to pose and repose the question of the ways in which synthetic biology is contributing or failing to contribute to the promised near future through its eventual input into medicine, security, energy, and the environment. The purpose of such a task is to assess this form-giving through critical examination. The question of how synthetic biology will inflect these domains as it develops, not only after it achieves something, constitutes a central, if not unique, concern of Thrust 4.

The SynBERC PIs have claimed in their grant proposals, and made structurally explicit in the initial formulations of the organization of the Center, that the far-reaching promises of synthetic biology cannot be realized under existing conditions and organization of scientific research. If the PIs are correct in their assessment, and if in basic ways the promise of synthetic biology is dependent on new forms of collaboration, then the success of SynBERC will depend as much on organizational change and change of work habits as it will technical virtuosity.

Given the power differentials among the bioscientists and the human scientists and the existing disciplinary structures of reward that shape and reinforce current practices, there is no guarantee that collaboration will be forthcoming. Indeed, there is evidence and experience to suggest that the habits and dispositions of elite scientists as well as the organization of their labs and objects will resist change, consciously and tacitly. Certainly, many of these scientists have made their accommodation with the ELSI mode. They are ready to fill out safety forms, they are open to ethics discussions as long as these are periodic and non-intrusive, and they are open to regulation as long as this is downstream of their research. Some are even open to hypothetical discussions about well-meaning social concerns and consequences. In short, some are willing to **cooperate**.

The question remains open, however, whether elite scientists with all the demands on their time are ready to submit themselves to changes of a transformative sort in their habits and procedures. The question remains as to whether or not they are willing to contribute to developing **collaboration**. This question is a genuinely open one for us, and constitutes a key starting point of inquiry that we undertake in an experimental mode. By experimental mode ,we mean that we will monitor the progression or lack of progression of this design initiative, and to analyze the results.

7.2 The Work of Equipment

The goal of our work has been to invent, experiment with, and, if successful, formalize a distinctive form of collaboration among and between synthetic biology, anthropology, and ethics. The first design parameter consists in taking into account the predominance of cooperation in existing modes of work. As a mode of work, **cooperation** should be distinguished from **collaboration**. A collaborative mode proceeds from an interdependent division of labor on shared problems. A cooperative mode consists in demarcated work with regular exchange; cooperation does not entail common definition of problems or shared techniques of remediation. The first practical challenge, therefore, is to identify a venue appropriate to and capable of such experimentation. In this paper, we identify one such venue in which we have begun to work—the Synthetic Biology Engineering Research Center (SynBERC). Our task is to analyze existing modes of interaction and engagement between and among the human sciences, the biosciences, ethics, and organizational forms.

We argue that standard **cooperative** models of science and society, such as those developed under the HGI ELSI program, need to be adjusted and remediated. By adjusted, we mean that given the significant changes that have taken place in the biosciences during the last decade, the core components of the ELSI program, developed to couple with the early stages of the genome sequencing projects, today need recalibration. By remediated, we mean redesigning formerly cooperative practices so as to create interfaces among

synthetic biologists, anthropologists, ethicists, and others such that mutual work on commonly defined problems can be undertaken. The success of such work depends on a number of factors, not least of which is the challenge of introducing new habits and forms of organization into the existing structures and practices of elite science.

As an initial step toward achieving this goal of a distinctive mode of practice, the Berkeley team proceeded with an informed awareness that, to use our technical language, there exists a rather inchoate, if insistent, demand for new **equipment** to reconfigure and reconstruct the relations between and among the life sciences, the human sciences, and diverse citizenries both national and global. This insight resonates with a year's intensive exploration with members of the Anthropology of the Contemporary Research Collaboratory (ARC), www.anthropos-lab.net[5] , indicating that the demand for conceptually comparative inquiry, exist in other emergent domains such as bio-security, bio-complexity, etc.

Further, this conviction that there is a need to invent new practices and imagine new relationships is buttressed by the demands of the pragmatic situation: the National Science Foundation funds our work. As we shall see, the demands coming from that quarter at times constitute a double- bind: an acceptance of the need to do something different and a pressure to produce immediate deliverables, in an older form, meeting older criteria of relevance. It is worth noting that large-scale programs are underway in Europe demonstrating the possibility and legitimacy of distinctive, post-ELSI approaches. The demands of the security environment in the United States, however, have overshadowed other imperatives and these new directions are, as of yet, largely unknown within the US funding structure.[6]

Our own research and reflection, our reading of the relevant literature in sciences studies, and insightful inquiry from intellectual historians has convinced us that there is—and has been—a level of pragmatic concern and development that lies between technology and method. Settled technologies honed to maximize means-ends relationships abound in our industrial civilization; the social and biological sciences have produced vast reservoirs of methodological reflection to justify and advance their work. Inquiry into past situations of change as well as contemporary explorations makes clear that neither technology per se or grander methodological elaborations quite cover the terrain of how diverse domains are brought together into a common assemblage. Nor do they sufficiently explain how ethical considerations and demands have been brought into a working relationship with the quest for truth and made to function pragmatically, i.e., they do not account for equipment.[7] Equipment has historically taken different forms, enabling practical responses to changing conditions brought about by such specific problems, events, and general reconfigurations.[8]

Turning equipment into **equipmental platforms** has been a central part of our work. Equipmental platforms are designed to be of general use in a broad problem area.[9] While equipment identifies basic components given specific problems, a platform distinguishes practices appropriate to pragmatic work on those problems, as well as serving as the basis for the organization of such pragmatic work. The kinds of practices that equipmental platforms distinguish and organize are those relevant to the objects, metrics, and purposes specified by equipment. In order to put equipmental platforms into use, to move from the general to the particular, equipmental platforms must be customized for particular cases. In this paper we are concerned with analyzing the modes of practice according to which issues and challenges in synthetic biology have been taken up. These modes can be thought of as cohering with the specifications of distinct equipmental platforms.

For example, through the 1960s concerns arose regarding the capacity of the developing medical and biological sciences to provide adequate means of analysis for understanding and coping with the ethical and ontological consequences of their own advances. A small number of leading scientists took the initiative to

[5]http://www.anthropos-lab.net/

[6]See the Science and Technology Foresight program of the European Union, http://cordis.europa.eu/foresi ght/home.html (<http://cordis.europa.eu/foresight/home.html>)

[7]Stephen Shapin, **A Social History of Truth Civility and Science in Seventeenth-Century England** (Chicago: University of Chicago Press, 1995); Andrew Barry, **Political Machines, Governing a Technological Society** (London: The Athlone Press, 2001).

[8]Paul Rabinow and Gaymon Bennett. (2007) "From Bio-Ethics to Human Practices or Assembling Contemporary Equipment." http://anthropos- lab.net/documents/wps/ (<http://anthropos- lab.net/documents/wps/>)

[9]Paul Rabinow and Gaymon Bennett. (2007) "A Diagnostic of Equipmental Platforms." http://anthropos-lab.net/documents/wps/ (<http://anthropos- lab.net/documents/wps/>)

invite philosophers and theologians to think about ways in which research might be moving in the direction of transforming or even destroying human life.[10] Out of these and other political encounters, by the middle of the 1970s a new kind of specialist, the "bio-ethicist," had appeared alongside the life scientist as someone authorized to offer serious truth claims about the relation of science and society. The bio-ethicists were assigned the task of elaborating principles according to which "good" science could be discerned from "bad" science. Such discernment was intended to provide an ordering and regulating function, assuring that science would contribute to a healthy society and would guard against pathological practices. That is to say, bio-ethicists were assigned the task of producing equipment. The first step in meeting this demand consisted in articulating principles required for composing appropriate equipmental platforms. In our terms, the actual challenge was to take philosophical principles and render them as design parameters for equipment. The challenges surrounding synthetic biology call again for the assessment of the extent to which existing equipment is adequate to emerging problems, and, where found to be insufficient, new equipment platforms developed.

7.3 Diagnostic

In what follows, we provide a diagnostic of three current equipmental modes. A **diagnostic** has two functions. The first is analytic. It functions to lay out distinctions. A diagnostic serves a critical function; it facilitates the work of decomposition of complex wholes in order to test the logic on the basis of which composition has taken place. In diagnostics, however, the work of decomposition cannot be an end-in-itself. Rather, analysis must be followed by recomposition. This synthetic work is the second function of a diagnostic. Thus, a diagnostic operates to distinguish and designate, as well as characterize and fashion, categories and elements so as to give them an appropriate form.

We are developing a diagnosis that is designed to be directly helpful for our work in SynBERC, but is also intended to be applicable (with appropriate adjustments) to a range of analogous problem- spaces. This approach has helped us to analyze more clearly the challenges of how to proceed in organizing and putting into motion this multidisciplinary endeavor. The diagnosis offered in this paper discriminates the ways in which various **modes of engagement** are designed to manage and respond to qualitatively different kinds of problems. In this way, distinctive modes of engagement can be interfaced and adjusted to each other such that the resulting assemblage is adequate to the kinds of problems that SynBERC, and other similar contemporary enterprises, are designed to address.

The challenge, as we see it, is to characterize existing and emergent modes in such a way that they can be constructed as complementary parts of a broader collaborative Human Practices approach. This paper analyzes two predominant modes of engagement—the representation of technical experts and the facilitation of "science and society"—as well as a third mode, emerging today: inquiry and equipment. A goal of this analysis is to explore the conditions under which existing expertise and "boundary organizations" can be appropriately adjusted and interfaced with synthetic biology, with each other, and with the third mode, which is emergent and in the process of design and experimentation.

To aid the design and construction of such interfaces and the overall project of remediation, we begin with an ideal typical and schematic presentation of these modes so as to determine practices that are helpful and unhelpful in order to determine more clearly existing limitations and challenges. Our approach is in the line of the construction of "ideal-types" proposed by Max Weber a century ago. We build three distinct forms that are constructed so as to be analytically distinct one from the others. We are fully aware that in the "real world" these divisions are not so neat and compartmentalized. The function of the ideal-type, after all, is to highlight distinctions so as to enable inquiry into the specifics of existing cases. At the same time, of course, these ideal types have been constructed from materials drawn from pre-existing efforts and examples. Hence there can appear to be a slippage between the ideal typical function of producing an analysis and a description of existing configurations.

[10] It shouldn't be overlooked that with the Belmont Report ethicist, for the first time, are made part of the U.S. government, despite the increasing turn to moral discourse as the site of truth distinctions since 1950.

7.4 Mode One: Representing Modern Experts

	Platform	**Key Externality**	**Critical Limitation**
Mode 1	Representing Experts	Emergent Problems	Metric of Uncertainty

Table 7.1

Mode One consists in inventorying, consulting, and cooperating with experts. The core assumption—often taken for granted and not subject to scrutiny—is that the expertise of existing specialists in one domain is adequate without major adjustment to emerging problems. Of course, in many instances, an adequate pairing of problem domain and expertise does exist. The vast number of technical specialists trained and supported by the state bureaucracies, corporations, international agencies, and non-governmental non-profits of the industrialized world certainly are competent to address many current challenges. It is worth remembering that many of these challenges have been formulated, worked over, and compartmentalized by these experts and the organizational form, practices, and limits within which they operate.

Expert knowledge functions as means-ends maximization. Even when such expert knowledge is operative, it gains its very strength precisely from its capacity to bracket purposes or goals. Expert knowledge is structured and functional only when that which counts as a problem is given in advance, stabilized, and not subject to further questioning. In emergent situations, however, neither goals nor problems are settled, and so technical expertise cannot be effectively marshaled without some adjustment. In many instances, obviously, when goals and problems become settled, technical expertise must be given a useful place within an assemblage. Said another way, routinization is normal but qualitatively different from states of emergence or innovation.

Having access to technical competence and successfully deploying it in delimited situations (which need to be identified and stabilized themselves) so as to effectively address problems is not the same thing. Hence, in addition to technicians, in stable organizations there is a need for managers or technocrats whose task is to oversee and coordinate specialists and technicians. Such coordination facilitates a **cooperative** mode of engagement by subdividing specializations and assigning tasks. As with technical expertise, it is frequently supposed that the competencies of technocrats are transferable from stable to emergent situations. As such, in the United States technocrats and technicians often rotate out of public, governmental, or corporate service, and take up positions as consultants or lobbyists claiming transferable competence.

In Mode One, the role of the social scientific Practitioner (MOP) is to identify and coordinate legitimated specialists and technocrats. The MOP is expected to maintain broad overview knowledge of a number of sub-disciplines at least to the extent that the MOP can legitimately claim to present a range of candidates as authoritative and available. Candidates are presented and ranked along scales (both formal and informal) of authority, availability, connections, and character. The MOP's authority is based on this work of inventory and ranking. The type of equipmental platform according to which MOPs calibrate their work are those that distinguish kinds of authorized experts and draw these experts into a cooperative frame.

The Mode One Practitioner frequently does not provide (or take as part of the job) a critical analysis of the status of expertise per se, or of existing expertise and its specific functions. Rather, the MOP understands his work as providing an evaluative assessment of specific first-order practitioners, in a first-order mode. The metric of this inventory- making is not a second-order one. We are taking the distinction between first and second order observer from the German sociologist Niklas Luhmann. A second order observer is someone who observes observers observing. This sounds opaque but is actually quite straightforward. First-order observers take their world as it comes to them (often in a highly mediated form). They then do their work. This intervention in the world is what Luhmann refers to as "observing"; hence the term is more than perceptual, it is an action, frequently a sophisticated one. A second-order observer observes actors acting. Such a second-order action is neither removed from the world nor given any special privilege. Furthermore, as Luhmann writes, "A second-order observer is always also a first order observer inasmuch as he has to pick out another observer as his object in order to see through him (however critically) the world."[11] We take

[11] Niklas Luhmann, **Die Gesellschaft der Gesellschaft**, 2 vols., trans. Nicolas Langlitz (Frankfurt-am-Main: Suhrkamp,

up this distinction in a non-judgmental and simple manner: it helps to distinguish different positions and different modes of doing one's work.

The Mode One practitioner **represents** existing **expertise**: this representation takes a twin form. The MOP literally re-presents existing expertise in a readily comprehensible form (often PowerPoint). The MOP is a representative for the legitimacy of existing expertise. The MOP does not put forth claims of validity concerning substantive issues dealt with by the chosen experts. It follows that under specific circumstances, in fundamentally stabilized situations, institutions, and problems, Mode One work can provide benefits by identifying, bringing together, and representing existing expertise.

From the outset of SynBERC, it was clear that even in the domains where the existing core of specialist expertise might well be more directly pertinent (e.g., intellectual property) than in some others (e.g., ethics), it was certain that start-up companies with whom scientists in SynBERC had direct association as founders or board members (e.g., Codon Devices, Amyris) would have ready access to such experts (e.g., would have already taken great care to address intellectual property issues). This supposition has been amply supported by the evidence. In a word, the small start-up companies associated with SynBERC and other parallel organization have already hired patent lawyers and given priority to related financial matters (or in the case of established organizations such as BP, have whole departments long in place). These counselors are privy not just to the generalities of synthetic biology as an emergent field but to the specifics of the scientific and technological inventions at issue. Further, venture capitalists who have invested in these start-ups provide the contacts necessary for maximizing protection and insist on their enforcement. Finally, SynBERC was conceived within a certain ethos of maximizing the "commons" and was associated in a working relationship from the inception with groups such as Creative Commons, with long experience in innovative patent and organizational design.

It is commonly recognized that questions concerning industrial strategies and IP are of fundamental importance to synthetic biology. Work to date has focused on how synthetic biology will have to adapt its open-source goals to existing models of industrial strategies and IP. Our approach is to inquire into what distinctive forms of industrial partnerships and IP can be invented, given the objectives of **specific synthetic biology projects**.

7.4.1 Externalities: The Price to be Paid

For each of the modes, after the ideal-typical figure, we present a list of "externalities" and of "critical" limitations as a series of talking points. There is a substantial scholarly and professional literature on many of these issues. Rather than giving the impression that we are comprehensively presenting each of these questions, we prefer a schematic form as a means of indicating that these are topics we are attempting to think about, explore, and draw lessons from at this initial stage of both our inquiry and the development of SynBERC. At the end of the paper, we raise a series of challenges that those attempting to work collaboratively must face.

There are some immediately identifiable externalities that bear on Mode One. The term externality as we are using it is taken from neo-classical economics. It refers to factors that "result from the way something is produced but is not taken into account in establishing the market prices."[12] The identification of such limits allows one to pose the question: when and where is it an effective use of limited resources to undertake MOP strategies?

1. In emergent problem spaces, appropriate experts do not necessarily exist. This fact falls outside of Mode One operational capacities. Such a deficit, however, does not imply that there is no possible way to adjust and integrate existing expertise. Rather, it simply calls for second order reflection on this state of affairs.
2. Even when appropriate expert knowledge does exist, its very strength, technical criticism as means-ends maximization, gains its legitimacy precisely from its capacity to bracket purposes or goals. In an emergent situation, such bracketing must itself be subject to scrutiny.

1997), 117.

[12] Microsoft Word dictionary definition.

3. In either case, a different skill set is required to move into the contested networks and pathways of what is taken to be the impact, consequences, opinions, of "society" or "the public." The response of MOPs to this challenge is to look for other specialists in surveying opinion, assessing consequences, and preparing for the impact. The reservations of numbers 1 and 2 thus apply here as well.
4. Mode One is based on the modernist assumption that there is a society, that it has been divided into value spheres, that there is a problem of legitimation, and that the challenge is to invent a form of governance in which these issues can be adjudicated through procedure and specialization. These assumptions have been debated and challenged for over a century.[13] And within a new globalized, accelerative, security, **oecumene**, it is not obvious, far from it, that MOP pre-suppositions are defensible.

7.4.2 Critical Limitations: Structural Incapacities

Given these externalities, the question still needs to be addressed: where expertise is engaged, what are its critical limitations? By answering this question we will be able to pose the question of where and when Mode One experts are useful in an assemblage such as SynBERC. We have identified several critical limitations:

1. In Mode One, the future appears as a set of possibilities about which decisions are demanded.[14] The range of these decisions is delimited by a zone of uncertainty. The genesis and rationality of such a zone is that Mode One experts operate with a metric of certainty. The ever-receding zone of uncertainty, however, is not fundamentally unknowable, only uncertain. But, precisely because it forms a horizon depending on current decisions, this zone of uncertainty cannot be specified in advance. Uncertainty, however, does not undermine the decision-making imperative of experts. Rather, it compels incessant decisions and affirms that an appropriate form of verifiable certainty (probability series, risk analysis, technical measurements, etc.) can be attained. The authority of experts is not undermined by the oft-demonstrated inability either to forecast the future or to make it happen as envisioned. Rather, this dynamic provides the motor of their legitimation. In sum, a zone of uncertainty is an intrinsic part of this equipmental mode.[15]
2. In Mode One, uncertainty is taken up as a boundary condition. It allows Mode One practitioners to move from the generation of verified claims and their delimitation to the coordination of discussion and communication. Rather than deflating the authority of experts or making obvious the need for other modes of inquiry, this move to discussion and communication allows for the rehearsal of the past triumphs of expertise, and renders such past verificational successes as points of reference to orient debate about the present and near future.[16]
3. Uncertainty entails an ever-receding horizon. As such, rather than functioning as a fundamental limitation, uncertainty provides a refinement and corrective such that Mode One Practitioners can (ostensibly) operate more realistically, and therefore more effectively. Mode One Practitioners attempt to factor in "uncertainty" as a parameter in identifying and ranking expertise. What they fail to factor in is the structural insufficiencies of existing expertise both external and internal.

[13] Max Weber, „Science as a Vocation," in From **Max Weber**, trans. Hans Girth and C. Wright Mills (New York: Oxford University Press, 1941), Ulrich Beck, Anthony Giddens, and Scott Lash, **Reflexive Theory of Modernization** (London: Polity Press, 1994), Luc Boltanski and Laurent Thevenot, **On Justification: Economies of Worth**, trans. Katherine Portor (Princeton and Oxford: Princeton University Press, 2006 (orig. 1991)).

[14] Reinhart Koselleck, **Futures Past, On the Semantics of Historical Time**, trans. Keith Tribe (Cambridge: MIT Press, 1985 (orig. 1979).

[15] Gregory Pence, Who is Afraid of Human Cloning? (New York: Rowman and Littlefield, 1998),

[16] Gilles Deleuze and Felix Guattari, **What is Philosophy?**, trans. Hugh Tomlinson and Graham Burchell (New York: Columbia University Press, 1994. (orig. 1991). Alain Badiou in his book, **L'éthique, Essai sur la conscience du Mal**, (Paris: Hatier, 1995) writes that one calls "opinions les représentations sans vérité, les débris anarchiques du savoir circulant. Or les opinions sont le ciment de la socialité. [ ].L'opinion est la matière première de toute communication. » P.46.

7.5 Mode Two: Facilitating Relations between Science and Society

	Platform	**Key Externality**	**Critical Limitation**
Mode 2	Facilitating Science & Society	Selecting Stakeholders	Formal Proceduralism

Table 7.2

We take the distinction between Mode One and Mode Two from the work of Helga Nowotny and co-authors. Nowotny et al have been part of an active debate and an articulated conceptualization of the strengths and limitations of Mode One.[17] Their book is an elaboration of a report commissioned by the European Commission. In fact, Mode Two has become the norm for official policy in Europe in regards to "science and society." Although there are examples of this mode in the United States (see below), such instances are dispersed and are not currently normative in an official policy sense. Mode Two arose as a reaction to the perceived arrogance of scientists and technocrats and their lack of professional competence to deal with concerns beyond their direct disciplinary or sub- disciplinary questions. Further, as policymakers and civil society activists have discovered and documented, the inability of Mode One to include a range of existing social values in planning; the honest admission that neither the purely scientific nor the technological per se were competent to evaluate consequences and impacts; that by including opinion both as a set of numbers produced by polling and surveying techniques, projects could be better designed so as to meet less resistance and be more representative.

Mode Two Social Science practitioners are **facilitators**. Their role qua facilitator is to bring heterogeneous actors (scientists, technical experts, policy makers, law makers, civil society actors, political activists, industry representatives, government and private funders, etc.) together into a common venue. That venue, often created for a particular crisis or event but eventually standardized and routinized, is fundamentally a space for **representation + expression**. Stake-holders are encouraged to express themselves, to advocate, to denounce, to articulate, to clarify, and eventually, it is hoped, to form a consensus. Such a consensus is taken to be normative and made to function equipmentally in the organization of research and development programs.

Mode Two is calibrated according to an innovative equipmental platform. This platform takes "social values" as norms for discriminating which activities are appropriate, and elaborates these values such that they can serve as the basis for the organization of such activities. It follows that the challenge for Mode Two practitioners is to develop procedures for identifying significant social stakeholders, discerning their opinions and values, and designing mechanisms through which such opinions and values become normative for research and development in the sciences. In order meet this challenge, venues that function to facilitate boundary organization and its modes of governance must be invented and institutionalized. Both in Europe and in the United States the venue for this work has predominantly been the "Center."[18]

7.5.1 Cutting Edge Example: Nanotechnology and Society

A leading example of Mode Two Social Science is the Center for Nanotechnology and Society at Arizona State University (CNS-ASU). CNS-ASU has been designed to take on board and adjust its organizational practices to the limitations of Mode One by focusing on "emerging problems" and "anticipatory governance":[19]

[17] Helta Nowotny, Peter Scott and Michael Gibbons, **Re-Thinking Science, Knowledge and the Public in an Age of Uncertainty**, (London: Polity Press, 2001). Michael Gibbons, Camille Limoges, Helga Nowotny, Simon Schwartzman, Peter, Scortt, Martin Trow, **The New Production of Knowledge, The dynamics of science and research in contemporary societies**, (New York: Sage, 1994.)

[18] See the BIOS Center, London School of Economics, www.lse.ac.uk/bios (<http://www.lse.ac.uk/bios>), Center for Bioethics and Medical Humanities, University of South Carolina, http://www.ipspr.sc.edu/cbmh/defa ult.asp (<http://www.ipspr.sc.edu/cbmh/default.asp>)

[19] CNS-ASU homepage at www.cns.asu.edu/network (<http://www.cns.asu.edu/network>)

> *Designed as a boundary organization at the interface of science and society, CNS-ASU provides an operational model for a new way to organize research through improved reflexiveness and social learning which can signal emerging problems, enable anticipatory governance, and, through improved contextual awareness, guide trajectories of NSE [nanotechnology science and engineering] knowledge and innovation toward socially desirable outcomes, and away from undesirable ones.*

The proposed means of moving toward such socially desirable outcomes is to "catalyze interactions" among a representative variety of publics. The metric of these interactions is not to produce technical expertise per se, but to raise the consciousness and responsive capacities of high level policy makers, scientists, and "consumers."[20] Interactions and awareness are facilitated by designed and monitored dialogues on the goals and implications of nanotechnology. This engagement will facilitate the construction of a communications network positioned upstream rather than downstream of the research and development process. Upstream positioning is designed to anticipate and evaluate the impact of nanotechnology on society before "rather than after [its] products enter society and the marketplace."[21]

7.5.2 Equipmental Platform: RTTA and Reflexive Governance

Two sets of strategies are being designed and developed in order to meet CNS-ASU's goals. The first is a program of "research and engagement" called "real-time technology assessment" (RTTA). RTTA consists of four components:

1. "mapping the research dynamics of the NSE enterprise and its anticipated societal outcomes";
2. "monitoring the changing values of the public and of researchers regarding NSE";
3. "engaging researchers and various publics in deliberative and participatory forums"; and
4. "reflexively assessing the impact of the information and experiences generated by our activities on the values held and choices made by the NSE researchers in our network."[22]

The second procedure is a program for "Anticipatory Governance." Anticipatory governance can be distinguished from "mere governance," defined as "the kind that is always found running behind knowledge-based innovations." Rather, through the facilitation of interfaces between societal stakeholders and researchers, CNS-ASU is attempting to develop practices of governance with the capacity to:

1. "understand beforehand the political and operational strengths and weaknesses of such tools," and
2. "imagine socio-technical futures that might inspire their use."[23]

7.5.3 Externalities: The Price to be Paid

There are some immediately identifiable externalities that bear on Mode Two. The identification of such externalities allows one to answer the question: to where and when should Mode Two strategies be undertaken in synthetic biology?

1. Mode Two attempts to factor in and move beyond the limitations of Mode One's focus on existing expertise. However, given built-in funding and legitimacy demands, such a move is frequently hindered. For example, the identification and management of polling such diversity itself requires further experts. Yet additional specialists are required to manage these burgeoning classifications, groups, and sub-groups. Audit culture expands to meet its own criterion of inclusiveness, accountability, and

[20] Erik Fisher, "Ethnographic Invention: Probing the Capacity of Laboratory Decisions NanoEthics," Nanoethics online at http://www.cspo.org/documents/Fisher_ProbingLabCapacity_Nanoethics- 07.pdf (<http://www.cspo.org/documents/Fisher_ProbingLabCapacity_Nanoethics- 07.pdf>)

[21] http://cns.asu.edu/ (<http://cns.asu.edu/>)

[22] Ibid.

[23] Ibid.

responsibility (bureaucratic demands of accountability): that technologies of polling and opinion collection be developed and managed by experts (in polling, in the presentation of results, in public relations, etc.).[24] In sum, the challenge of moving beyond expertise encounters the requirement for new experts.

2. Mode Two supposes that ethical science is science that benefits society, which is made up of stakeholders, whose values must be given a venue for expression. Such supposition generates two problematic limitations. The first is that various stakeholders are vulnerable to the charge of being ignorant or not competent: scientists often believe that lay people are incapable of understanding the details of their work in its own terms (often correct) and hence are not capable of producing legitimate evaluations (often contestable). Policy makers, social activists, and social scientists often believe that the results presented in scientific or technology journals do not correspond to the complexity of social reality. Journalists' attempts to explain science to society are thought to simplify both poles. It follows that charges and counter-charges of hype joust with charges of ignorance.
3. The second limitation is that it has become clear in Europe that techniques of producing society's representatives were required, as well as techniques of legitimating these representatives. The legitimating process is frequently challenged by those who consider themselves to be excluded.

7.5.4 Critical Limitations: Structural Incapacities

Given these externalities, the question needs to be addressed: once the appropriate venues for Mode Two have been established, what are its critical limitations? By answering this question, we will be able to pose the question of where and when Mode Two practitioners are useful in a collaboratively normed assemblage such as SynBERC.

Mode Two is characterized by at least three identifiable critical limitations:

1. Mode Two takes seriously the challenge to respond to Society and the Public in order to orient research responsibly. However, experience has shown that specifying who exactly one is talking about when one references Society and/or the Public frequently turns out to be an elusive task.[25] These broad rubrics cover highly diverse actors.
2. Furthermore, two decades of work in STS and related fields have put into question the very existence of referents to such homogenizing terms as "science," "society," and "public." Sciences are plural when they retain any distinctiveness at all. Society has been increasingly replaced by Community and the Individual in its neo-liberal frame.
3. In Europe, given the bureaucratic framework of the European Union, not surprisingly, the way in which the first critical limitation has been dealt with has been through the channels of representation and formal procedures. Proceduralist approaches, however, rarely resolve value disputes although they may provide means of adjudication in specific instances. Likewise, proceduralist approaches rarely resolve scientific differences. Finally, proceduralist approaches tend to mask power differentials.
4. Regardless of how successful bureaucratic procedures are designed and implemented, problems remain. As many critics have pointed out, such as the President's Council on Bioethics in the United States and **ATTAC** in France, opinion polling, formal proceduralism, consensus building and the multiplication of representatives' expression cannot answer the ethical and political question of whether or not a given course of action is good or bad, right or wrong, just or unjust. In fact, proceduralist exercises have no way of posing this question. It follows that representation and expression as modes of organizing scientific and political practice, much like technical expertise, while coherent and valuable within a democratic framework, nonetheless, because of its inherent limitations, possess serious dangers that must be taken into account.

[24] Marilyn Stathern, ed., **Audit Culture: Anthropological Studies in Accountability, Ethics, and the Academy** (London and New York: Routledge, 2000).

[25] Sheila Jasanoff, **Designs on Nature: Science and Democracy in Europe and the United States** (Priceton and Oxford: Princeton University Press, 2005).

7.6 Mode Three: Inquiry + Equipment

It is not the "actual" interconnections of "things" but the ***conceptual*** *interconnections of* ***problems*** *which define the scope of the various sciences. A new "science" emerges where new problems are pursued by new methods and truths are thereby discovered which open up significant new points of view. — Max Weber, "Objectivity in the Social Sciences," in* ***The Methodology of the Social Sciences*** *(New York: Free Press, 1949) (orig. 1905), p. 68.*

	Platform	**Key Externality**	**Critical Limitation**
Mode 3	Inquiry + Equipment	Cooperative Engagement	1st Order Deliverables

Table 7.3

A defining goal of Mode Three work is to design practices that bring the biosciences and the human sciences into a mutually collaborative and enriching relationship, a relationship designed to facilitate a remediation of the currently existing relations between knowledge and care in terms of mutual flourishing. The means to inquire and explore to what extent these new relationships will be fruitful consist in the invention, design, and practice of what we have referred to as **equipment**. If successful, such equipment should facilitate our current work in synthetic biology (understood as a Human Practices undertaking) through improved pedagogy, the vigilant assessment of events, and focused work on shared problem-spaces. An ongoing task is to provide conceptual analysis of these three elements, so as to reflect on their ethical significance and ontological status, as well as to provide equipment that contributes to solutions that are more responsive and responsible. To summarize the distinctions made in the early prospectus documents for our undertaking with SynBERC:

1. **Pedagogy**: Pedagogy involves reflective processes by which one becomes capable of flourishing. It is not equivalent to training, whose norm is expert knowledge. Rather, it involves the development of a disposition to learn how one's practices and experiences form or deform one's existence and how the sciences, understood in the broadest terms, enrich or impoverish those dispositions. Pedagogy teaches that flourishing is a lifelong formative and collaborative process.
2. **Events**: A second set of concerns involves events that produce significant change in objects, relations, purposes, and modes of evaluation and action. By definition, these events cannot be adequately characterized until they emerge. Emergence should be distinguished from uncertainty. Uncertainty operates under a mode of verification, i.e., it takes for granted that the future, though uncertain at present, can be anticipated as knowable, following regular patterns. Emergence, by contrast, calls for equipment capable of operating in a mode of **remediation**. It takes for granted that the future, although unknown at present, will have distinctive features that do not depend on the regularities of current configurations.
3. **Problem-space**: Events proper to research, as well as adjacent events, combine to produce significant changes in the parameters of scientific work. These combinations of heterogeneous elements are historically specific and contingent. At the same time, they produce genuine and often pressing demands that must be dealt with, including ethical and anthropological demands.

Mode 3 is oriented to the near future. Situating ourselves among blockages and opportunities, the challenge is to conceptualize them. By so doing, this facilitates giving form to the near future as a series of problems in relationship to which possible solutions become available.

In addition, Mode 3 equipment has the challenge of how best to design and implement interfaces among and between the three modes. This challenge is a daunting one, as older patterns of power inequalities and its associated dispositions continue to remain in place. It is even more daunting if Human Practices attempts to operate (to use two technical terms) according to the metric of flourishing for the purpose of remediation. When synthetic biology is confronted by difficulties (conceptual breakdowns, unfamiliarity,

technical blockages, and the like), ethical practice must be able to render these difficulties in the form of coherent problems that can be reflected on and attended to. That is to say, ethical practice remediates difficulties such that a range of possible solutions become available.

In the 1970s, bio-ethical equipment was designed to protect human subjects of research, understood as autonomous persons. Hence its protocols and principles were limited to establishing and enforcing moral bright lines indicating which areas of scientific research were forbidden. A different orientation, one that follows within a long tradition but seeks to transform it in view of reconstructive and emergent situations, takes ethics to be principally concerned with the care of others, the world, things, and ourselves. Such care is pursued through practices, relationships, and experiences that contribute to and constitute a **flourishing** existence.

Understood most broadly, flourishing ranges over physical and spiritual well-being, courage, dignity, friendship, and justice, although the meaning of each of these terms must be re-worked and re-thought according to contemporary conditions. Such conditions are not constituted by fixed or pre-given forms. If so, they would neither be appropriate to the emergent, nor could they be useful in the work of remediation. Rather, these conditions must be taken up as dynamic and adjustable, calibrated to actual conditions under which the terms of flourishing can be concretely specified. The conditions of flourishing must be specified in a form that is amenable to intervention and amelioration under concrete arrangements.

The question of what constitutes a flourishing existence, and the place of science in that form of life, how it contributes to or disrupts it, must be constantly posed and re-posed. In sum, Human Practices equipment is designed to cultivate forms of care of others, the world, things, and of ourselves in such a way that flourishing becomes the mode and the purpose of bio-scientific, ethical, and anthropological inquiry and practice.

7.6.1 Externalities: The Price to be Paid

There are a number of immediately identifiable externalities that bear on Mode Three. The establishment of clarity about external and internal limits distinguishes warrantable scientific advance from opinion and hype. The identification of such limits allows one to pose the question: when and where is it an effective use of limited resources to undertake Mode Three strategies?

1. Mode Three is allied with, but should be carefully distinguished from the Foucauldian analytic practice of the **History of the Present**.[26] When analysis is undertaken with that goal, its task is to show the lines flowing back from the present into previous assemblages (and elements and lines that preceded those assemblages). Such work functions to make clear the contingency of current expert knowledge, its objects, standards, institutions, and purposes. The goal is not primarily to debunk or de-legitimate such expertise, although a dominant mode of academic criticism habitually does takes the form of denunciation. Rather, the goal is to make clear how such expertise came about, what problem-space it arose within, what type of questions it was designed to answer, how and where it had been successfully deployed, and what blind spots were produced by its very successes. The purpose of analytic work in the History of the Present is not necessarily to replace the specialists and managers that already exist. Above all, it aims to open up current practices to critical scrutiny.
2. The habits of elite scientists as well as the institutions and ethos of bio-ethics orient expectations toward a mode of cooperation, not collaboration.

7.6.2 Critical Limitations: Structural Incapacities

Given these externalities the question needs to be posed: what are the critical limitations of Mode Three? The range of critical limitations of Human Practices is not yet known. However, two limitations can be identified at the outset:

[26] On the History of the Present, see: Michel Foucault, **Discipline and Punish** (New York: Vintage Books, 1977) (original 1975).

1. Mode One and Mode Two are designed to work within and be facilitated by governmental, academic, and other stabilized venues. These are legitimate venues when the equipmental demands consist in the regulation or regularization of a problem-space. Well characterized equipment exists for operating in such non-emergent spaces. Adaptations to emergent fields such as synthetic biology and nanotechnology are underway.
2. There will be a repeated and insistent demand for Mode Three practitioners to: provide expert opinion, propose first-order solutions, represent opinions, invent and implement a venue for expression, and facilitate consensus. Mode Three practitioners acknowledge the validity of such demands for certain problem-spaces, certain actors, and certain venues. Mode Three, however, is designed such that fundamentally it cannot—and should not—honor such requests in so far as it operates on and in emergent problem-spaces. There clearly is a price to be paid for respecting this externality. It is the price to be paid for being patient, consistent, and clear-sighted. This consistency may well add value eventually to Mode Three. Its immediate worth, however, is found in its bringing attention to the need for inquiry.

7.7 Conclusion: Interfaces.

What if, as seems likely given the premises of the strategy of designing and constructing appropriate form, there actually were no experts in emergent domains and problem-spaces? Thus, for example, everyone would have agreed readily that at the time of the SynBERC's founding there were no specialists in the first three Thrusts ("parts" or "devices" or "chasses"), although there were scientists with diverse skills that held potential for such innovation and coordination. Developing venues, modes of practice, technical and other equipment, modes of collaboration, etc., is after all a central goal of the Center. The founding strategy was to identify a challenge, make its significance comprehensible, and pursue strategies for addressing it. There was an excited confidence that with success, others—many others—would follow. A new mode of practice would be launched.

7.7.1 Human Practices: Interface with Mode One

Logically, it follows that, as with Thrusts One- Three, so too, with Thrust Four. Simply cooperating with technical experts and keeping a watchful eye on the scientists seemed and seems to be an insufficient, even an implausible, way to proceed. Indeed, such an approach seemed and seems likely to provide the false assurance of short-term deliverables and the potential for strategic misdirection over the longer term. Consequently, an obvious initial challenge has been to invent venues within which academic experts-at-a-distance, who might otherwise only share a cooperative relation to emergent hybrid assemblages such as SynBERC, are situated in such a way that their existing expertise can be remediated and redeployed in view of new problems. The claim is not that existing experts have nothing to offer. The question to be explored is: what can Human Practices provide that existing experts themselves cannot?

One of the distinctive organizational characteristics of SynBERC was its division into Thrusts; another was its strategy to include "test-beds" from the start. A "test-bed" is a concrete research project designed to function as a proof-of-concept for work in the Thrusts. Originally there were two of these—bacterial foundries, tumor-seeking bacteria—and then a third, biofuels. The Berkeley and MIT Thrust Four leaders agreed that, informally, the MIT group (and its Mode One collaborative approach) would serve, in addition to its other contributions, as a test-bed for the Berkeley group's experiment in inventing a new type of equipment. With this division of labor, it was hoped, a collaborative approach could be developed. The advantage of this strategy was that the Mode One team would produce immediately recognizable deliverables: workshops, conferences, specific recommendations, organizational advice, network connections in the power centers of the East Coast, etc.

It was clear that initially, Mode Three would have no such list of familiar deliverables or modes of delivering them. What Berkeley did have, however, was a keen sense (based on years of anthropological research in the world of biotech and genomics, contemporary reflections on that world, and deep experience in ethical work in the broader political and industrial context) that current modes of practice had built-in

structural limits, and, because of the very way they had emerged and been institutionalized, were unlikely to be flexible and creative enough to collaborate effectively within an organization such as SynBERC. We took as an initial task a rigorous diagnosis of what such change might look like, and the initial steps toward actualizing such change. Of course, no one knew in advance if the scientific test-bed form would produce successful collaboration with the separate thrusts. And after one year, the proverbial verdict is still out.

7.7.2 Human Practices: Interface with Mode Two

If a primary task of Mode Two is to facilitate representation and expression of stakeholders, this work is likely to be relevant at a subsequent stage. As fields such as synthetic biology have barely begun to take shape, to gain funding and attain a visibility arising from their accomplishments as opposed to the positive or negative hype that surrounds such enterprises, it is likely to be the case that the "public" or "society" may well have no opinion whatsoever, and certainly no detailed opinion or well-informed representatives (none exist) at the early stages of emergent disciplines and assemblages.

There are now professionals at organizing public opinion and alerting stakeholders in other assemblages of how they might or should be concerned about developments in related fields. These analogy- professionals' claims to be representing broad numbers of people and civil society interests should be examined with care. That being said, these Mode Two professionals have already established funding mechanisms, relations with journalists, functioning websites, networks with heterogeneous civil society groups, etc. It would seem to be a pressing and legitimate function of Mode Two practitioners to assess, sort, adjudicate, and moderate emerging common places and rhetorical thematics.

If pre-emptive analogizing is both rampant and low on the serious speech act metric, equally futurology is not the answer to emergent things. There are many version of predicting or narrating the future. Among them is forecasting. Forecasting refers to the use of quantitative analysis to identify the future trajectories of current trends. The goal of such forecasting is to anticipate small variations from these trends (e.g., variations in oil prices). Forecasting has two built-in limitations. First, it bases its conclusions on the logical outcomes of only one possible future. Second, this one possible future is thought to be a direct and predictable unfolding of current states; as such, it assumes a much greater similarity between the present and the future than usually proves to be the case. Forecasting as a way of dealing with the future requires assembling technical experts that can quantitatively elaborate extensions of current trends. If the future is contingent and emergent as in zones such as synthetic biology, however, such forecasting has limited value.

Human Practices takes up the question of the near future and its bearing on current practices in a different way: scenario thinking. Scenario thinking identifies a range of logically distinct futures. All of these futures are feasible, and yet each one entails dramatically different implications for current and near future practices and institutional organization. Techniques of scenario thinking help to create a matrix of much more complicated future possibilities than forecasting does. It helps tease out and pull apart assumptions about the relation between the present and the near future. It underscores that what is needed are not better predictions about the unfolding of current trends, but the development of capacities for imagining different futures and exercising real-time changes in practice and organization. This work highlights the ways in which current practices and organizations may or may not adequately prepare us to respond effectively to such different futures.[27]

Scenario thinking involves the identification of critical contingencies about the future that may play a formative role in the shaping of synthetic biology. This approach underscores that the stakes of scientific development cannot be sufficiently known in advance, and that forecasting and prediction by experts is likely to provide false assurance. Critical contingencies can be fleshed out and articulated as variations within specific scenarios. In turn, these alternatives establish a common framework for articulating and working on shared problems.

[27] See Global Business Networks at www.gbn.com (<http://www.gbn.com/>)

7.7.3 Human Practices: Interface with Mode Three

We do not think that what is distinctive and intriguing about developments in synthetic biology is that they are "revolutionary" or even "cutting-edge." These are modernist terms from a prior historical configuration that draws attention to what is "new" and "radically transformative" as the locus of significance. Our interest and attention is drawn to the combination and recombination of elements old and new into a stylized form whose defining diacritic is not its new-ness per se. Rather, in what has been described elsewhere as "the contemporary," as opposed to the modern, what counts as significant are the forms and possibilities that open up once the quest for the new is moderated and back-grounded (although not ignored). Hence, the basic rules of what counts as good science and engineering in synthetic biology are the traditional or standard ones. What objects are taken up and how they are combined and recombined are themselves part of a larger **Gedankenbild** that is part organizational, part conceptual, part technical—and part equipmental. How such an assemblage might be put together, made to function effectively, cope with breakdown and unexpected occurrences, and discern and address emergent problems is both what intrigues us and concerns us.

Additionally, well established modes of engagement are structured by specific metrics. Prominent metrics have included normalization and the protection of dignity. Normalization allows for the regulation and modulation of fields of statistical regularities, such as industrial safety. The metric of dignity facilitates emergency intervention into situations of rights abuse. While recognizing the worth and utility of these metrics, Human Practices is designed to discover if it can function according to a different metric—flourishing.

We were oriented towards a reconstructive effort because various research teams at the ARC had been engaged in intensive inquiry on emergent topic areas such as bio-security and bio-complexity for the preceding two years. For example, we had observed in the latter how a re- thinking of issues had contributed to a shift from bio-diversity as a central approach to a range of environmental concerns, to the emergent field of bio-complexity. While the former approach was based on understanding and preserving species as an inherent good, the latter concentrated more on the types of milieu that would sustain biological complexity to flourish. Hence a certain range of prior expertise, and prior disciplinary suppositions and ethical commitments, taken as settled and desirable, could well slow or even block the understanding and collection of the data required for the conception of sustainability at work in bio-complexity.

A similar example can be given with bio- security. It has become clear through our research that recombinations and reconfigurations of existing expertise is required if a bio-defense system is to be constructed which is adequate to emergent problems. Although previous Cold War experience can constitute a baseline for thinking about bio-security today, we find ourselves in a radically different type of security situation. It follows that in a vastly different array of bio-scientific understandings and technologies, new dispositions among security experts were just as vital as new dispositions and approaches among bio-scientists, and, for that matter, potential aggressors.

As an integral component of the overall enterprise, Human Practices is positioned to take up problems in a way that experts-at-a-distance cannot. For example, problems in industry relations and intellectual property are certainly crucial to how synthetic biology will develop. However, Human Practices does not need to ask the question of what IP platforms exist and how can they be applied. Rather, Human Practices is in a position to pose the question of what kinds of objectives are really at stake in specific projects, how those stakes require rethinking about the interfaces among university labs, government funding, biotech interests, and the like. In this way, the problem of how to leverage existing resources, talents, and technologies in order to advance the aims of synthetic biology can appropriately be posed. Once posed, these problems can be collaboratively worked on. Such collaboration will require existing experts, to be sure. However, the expertise will need to be interfaced with emergent problems in such a way that experts will be required the think forward rather than reproduce existing insights. In sum, our work is oriented toward understanding how potentially viable design strategies emerge, how these strategies might inform synthetic biology, and what efforts are undertaken to integrate them into a comprehensive approach to the near future.

In the early stages of Human Practices development, Mode Three has been faced with three primary challenges, one critical and two productive. The first challenge facing Mode Three is to accept its positionality as adjacent and second-order. Given the positionality of Modes One and Two as consultative and first-order, it is not surprising that even sympathetic observers and participants would put forth the demand for first-

order and advisory deliverables. Consequently, a primary challenge for Mode Three is to develop a toolkit of responses and practices that temper and reformulate such demands.

A second challenge concerns the form of **collaboration**. Given the emergent character of innovations and practices in synthetic biology, the precise forms of collaboration have not and cannot be settled in advance. Rather, such collaborations will require intensive and ongoing reflection with SynBERC PI's on emergent ethical, ontological, and governance problem-spaces within which our work is situated and develops. We have been experimenting with both directed group meetings as well as having undergraduate and graduate students directly engaged within SynBERC labs as their work unfolds.

A third challenge concerns **reconstruction**. We are giving reconstruction in Human Practices a specific technical meaning, similar to that put forward by John Dewey: [28]

> *Reconstruction can be nothing less than the work of developing, of forming, of producing (in the literal sense of that word) the intellectual instrumentalities which will progressively direct inquiry into the deeply and inclusively human—that is to say moral—facts of the present scene and situation.*

What is pertinent in Dewey's formulation is that science and ethics are interfaced and assembled in accordance with the demands of "progressively directed inquiry." Such inquiry is not primarily directed at real or imagined consequences or first-order deliverables, although the work of Modes One and Two on these topics is both relevant in-and-of-itself as well as primary data for reflection. Rather, inquiry is directed at the possibility of the invention and implementation of equipment that facilitates forms of work and life. Whether such facilitation will occur, and whether it is efficacious or beneficial, remains to be seen.

[28] John Dewy, **Reconstruction in Philosophy**, enlarged edition (Boston: Beacon Press, 1957).

Chapter 8

Synthetic Biology 2007. From Manifestos to Ramifying Research Programs[1]

What is synthetic biology? In 2005 this question could not have been answered with any degree of specificity. Rather, for a small group of researchers the question was: What do we want synthetic biology to be? At that point, synthetic biology existed as informally connected visions of how one might make biological engineering robust and standardized. During 2006 and 2007, two major obstacles were cleared for testing whether, and if so how, that imagined discipline could be made operational. First, the stirring, if inchoate, visions for synthetic biology were turned into crisp manifestos: discursively coherent, PowerPoint-friendly, declamations of broad programmatic objectives. The manifestos included a sketch of preliminary design principles conceived to realize the initial steps. Second, in turn, the manifestos were crafted by representatives of a consortium into a grant proposal that led to the funding by the National Science Foundation of a new venue, SynBERC.

As with other NSF research centers, SynBERC included an ethics component, which we renamed human practices. Human Practices is designed to focus on reciprocal interfaces between and among synthetic biology and economic, political, and cultural forces, with attention to questions of security, new organizational forms, ethics and industrial relations. To the extent that its technical goals are achieved, synthetic biology is likely to play a formative role in contemporary human life. As such, following the mandate of the funders and other thoughtful observers, we hold that technical virtuosity per se cannot be the only measure of success in synthetic biology. Rather, integral to the worth and distinctiveness of synthetic biology is the elaboration of a broader framing of how science can be undertaken and organized as a comprehensive Human Practice from the outset.

The goal of Human Practices, according to the original SynBERC strategic plan and grant proposal, is to contribute to the design and construction of synthetic biology within such a framework. The task of Human Practices is to pose and repose the question of the ways in which synthetic biology is contributing—or failing to contribute—to the promised future through its specific research problems in medicine, security, energy, and the environment. But how to make these efforts collaborative remains problematic. What form this critical collaborative role will take, is still unclear and currently the subject of muted contestation.

SynBERC's stated goals are grand, to say the least: to turn biology into a full-fledged engineering discipline usually imagined on the analogy of electrical engineering. During 2007, efforts at SynBERC (and in other allied venues) shifted from writing and disseminating manifestos and grant proposals to facing the challenges of animating research programs. Synthetic biology began confronting the challenge of becoming more than a brand and more than a fundable vision. A major research center was established, as well as strong institutional presences elsewhere. It has become clear that there are diverse, if overlapping, scientific and organizational strategies emerging under the generic label of synthetic biology. Synthetic biology is **ramifying**; to ramify means to produce differentiated trajectories from previous determinations. This

[1] This content is available online at <http://cnx.org/content/m18822/1.1/>.

unmooring from previous determinations produces unexpected effects that "may complicate a situation or make the desired result more difficult to achieve."[2] As synthetic biology shifts from manifestos to research programs, its initial directions, distinctiveness and results can now begin to be specified and characterized.

SynBERC's Berkeley Human Practices Lab—the Rabinow Lab —currently is devoting its efforts to documenting and analyzing these ramifications as they emerge. Our purpose is to make these trajectories available for critical understanding and evaluation—and, we hope, for eventual remediation. In sum, we are taking up the daunting challenge of developing new modes of collaboration between the biosciences and the human sciences. Such collaboration requires the design and implementation of recursive pathways between and among the purposes, venues, and specialists in synthetic biology as well as those who are charged with regulating them. Our initial task has been to specify and characterize the ramifications of various strategies for moving from manifestos to research programs in both the biosciences and the human sciences. In this paper, we provide a diagnosis of the state of play at the end of 2007.

8.1 Recent Past: Genes and Social Consequences

After the completion of the Human Genome Sequencing projects, it became clear to most observers (and many participants) that the nucleotide sequences themselves were neither the "Holy Grail" nor the "Code of Codes" that the proponents of the projects hoped they would be. Nor were these seemingly endless strings of base pairs the key to "playing God" or "Franken- futures," as opponents warned. By the early years of the twenty-first century, whatever work these analogies had originally been designed to do, they had become outmoded and misleading. It is now clear that the sequence information is one of the most important foundational elements—necessary but hardly sufficient— for constructing a contemporary biology.[3] What was missing most conspicuously was a credible scientific program for moving from the hope (and desire) that bio- informatics would provide the technological means to deciphering an ever- increasing quantity of molecular information to a more closely calibrated strategy for laboratory experimentation in the near future. Correlatively, an honest inspection revealed an even bigger gap between the overflow of information and its promised transformation into ameliorative and lucrative applications. Finally, there was an amorphous but haunting awareness that what was required ultimately was a firmer scientific understanding of the material under consideration, an explanatory frame adequate to biological structure and function beyond suggestive statistical correlations and broad generalizations about life.

This over-abundance of data and under-determination of its significance yielded a surfeit of visions cum manifestos. The manifestos were driven by the need to articulate and defend a new mission for the large bureaucracies and their costly technologies and facilities that had been constructed as part of the sequencing projects by a drive to attract venture capitalists; and by a drive to develop and implement research strategies that would be scientifically and financially rewarding, etc. The hectic activity devoted to defining the framing and analogical correlatives of a convincing post-sequencing orientation goes some way to situating the effervescent (and largely evanescent) efforts to brand and promote proteomics, systems biology, gene ontology, synthetic biology, and the like, as the crucial next stage in bringing into existence the hoped-for wonder and bounty of a biologically based future of knowledge, health, and wealth that had been so forcefully articulated and promoted by the proponents of the sequencing projects.

Equally significantly, but with less hoopla, by 2007 the ethics initiatives which had come into existence as part of the sequencing projects—the ELSI (Ethical, Legal, and Social Implications) programs—were also beginning to be critically scrutinized.[4] These programs were constituted according to the terms of a political agreement among the Human Genome Project funders that ELSI would be supported on condition that it operated downstream of the science and technology, and should concern itself primarily with framing **social**

[2] **Encarta** dictionary.

[3] On the Code of Codes, see Daniel Kevles and Leroy Hood, **The Code of Codes**. On one ambitious attempt to move directly from sequence information to diagnostic applications, see Paul Rabinow and Talia Dan Cohen, **A Machine to Make a Future: Biotech Chronicles** (Princeton: Princeton University Press, 2005).

[4] On the genome sequencing projects, the best books are Robert Cook-Deegan, **The Gene Wars: How Science, Politics and the Human Genome Project** (New York: Norton, 1995), and Robert Shreve, **The Genome War, How Craig Venter Tried to Capture the Code of Life and Save the World** (New York: Alfred Knopf, 2004). .

consequences. The demand for re-thinking this approach has come in part from the funders of the thirty-odd centers in nanotechnology and now in synthetic biology, i.e., the U.S. Congress and the National Science Foundation. For synthetic biology, the NSF made the funding of the Center conditional on inclusion of an "ethics" component. Responding to this mandate is our charge: what should that component look like? To their credit, the officers at NSF were frank in admitting that they did not know. Hence a challenge now exists in parallel to the challenge of constituting a program for post-sequencing biology: what form should be given to a biological engineering center that incorporates collaboration as equals with human scientists?

Said another way, if today there is a broad consensus that the genome sequences were not the key to life, only the "end of the beginning" of biology as Sydney Brenner put it, then it follows logically at least that the ELSI programs that were constructed within the political and scientific consensus about the significance of the genome sequencing projects, while continuing to provide useful safeguards and as venues for conducting public conversations, are themselves limited in their scope by their original mandate to operate downstream and outside of the sequencing efforts.[5] Agreeing with Brenner that there is a compelling need for scientists to rethink their understanding of **the gene**, we argue in a parallel fashion that there is an equally if not more compelling need to rethink the cornerstone concept of ELSI—**social consequences**. The need for rethinking what is meant by **social consequences** is actually more compelling because while it is habitual for normal science that outdated concepts will sooner or later be replaced, there is no guarantee whatsoever that a parallel process exists for the human sciences (not to mention media discourse). It follows logically—although many pragmatic obstacles remain in place to making it a reality—that contemporary post-genomic research programs can no longer be constituted as they were in the recent past.[6] And, of course, the challenges of rethinking the gene and rethinking social consequences can no longer be ignored. But how to make this two-fold task collaborative and synergistic remains problematic.

8.1.1 Human Practices: Beyond Social Consequences

At the level of manifesto, a distinctive feature of SynBERC has been its inclusion of a component, which the Rabinow lab at Berkeley has called **Human Practices**. We coined the term so as to avoid the current commonly accepted label, **social consequences**. We began with the working hypothesis that an attempt to develop and implement a Human Practices approach different from ELSI, and the standard policy specialists that it has generated, would encounter conceptual and pragmatic blockages. The reason we anticipated blockages was that we knew we would be operating in an emergent terrain. And we knew that past expectations, practices, and expertise would be only partially applicable. We also knew that there was a deep conservatism in the policy-oriented branches of the human sciences. Careers change slowly and rewards are generally scant for rethinking categories and practices upon which those careers have been fashioned and sustained. We took our mandate to consist in experimentation and eventual implementation of the collaborative design and development of distinctive approaches to bringing the human and biological sciences into a new set of relationships. Consequently, the shift from manifestos to research programs in Human Practices required an orientation stage during which we charted the move from manifestos to research programs in terms of organizational ramifications. Developing the diagnostic and analytic tools necessary for this work laid the groundwork for implementation of a research program in Human Practices as part of a comprehensive program for synthetic biology. Given our working hypothesis, we were cognizant that reflecting on how, where and when organizations and programs did **not** ramify was another, equally interesting, if not always pleasurable aspect of our inquiry and of our practice.

8.2 In Search of Synthetic Biology: Four Research Programs

The great danger of analogy is that a similarity is taken as an identity.

[5] Sydney Brenner, "The end of the beginning", 2000, Science #287, 2173-74.

[6] The pillars that support genomic sequencing models of organizing scientific research as well as the ethics of such research, while deteriorating, are still standing: first, the generation of interest and ample funding based on manifestos and their skillful dissemination; second, the construction of technology and appropriate facilities (including start-up companies); third, scientific advance that can be articulated with the manifestos; eventually, attention (or lip service) to ethical, legal and social consequences.

-Kenneth Burke, Permanence and Change (Indianapolis: Bobbs-Merrill, 1965), p. 97

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From the inception of synthetic biology through 2007, researchers at MIT have provided the framing vision that has been adopted by funders, used as a framing device for scientific journalists, and that orients the way in which many (but not all) researchers discuss synthetic biology. This framing confidently envisions synthetic biology as a nascent engineering discipline predicated on its self-proclaimed ability to produce standardized and interchangeable parts. However, upon closer examination—not surprisingly—what is actually taking place in these research centers and their labs is more complicated. Most of the players in this field agree on the need for (a) rationalized design and construction of new biological parts, devices, and systems as well as (b) the re-design of natural biological systems for specified purposes, and that (c) the versatility of designed biological systems makes them ideally suited to solve challenges in renewable energy, the production of inexpensive drugs, and environmental remediation, as well as providing a catalyst for further growth of biotechnology.

However, what is understood by these goals is quite diverse. In fact, those assorted understandings are currently contributing to different ramifications of synthetic biology. In order to clarify this situation, we distinguish at least four design and composition strategies currently operating under the name of synthetic biology. In the section that follows, we provide a characterization of each these four strategies, first considering their biological research programs. Then, we provide a synopsis of efforts within these programs that fall under the Human Practices rubric. We pay special attention to externalities (those costs expected to be paid by someone else) as well as critical limitations (the—often unacknowledged—range of structural capacities and incapacities) of each research strategy. We should emphasize for the reader that we are once again presenting these strategic orientations as ideal types. Ideal types are analytic devices constructed so as to sharpen differences in order to make emergent trends easier to characterize. Once a diagnostic overview of the objects, methods and purposes has been conducted, then we will be in a position to carry out Human Practices research.[7]

8.2.1 Parts

	Problem	**Analogy**	**Venue**	**Human Practice**	**Externality**
Parts	Standardizing Biological Units	Computer Systems	iGEM	Voluntary Openness	Non-enforceable Venue

Table 8.1

The first and most widely publicized type has been formulated by researchers at MIT, and is exemplified by the BioBricks Foundation (www.biobricks.org[8]). This approach has two goals. The first goal is to transform biology into a fully standardized and abstracted engineering discipline understood in a literal sense on the **analogy** of electrical and computer engineering. The second goal, in line with the first, is to reduce biological systems to modular and additive parts, which can be combined in a linear fashion to form more complex functional units.[9] Such standardized biological parts are the principle objects of interest and investment. The success of this approach depends on the ability to black box the evolutionary contingency

[7] Max Weber, "Objectivity in social sciences and social policy," in **The Methodology of the Social Sciences**, trans. Edward Shils and Henry Finch (New York: The Free Press, 1949).

[8] http://www.biobricks.org/

[9] As MIT's part's registry puts it, as an: "Assembly of parts into devices and systems is being performed using traditional cloning techniques with a set of restriction sites that allow easy composition of composite devices that, in turn, can themselves be used as parts. Simultaneous parallel assembly lets us build many biological systems quickly." www.parts.mit.edu (<http://www.parts.mit.edu/>)

and non-linear dynamics of underlying biology, just as, or so the analogy runs, the development of computer software succeeded in black boxing micro-physics.

The responsibility for designing the parts-based approach—and publicizing it—has been taken up by engineers (electrical and civil) at MIT, especially Tom Knight and Drew Endy. A unique contribution of their "Legos" approach has been the development of the "BioBricks" standard as well as the registry of standardized parts (http://parts.mit.edu[10]). The principle venue for the expansion of this approach is MIT's annual International Genetically Engineered Machines (iGEM) competition (http://parts.mit.edu/igem0 7/index.php/Main_Page[11]) ; iGEM brings together a growing international set of undergraduate research teams whose projects, in order to qualify, must meet the BioBricks design standardization criteria and, to qualify for awards, whose parts must be deposited in the BioBricks registry. The iGEM competition constitutes, for the BioBricks approach to design and composition challenges, the central vehicle of expansion and legitimation for establishing itself as the norm for synthetic biology.

The manifestos of the BioBricks approach imagine and plot a comprehensive remaking of the biological sciences. Moving from the scale and scope of their guiding vision to more mundane experimental results has encountered research obstacles. Not only are biological processes more difficult to black box in the lab than in discourse, but the original and innovative venue lacks the power to enforce its standards. It seems clear that an adequately financed "parts fab" will be required if the BioBricks approach is to be fully vetted and its range of applicability tested. Such a parts fab would be a stable, industrial scale organization with a clear mandate to produce standardized parts. It would presumably be staffed predominantly with technicians, not undergraduates or post-docs.

8.2.1.1 Voluntary Openness

The BioBricks vision and its manifestos has been the most comprehensive and inclusive of Human Practices considerations. It explicitly recognizes the need for innovative rethinking of Intellectual Property issues, security concerns, organizational form, and ethics. This vision turns on the idea that in order for synthetic biology to be successfully realized an ethos of openness and collaboration must be fostered from the outset, and venues created for its implementation.

A primary **externality** of the parts approach is that there is no enforcement mechanism connected to the ethos it proposes as the guiding feature of synthetic biology's vision. In the initial stages, the expansion of practices of openness and sharing has been dependent on the good will of participants; insufficient attention has been paid to the pragmatics of organizational enforcement.

One key critical limitation of the BioBricks approach is its own tacit resistance to establishing a venue in which Human Practices participants can play a collaborative and productive role as equal partners. Perhaps a more intransigent obstacle to realizing the Human Practices ethos of openness is the fact that many of the major players are currently invested in pursuing other IP commitments.

8.2.2 Pathways

	Problem	**Analogy**	**Venue**	**Human Practice**	**Externality**
Pathways	Designing Synthetic Pathways	Microbial Chemical Factories	Agile Assemblage	Cooperative Specialists	Non-recursive Pathways

Table 8.2

The first completed project that showed that synthetic biology could be a robust and effective approach is the Keasling lab's (http://keaslinglab.lbl.gov[12]) design of microbial pathways for the production of an

[10] http://parts.mit.edu/
[11] http://parts.mit.edu/igem07/index.php/Main_Page
[12] http://keaslinglab.lbl.gov/

anti-malaria molecule, artemesinin. Although the Keasling lab is committed publicly to supporting the parts-based approach to synthetic biology, the artemesinin research program was constituted on a different analogical basis. If the analogical basis of the BioBricks approach is computer engineering, and the objects it seeks to construct are standard biological parts, the analogical basis of the Keasling lab's approach is industrial chemistry transferred into the cell (i.e., "microbial chemical factories"), and the core objects, on which it focuses its attention and its resources, and around which it has constructed its facility, are enzymatic pathways.

A distinctive aspect of the Keasling approach is its venue. The artemesinin project, like Keasling's next project on biofuels, is set within an institutional framework that allows research to be directly ramified into practical solutions to real-world problems. The artemesinin project was organized as a collaborative endeavor by specialists from the Keasling lab at UC Berkeley, the Bill and Melinda Gates Foundation, One World Health, and Amyris Biotechnology. This approach not only enabled the design and development of new microbial pathways in yeast (and **e. coli**), but required that essential connections be fashioned from the outset among and between strategic partners. As a result, this endeavor set a precedent for the organization of synthetic biology as a collaborator in a multi-institutional approach to addressing some of the most pressing real-world problems. This same approach is now being applied to biofuels at the Keasling-directed Joint Bio-Energy Institute (http://jbei.lbl.gov[13]).

A defining characteristic of a pathways-based approach is the study of evolutionary processes so that dynamics such as fitness and variation can be leveraged as part of the design toolkit. Rather than black boxing biological complexity, evolutionary processes, and variation, this approach embraces them in order to produce specified molecular compounds in an efficient and scalable manner.

If the power of this approach is its problem- driven focus on pathways, this is also its limitation. The production of enzymes and the reconstruction of pathway dynamics are only one set of processes to be learned from evolution. Although this approach has proven successful in producing high-value compounds such as artemesinin, at present it is not formulating a research program that squarely addresses the challenges of constructing yet more complex devices and systems. This remark is not a criticism, only an observation as to the form of the Keasling orientation.

8.2.2.1 Cooperative Specialists

Currently, the Human Practices dimension of the pathways approach recognizes the need to engage specialists for managing financial and regulatory matters as well as the work of developing deliverables. The strength of Keasling's venue is that it considers and accounts for this need by building pathways between the lab and other institutions from the outset, such that once the scientific milestones have been reached an apparatus is in place for the translation of the designed pathways into effective solutions.

This arrangement, however, implies an **externality**. It assumes a cooperative division of labor in which its scientific work assumes a linear and unidirectional relation to the rest of the pathway. The other research departments of Keasling's venues have been designed such that developments in any one area of research can rapidly be accounted for and adjusted to in the other areas of research. Unlike these biological research and engineering departments, those specialists tasked with managing Human Practices issues are downstream and external to the biological research. The price to be paid for such an externality is that while the strength of Keasling's cooperative approach is the anticipation of how to move from the lab to deliverables, its weakness is that if these pathways prove inadequate there is no available internal mechanism for adjustment. This agile assemblage remains agile only under certain circumstances.

The success of the artemesinin project covers over the fact that these venues are not as flexible and agile as the actors believe them to be. As such, what is taken to be an acceptable externality in one case—i.e., a cooperative pathway—is structurally assumed to be sufficient in other cases. A key Human Practices **critical limitation** of the cooperatively constructed pathways approach is that it is not collaborative. By this we mean that if the original division of problem areas and specialties proves to be insufficiently agile or flexible, there is no internal mechanism to rethink and implement rapid adjustments. This arrangement

[13] http://jbei.lbl.gov/

is likely to prove troublesome in areas where the scientific product, the regulatory challenges, the financing, the mode and ramifications of applications, and their interconnections are not known in advance. For example, artemesinin was identified from the start as the malaria molecule of choice, the appropriate funding was noncommercial, and a non-governmental agency (experienced in bio- tech-based health care delivery in developing countries) was available. Had any part of this pathway not been already in place, more Human Practices input would have been required. By contrast, in an area such a biofuels, where none of the components of the proposed pathways are already in place, and where the contours of the field of ramifications is largely unknown, the smoothness of the previous operations is unlikely to be replicated. In sum, a cooperative state of affairs, taken as sufficient for all cases, becomes a critical limitation and not only an externality.

8.2.3 Genomes

	Problem	**Analogy**	**Venue**	**Human Practice**	**Externality**
Genomes	Designed Genomic Platforms	Cloning	Lab Fab (building prototypes)	Safety-By Design	Technological Reductionism

Table 8.3

Another type of research program focuses on the design and construction of "minimal cells." This self-description, however, is somewhat misleading. Actually, the privileged objects of study and intervention in these programs are **synthetic genomes**, which are designed, modified, reconstructed, and synthesized. The analogical basis of these programs is **cloning**. The goal is to fashion synthetic genomes so that they can be inserted into and function within existing cellular hosts. The purpose is to leverage cell functions, including mechanisms of self- reproduction and the capacity for adaptation. This whole-genome approach to synthetic biology is predicated on the assumption that existing cellular machinery will function as a predictable and (ultimately) non-problematic biological chassis for these designed genomes. A common feature of these approaches is the claim that enough is known (or will be known) about evolutionary processes and genomic biology to proceed with the construction of synthetic genomes designed for specified functions. It is anticipated that genomes would be versatile as a refactoring machine for synthetic biology.

Two examples of labs using this strategy are those of George Church at Harvard Medical School (http://arep.med.harvard.edu/[14]) and the J. Craig Venter Institute (http://www.jcvi.org/[15]). Church, a PI in SynBERC, is directing a project to design and construct a minimal genome "capable of replication and evolution, fed only by small molecule nutrients."[16] Given what has been learned from the genome sequencing projects and from the study of directed evolution, the Church lab is attempting to build a minimal genome that can function as a safe and controllable chassis. Church's minimal genome offers at least two immediate benefits to synthetic biology. First, it demonstrates a strategy for minimizing the scale of complexity in engineering design. Second, from the outset, it is attentive to issues of safety; it has built-in internal control mechanisms based on new nucleotides (that don't exist naturally) that the lab has designed specifically for this purpose.

The J. Craig Venter Institute has set as its goal the construction of artificial genomes that serve as multi-flexed platforms capable of receiving (and continuing to function with) a series of specific molecular inserts—genetic "cassettes" carrying designed functions. The goal, one might say, is to build a prototype organic robot.

[14] http://arep.med.harvard.edu/

[15] http://www.jcvi.org/

[16] From "Towards synthesis of a minimal cell." Molecular Systems Biology 2 Article number: 45 doi:10.1038/msb4100090v. Published online: 22 August 2006 Citation: Molecular Systems Biology 2:45

The Venter Institute has devoted time and resources to charting a wide range of variation and diversity existing in the wild. It has demonstrated that there is an existing dynamic exchange of molecular material in evolutionary regulated milieus. The documentation of these processes is normative in its use of such milieus to argue that a type of genomic experimentation is a naturally occurring phenomenon going on in the wild with salutary evolutionary consequences.[17] The Venter design and research strategy—as well as its manifestos—is at the opposite pole of BioBricks within synthetic biology's current field of options. Instead of black-boxing biological processes, Venter's Institute approaches evolutionary resources as a vast lab within which a nearly infinite number of experiments past and present provide invaluable lessons of what nature has allowed is taking place.[18]

8.2.3.1 Safety-by-Design

Those currently working on the design of synthetic and artificial genomes devote attention and resources to issues of safety and security, and what they take to be attendant social consequences. Their strategy for addressing these Human Practices concerns can be called "safety-by-design."[19] There is an explicit effort to design genomes in such a manner so as to exert maximum control over their functionality. Design attention is devoted to minimizing the risk of survival or re-programmability outside of the lab. Safety-by-design's purpose is the fabricate genomes so that, when circulated, their effects, both negative and positive, can be accounted for and prepared for in advance.

The key **externality** of this approach is that it can only address those aspects of the security challenge that are amenable to technological safeguards. Security issues are framed as a problem of dual-use in which the principle challenge arises from the threat of "bad" actors "misusing" technologies created for benevolent purposes. This framing is taken to call for a technological response by existing specialists: can a biological chassis be designed in such a way that it cannot be subsequently "misused"? Other significant aspects of biosecurity, such as challenges associated with the current political milieu or preparation for unexpected events, which are not amenable to safety-by-design, are externalized.

To the extent that this externality is taken to be generally sufficient, it becomes a **critical limitation**. That is to say, safety-by-design becomes a critical limitation when it is held that the salient security challenges can be mitigated adequately through technical means, police procedures among and between labs, and trust in the expertise and character of current specialists. Once this externality becomes a critical limitation, there are no other Human Practices resources within this venue readily available for responding to other unexpected and unpredicted ramifications.

Safety-by-design is an attempt to extend self- governance models developed by the 1974 Asilomar conference and its successors. However, the success in managing "experiments of concern" depends on the kinds of venues developed in the 1970s, 80s and 90s. The scientific, industrial, and political milieus today are strikingly different. Given the Internet and the globalization of science, access to materials and specialized knowledge is widespread. As such, the technical safeguards being developed by those designing genomes can only have limited efficacy. To the extent that these technical procedures give the illusion that security issues amount to the management of "experiments of concern," they themselves function misleadingly as "experiments of reassurance," to coin a phrase. We hold that taking such experiments of reassurance as sufficient, explicitly or otherwise, constitutes the significant critical limitation of a safety-by-design approach.

[17] Craig Venter, A Life Decoded (New York: Viking, 2007), 356.

[18] Existing structures and processes can be either directly taken up or refashioned. Like Keasling, Venter wants to use organisms to produce specific molecules of interest. It is a step beyond redesigning pathways— redesigning genomes is an attempt to control all of the coding and reproduction operation.

[19] The expression comes from Chris Kelty and Elise McCarthy in their unpublished working paper, "Responsibility in Nanotechnology (1)."

8.2.4 Systems

	Problem	Analogy	Venue	Human Practice	Externality
continued on next page					

Systems	Regularizing Biological Cybernetics	Heuristic use	Traditional	Moral Contract	Insufficient Attention to New Forms

Table 8.4

The fourth type of approach in synthetic biology takes as its targeted object neither parts, pathways, nor genomes. Rather, the object of scientific and technological interest is a biological system (often multicellular) understood in an evolutionary milieu. The aim of synthetic biology is not only to produce intracellular functions, but includes the goal of intervention in and redesign of multi-cellular systems as well. Its goal is to discover the extent to which abstraction and standardization of bioengineering is feasible at the systems level. New design and composition techniques as well as collaborative strategies are required to pose the question of standardization and abstraction in a manner that will allow them to be approached experimentally.

This approach proceeds by explicitly taking into account the critical limitations of the analogies at work in the other approaches. It acknowledges the heuristic value of analogies from other engineering domains for the provisional orientation and initial design. However, it understands that the use of analogies can be misleading. It follows that, at the level of specifying design parameters, some attention must be paid to the limits of dominant analogies in synthetic biology (computer engineering, microbial chemical factories, cloning) and the extent to which they apply to biological systems.

The Ron Weiss lab at Princeton University (http://www.princeton.edu/∼rweiss/[20]) is the prime example of the systems approach in synthetic biology. The Weiss lab's strategy takes up familiar engineering goals such as standardization, decoupling, abstraction, predictability, and reliability. The problem the lab poses is: given the seeming complexity and idiosyncrasy of cellular context, the challenge is to account for and abstract from the distinctive characteristics of living systems and to formulate principles of design accordingly. By contrast to the other approaches, the notion of cellular context is made an explicit part of the design strategy from the start, and strategically factored in to such challenges as the "the functional definition of devices and modules" and the "rational redesign and directed evolution for system optimization." The purpose of such contextual considerations is to make biological engineering modular and predictable at the level of cell populations as well as individual cells.[21] Weiss's lab is distinctive in that it is oriented so as to pose and answer questions of the limits of standardization, while at the same time designing specified research projects that are addressed to real-world problems and applications that contribute to their solution.

8.2.4.1 Moral Contract

Although there are no explicit statements in the manifestos, personal communications and closer examinations of scientific articles reveal an underlying ethical substrate in which developments in science and significant medical issues are combined in commitment to the common good. The funding of a series of their research projects reveals a connection and a commitment to medical issues. For example, a project funded by the Cystic Fibrosis Foundation explores signaling systems in bacterial populations so as to design biological interventions that would down-regulate the production of microbial biofilm, a source of great distress for CF patients.

The Weiss lab approach to issues of Human Practices is in the line of the alliance between patient groups and genome sequencing that was prominent in the 1990s. This alliance consists of patient groups providing funding for research projects that, while not being immediately therapeutic or instrumental, hold a plausible promise of identifying and characterizing the underlying biological conditions within which pathologies develop. Moral commitments are addressed in the form of contractual arrangements wherein research results are made available to more clinically oriented specialists in return for funding.[22]

[20] http://www.princeton.edu/∼rweiss/

[21] Andrianantoandro, Basu, Karig, and Weiss. "Synthetic biology: new engineering rules for an emerging discipline," **Nature Molecular Systems Biology**, 2006, Volume 2, pp E1 – E14.

[22] Paul Rabinow, **French DNA: Trouble in Purgatory** (Chicago: Chicago University Press, 1999).

An **externality** of this moral-contract approach to Human Practices is that when there are fundamental shifts or blockages, or for that matter successes, there is frequently no built- in capacity for adjustment between the contractual parties. Consequently, the arrangement either dissolves or must be renegotiated. The researcher in this arrangement is bound by the problems and interests of the patient organization; if his or her own research ramifies in other directions, other sources of funding must be found.

A **critical limitation** of this approach is the tacit assertion that paying the price of externalities frees the research program from having to build collaborative venues within which Human Practices can function as an integral element of research design and priorities. The moral-contract frame for Human Practices concerns runs into the critical limitation of presuming that these concerns can be sufficiently accounted for through externalities. There are parallels to this critical limitation in the recent past: the sequencing projects positioned Human Practices downstream and outside of the design of their own research programs; the parts-based approaches have included Human Practices at the discursive level, but have not involved them in the shift to research programs; the pathways approach has designed and implemented interfaces with Human Practices specialists, but this is cooperative and non-recursive; and synthetic genomic design approaches seek to convert all security problems to technical problems as a way of retaining autonomy.

8.3 Human Practices: The State of Play

What is at stake in these shifts from manifestos to research programs? What is the best way to understand them? And how is this shift taking place in Human Practices? One thing is clear analytically: to characterize the stakes or the process involved as engineering and its **social consequences** is rhetorically misleading and conceptually inadequate. There are several reasons for making this claim. First, none of these programs or Centers was funded by the U.S. government in order to engage in the untrammeled pursuit of knowledge. As with the Human Genome Project, they were established to keep sectors of the US economy and its scientific and technological base at the forefront of an ever more competitive global playing field. That playing field includes concerns with health, environment, and security. All the manifestos and all the grant proposals underscore and justify themselves, at least in part, on this ground. In that sense, what is loosely referred to as the society is an unexamined presupposition, not a consequence. Second, all of the NSF-funded Centers have a mandate to achieve financial independence after ten years, and all are obliged and pressured to establish relationships with industrial partners as soon as possible. In sum, the idea that a practical discipline like engineering, supported for economic and political reasons, is somehow separate from **social consequences** is misleading.

Of course, many other things will follow from scientific developments: discoveries, blockages, power struggles, patents, career moves, etc. Some of these will be planned, others not, some predictable, others not, some desirable, others less so. All of this will depend in large part on the degree of success or failure to achieve results, to meet milestones, to raise money, etc. It is more rigorous to analyze this situation not simply as the cause-and-effect **consequences** of the production of truth claims in engineering disciplines, but as **ramifications** to be analyzed and refashioned. Upon reflection, it is obvious that the very same scientific or technological results could be taken up and mobilized in many different directions. Thus, the **object** of Human Practices research is ramifications not consequences; its **method** is observational and analytic; its **mode** is collaborative.

The difference between a **social consequences** approach and a Human Practices **ramifications** approach can be highlighted by a non- exhaustive list of the factors involved in the creation of Amyris Biotechnologies in Emeryville, California. Although Jay Keasling is one of the founders of the company, Amyris is not a **social consequence** of Keasling's work at Berkeley. Rather, it is a **ramification** of the Keasling lab's overall research agenda, of the need for increased funding to accelerate promising work in a competitive environment, of the mandated obligation in American universities to commercialize their research, of the quest for novel solutions to real-world problems, of the desire to prosper beyond the lifestyle provided by a university salary, of the rewards and incentives of creating jobs, of the taxes generated, of the need to experiment with new hybrid alliances of industry-philanthropy- university partners, of the drive to open new markets, of the pursuit of venture-capital funding, of the need to patent products of these hybrid alliances

in innovative ways, of the response to growing concerns about the deteriorating state of the environment, health and security...and the like! Each one of these vectors pre-existed any specific research agenda, forms assemblages with the other vectors in distinctive ways, and will partially inflect the fate of the enterprise. This claim does not mean that the production of enzymes through designed divergent evolution is the same as patent contests, only that they both operate within close proximity to each other and are co-dependent. The patent policy is no more the **social consequence** of the drive to engineer enzymes to break down cellulose than that drive is the **social consequence** of the current structure of the American university. Rather, they form dynamic, sometimes predictable, sometimes turbulent, and at times emergent, configurations. In sum, the objects that concern us can ramify in different directions depending on events, capacities, obstacles and interventions. Or the lack of intervention, for, as Niklas Luhmann has taught us, in a situation of contingency—and that is unquestionably the situation of synthetic biology in 2007—non-action is also an action.

8.3.1 Observations: Initial Ramifications

We note that during the first year or so of SynBERC's operations, there have been instances where we have observed the thwarting, tacit or explicit, of potential branching effects, which seemed to be moving in promising directions. An initial task, therefore, was to document and analyze those blockages. We identify three areas of blockage that have been pertinent to synthetic biology's development: (a) intellectual property and open source, (b) security and safety, and (c) moralistic and ethics.

One domain that aroused and sustained interest among the researchers is **intellectual property**, especially patenting. From the outset, the BioBricks Foundation has spearheaded the discussions of creative approaches to open-source strategies. Starting with the analogy of patent issues in software, and drawing directly on the Open Source Initiative templates, BioBricks has held forums on the topic of intellectual property, issued general guidelines and statements of principle, and continues to animate discussion and debate over the more technical standards and norms that are appropriate and productive for the specific concerns of synthetic biology.

We note, however, that the impact of these discourses on actual patenting practices within the larger synthetic biology community, and even within SynBERC, has been limited. There are a number of reasons for this disjunction between arousal and performance. For example, previous contractual arrangements by the Keasling lab's artemesinin project with its partners, the Bill and Melinda Gates Foundation, and the NGO One World Health, constrain the partners from making their discoveries (including parts) available to others under an open-source agreement. Other researchers have made arrangements with a growing list of biotech companies that limit their participation in an open-source arrangement. Many of the younger researchers expressed an interest in following this direction. In sum, while a discourse of open-sourcing of parts holds a certain normative sway for at least one faction of SynBERC, so far its pragmatic bite has been minimal.

Another key area in which discussion has taken place during the manifesto stage of synthetic biology is **security**. This topic has been given a place of prominence by the National Science Foundation. Although one of the visionaries of synthetic biology, Drew Endy, has worked long, hard and responsibly to put issues of biosecurity on the collective agenda, there has been only a minimal and rather grudging response (again, mainly discursive) to his efforts from within the community. Many of the researchers we have talked to, while acknowledging that the topic is considered significant in Washington and in the media, do not themselves place security issues high on their own personal agenda. They seem to feel that someone else should take care of it, propose regulations and safeguards, and they will simply comply with them. Just as bioscientists (and others) have learned to accommodate safety procedures (especially rigorously regulated at the National Labs) as necessary, if minor, annoyances, so, too, our experience has been that members of SynBERC are willing to follow whatever directives might be forthcoming but do not themselves take a proactive stance towards developing such policy. We observe that as with the series of reports on bio-security sponsored by the Sloan Foundation, the sentiments of concern expressed are sincere, the actual recommendations are limited in scope, albeit laudable first steps.

Within SynBERC the most overt attention to **safety** issues has been given by the Church lab in its

work on safety-by-design (the design of chasses that would either be unable to survive in the wild or are designed with multiple, fail-safe mechanisms). The strategic orientation of this approach follows in a direct line with that of the Asilomar conference.[23] The Asilomar strategy can be summarized as follows: accept the need for public reassurance; establish laboratory safety as the defining characteristic required for such reassurance; strive to achieve autonomy from regulation of an onerous sort through the performance of responsible laboratory procedures and safeguards; equate those safety procedures with security compliance. This strategy has been successful over three decades.

We observe, however, that there is room for doubt as to whether what we call these experiments of reassurance—to juxtapose them to the national security focus on "experiments of concern"—actually do provide general safety and security technologies that extend beyond the specific parameters of each individual lab's experimental system. Finally, nothing in this strategy directly addresses in a pragmatic manner the broader issues of the emergent national security environment in the United States and its potential to ramify in directions that synthetic biologists and others would find extremely constraining. The most obvious lacuna is the issue of preparedness: scenario enactments for the aftermath of either an accident or an act of terrorism. The ramifications of such an event would depend on its timing, nature, and effects, but no one can doubt that the ramifications would be significant and enduring.

Initially surprising, but less so upon reflection, has been the tacit acceptance and even an overt demand by researchers and others within SynBERC that Human Practices operate in the ELSI **mode**. There is willingness, even an eagerness, among some researchers to discuss, from time to time, "ethics." By this term, they mean the type of questions and answers, as well as the way in which they were posed and responded to, that were developed in ELSI: "Are we violating nature?"; "Are we being responsible?"; "Are we contributing to progress?"; and today: "What would a terrorist think about?" The researchers understand these topics in a broadly moralistic frame: "Is science good or bad?" Were they to take them up as ethical issues, they would have to consider changes in their own practices and habits. This they are reluctant to do; and there are no career or institutional rewards for doing so. Thornier and more intrusive matters such as Human Subjects requirements and IRB constraints have not yet been an issue since synthetic biology has not advanced to a stage where it would have to accommodate these regulations and bureaucracies.

This informal, consultative and communication- oriented mode of interface among researchers and ethicists took shape during the reign of ELSI even if it was not a formal part of its program. The researchers do their work in their university and commercial laboratories (and in consultation with their technology transfer officers, patent lawyers, venture capitalist associates, etc) and then they convene for conversations at lunch (pizza is often the **plat du jour**) to have a discussion about issues of broad concern and general interest. Not surprisingly, the mood in such a venue is positive: no one is required to attend; no decisions are made; there is no production schedule; there is no accountability; the policy- oriented professors who convene such get-togethers have neither the power nor the authority to make anyone do anything; the discourse of freedom and autonomy of responsible actors discursively produces self-satisfaction—one feels serious and well-rounded discussing matters of concern. As they say in New Jersey: "What's not to like?"

8.3.2 Diagnosis: Incapacity by Design

We argue that these areas of blockage indicate scientific and ethical inadequacy. For the situation and its dynamics to be otherwise, however, power relations and institutional practices would have to be altered in a significant fashion so as to be genuinely open to contestation, collaboration and rethinking. In order for SynBERC to live up to its manifestos and its mandates, there would have to be a program of research and collaboration that took these considerations seriously and was willing to change practices, habits, dispositions, and career patterns. Today, although is not unimaginable that such changes could begin to be implemented, it is far from the actual state of affairs. It is no surprise that Human Practices interventions that would require more difficult thinking and action are less welcomed and less easily accommodated. We identify two reasons why, to date, SynBERC has not been able to integrate its Human Practices' mandate into its

[23] See Paul Berg, "Asilomar and DNA" at Nobleprize.org. http ://nobelprize.org/nobel_prizes/chemistry/articles/berg/index.html (<http://nobelprize.org/nobel_prizes/chemistry/articles/berg/index.html>)

research programs. There are fundamentally two reasons for this state of affairs: (a) **trained incapacity** and (b) **current power relations**.

Current practices among the Principle Investigators of synthetic biology reinforce the ELSI mode of defining and addressing issues as **social consequences**. They position Human Practices as downstream and external to their research, as capable of contributing in a soft advisory mode, or as an extracurricular, enrichment-for- the-soul get-together. Surprisingly, this positioning has come not only from the bioscientists, but has been taken for granted by non-Berkeley human scientists. What seems to be operating is not bad faith or ill-will. Rather it seems to be an instance of what the great, iconoclastic social thinker Thorsten Veblen called "trained incapacity."[24] By this telling phrase, Veblen means simply that those trained in one set of capacities developed for one set of circumstances, and who having been using those capacities over long periods of time, are as a type unlikely to be able to remediate their skill set to accommodate new situations with new problems.

In the case of synthetic biology, such trained incapacity encourages participants to suppose that while the biological challenges of post-genomics require new thinking, new technologies, new forms of organization and interfacing among labs, and the like, work in ethics and the human sciences can be conducted using prior modes, prior questions, and be governed by prior power relations. When trained incapacity is coupled with active disinterest, there is unlikely to be innovation or remediation.

In the recent past, when forceful proposals for structural change that would have constrained the actions of the principles within SynBERC have been put forth, they have occasioned vehement disagreement— in and of itself a healthy reaction in a young organization. These disagreements, however, did not result in a rethinking of organizational form or in any refashioning of interfaces. Rather, they resulted in an exercise of sovereign power that substituted itself for the procedures, practices and ethics of a more representative constitutionalism. Anthropologically, we have observed that sharp exchanges over research issues in the biosciences are a part of the mode in which research as well as business is conducted. When disputes arise from within the Human Practices side of the organization, however, such productive exchange is stymied and even actively resisted. Given the fundamental inequality of the power relations within the organization, intervention by Human Practices has not been well-received. In such instances it has been brought to the attention of the Human Practices participants that they have not fully grasped which part of the discourse of collaboration is for official consumption and which part is off-limits to those not within the higher reaches, to use an analogy, of court society, with its ranked nobles and its sovereign.[25]

That being said, there were ramifications of an initial confrontation that remain worthy of attention. One significant event that took place in the weeks preceding Synthetic Biology 2.0 (the annual international conference on synthetic biology) is worthy of note. The final day of that conference was to be given to a discussion of security and synthetic biology. A pressing issue confronting the organizers was how to formally constitute the community of synthetic biology researchers so as to institute procedures of self-governance. The immediate reason for attempting this constitutional apparatus was to establish policies for monitoring and regulating purchases of oligonucleotide sequences. Central players in the formation of synthetic biology balked. Extended and vehement behind-the-scenes discussion resulted in the proposal being withdrawn from the agenda. Rather than constituting procedures of self-governance, a proposal was substituted to have the Sloan Foundation fund a study as to how best regulate the emergent synthesis industry, which, all parties agree, with its vastly increased technological capacity to provide longer and longer base pair sequences, constitutes the basic steppingstone to the wholesale construction and distribution of parts.

The Sloan Report responsibly lays out the issues in detail and does provide a valuable baseline for discussion. However, such issues as how to think about transnational governance, presumably one of the most important issues for those concerned with controlling the dual-use potential of synthetic biology, were not seriously addressed. Issues of preparedness were sidestepped as well. In sum, the mode chosen for the governance questions was to outline a (preliminary) technical response, articulated by a hand-picked group of experts, vetted by a very small group of actors. This mode of decision-making and of community governance is consistent with the drive to autonomy, minimal regulation, and translation of all concerns into technical

[24] See, Kenneth Burke, **Permanence and Change: An Anatomy of Purpose**, 3rd ed. (Berkeley: UC Press, 1984), p. 7.
[25] Norbert Elias, **The Court Society** (Oxford: Basil Blackwell, 1983) (original 1969).

questions developed at Asilomar. This mode of decision-making and governance has proved to be quite robust since, it should be noted, it has survived the arrival of the Internet as well as the rise of the biotech industry.

Another result of the sovereigntist intervention was to summarily oust the person who had occupied the "ethics" and "policy" position in the original constitution of SynBERC and to replace him with an anthropologist at Berkeley and a political scientist at MIT. That decision was made with minimal consultation; at the time it seemed to be a plausible choice both because SynBERC itself was bi-coastal and because the political scientist was primarily interested in policy issues and the anthropologist in inquiry and critical reflection. Although this choice seemed logical and complementary at the time, the decision has ramified in directions that perhaps could have been better directed had the SynBERC directors taken seriously the difficulty and importance of the task of inventing a form of Human Practices adequate to synthetic biology.

8.4 Conclusion: Year One—From Manifestos to Research Programs

Synthetic biology might continue to develop in a mode of trained incapacities, comfortable cooperation, decidedly unequal power relations between the biological and human sciences, and its focus on social consequences, which, by definition, remain external to the biological research per se. There is little question that such a direction is the one that the majority of the biological researchers involved, to the extent they have any position at all on these issues, are comfortable with. There is also little question that one wing of the Human Practices thrust has adopted this approach as well.

The critical limitations of such trained capacities and incapacities, however, are evident in their general outline, if not their specifics. First, the opportunity to develop an innovative and responsible post- genomic form will be blocked. Second, should things ramify into domains replete with dangers (known and unknown), there will be no internal mode of operation that would be capable of turning those dangers into risks that might be assessed in such a way as to manage them in an optimal manner. Third, given this situation, should security events take place, preparedness actions will come from governmental authorities whose power far and away trumps the minor sovereigns of the biosciences. Fourth, there is a distinct likelihood that a Monsanto-like event and reaction will take place, in which the framing of synthetic biology—first, discursively and later, regulatorily—will be given over to external critics.

The manifesto stage is relatively enjoyable. The trained capacity/incapacity of filling in the boxes in an already existing spreadsheet is painless, if time-consuming, and apparently some find it rewarding and are routinely rewarded for their diligence. It is true that facing up to the fact that manifestos are not research programs does slow things down, but it equally demonstrates seriousness, diligence and discipline. **Observing and analyzing** the motion of ramifying pathways and forms in something approaching real time is a conceptual challenge, with its own pleasures. Currently, however, how to address the challenge of inventing a form to collaborate in **inflecting** ramifications, in something like real time, within a situation of indeterminate pathways and unequal power relations, is an unknown. Solving unknowns in such a venue requires thinking as well as the capacity to intervene. By the end of 2007, we have made real progress on the former and have been blocked on the latter. As of now, the biosciences are moving into post-genomic territory accompanied by a set of human scientific correlative categories, practices and (in)capacities from a prior genomic formation.

Chapter 9

Lessons Learned 2008. Discordancy[1]

An unsuccessful experiment is not a failed experiment. An unsuccessful experiment can be considered worthwhile for several reasons. It might demonstrate that the whole experiment was misconceived; there was no real **problem** to which the experiment could provide answers or clarifications. It might demonstrate that the experiment was crude in its initial formulation and needed to be refined so as to become fruitful. It might demonstrate that the nature of the **objects** (and their component **elements**) under consideration were incommensurate with the larger goals of understanding that the experiment was designed to explore in the first place. It might demonstrate that aspects of the experiment needed to be modified so as to **perform** it better. In the latter case, if one can identify the elements that functioned as expected and those that did not, then one would have made scientific progress. And one would then be in a position to recast the experiment in more precise **terms**.

More specifically, undertaking an analysis can indicate mistakes in the handling of materials, reagents and technical procedures. It points to the degree of **skill** or **incapacities** of the researchers, thereby opening up **pathways** for renewed **training**, **exercise** and **remediation** of the **practices** involved in the experiment. Finally, it might indicate that regardless of how the given elements, objects, procedures and skills were handled, the **venue** was inappropriate, and regardless of the degree of competence involved in carrying out the experiment, the results produced would by definition be inconclusive as to the status of the problem. In that case, one would need to focus on finding or inventing a different venue for the experiment.

We have concluded that in important yet ultimately constructive ways, the results of our first set of experiments in Human Practices at SynBERC proved to be unsuccessful. The results were ultimately constructive because experimentation is undertaken to discover something about reality, and what counts most in experimental terms are the contours of that reality, not one's hopes or desires. In that light, the results were neither disastrous nor inchoate: lessons can be drawn as to how the experiment unfolded and, given its initial objectives, went awry. Consequently, the purpose in pursuing this analytic work is to provide a reflective assessment that should make it possible to proceed with a rectified experimental practice. We pose the question to ourselves: what are the adjusted series of steps required in order to proceed toward a remediated compositional strategy that will better facilitate our experiments?

9.1 Remediation: From Topics to Elements

In this chapter, we take up the task of identifying and arranging the elements that had been deployed in the first (unsuccessful) human practices experiment into two groups according to types of discordancy—**equipment and venue**, **contestation and secession**. The intent in adopting this approach is to facilitate a consideration of which of these elements might be decontextualized from the situation of indetermination or discordancy (or both) in which they had become embedded. To the degree we can achieve this task analytically, the next step would be to consider possible strategies of redesign of potential equipment through

[1] This content is available online at <http://cnx.org/content/m18815/1.1/>.

the recomposition of elements into modules. The task is remediative, transforming situational discordancy into discursive topics (i.e., a change of medium) so as to open the possibility of converting elements of our experiment into equipmental modules (i.e., to bring about an improvement).

One striking confirmatory result of this first large experiment is that given our analysis of how things unfolded at SynBERC (but also our work with the Diagnostic in the fall 2007 labinar), we have not felt the need to invalidate (or even supplement) the basic categories we have been using. Hence the task at hand is to analyze the particular situations that we had to operate in with the goal of reflecting on the status of the elements deployed. We can then proceed to redesigning a different series, and consider how to deploy them in a different venue.

9.1.1 Discordancy One: Equipment and Venue

Although SynBERC was a new organization with ambitious goals oriented to building an innovative organizational form that would be suitable to scientific collaboration, we encountered an entrenched set of **equipment** and a desire to re-inscribe an older **venue** with which much of that equipmental platform had been originally designed to function. The source of both the equipment and the venue are easily traceable. The ease with which they were imported more or less whole cloth, as well as the tenacity with which they were defended, proved to be an unanticipated obstacle that we were not able to overcome.

9.1.2 Lesson: ELSI is dead, long-live ELSI.

There was a uniform adherence by each and every one of the participants in SynBERC to what we would characterize as either an ELSI model or an Asilomar model (or a combination of both). In either case, scientific and technical work is fundamentally cloistered, thereby guaranteeing a significant degree of autonomy for those engaged in that work. The price to be paid by the scientists for that autonomy appears to them to be minimal. Seen from the perspective of Human Practices, the price to be paid is extremely high. Currently, despite efforts by the NSF and other funders to insist on the inclusion of ethics as part of an overall research structure, little has been done in moving in that direction.

- As discussed previously, the Asilomar model succeeded in framing all issues of security, participation, goals and the like as safety issues. Elite bioscientists insisted that they were being responsible by instituting safety procedures. They acquiesced to temporary government advisory commissions. This set of relationships remains normative.
- The ELSI model introduced broad ethical topics into the cooperative framing but only on condition that the ethical, legal and social topics were quarantined as "implications" and "consequences." Ethicists could establish bright lines delimiting zones of research and practices that should be considered illicit, but short of those bright lines, autonomy for the scientific practitioners was guaranteed. We found variants of this model in place.
- Both the Asilomar and the ELSI model structure interaction as cooperative. Both function so as to preclude collaboration.
- The Asilomar and ELSI models provide a rationale for a clear conscience for those adhering to them (bioscientists and human scientists alike). They are, after all, they tell themselves, taking the necessary steps to ensure safety; they are willingly complying with ethical limits. And, as a surplus of morality and virtue, they encourage outreach and a form of education known as vulgarization. The public needs to be assured of safety, of ethical limits, and helped to understand, as best they can given what they know and don't know, instructed. And their affect structure combined self-assurance and vehemence.

The mandate of the National Science Foundation to SynBERC was to invent a form of Human Practices that integrated the valuable aspects of ELSI but moved beyond them. Otherwise there was no reason to have an ethics component within the Center. We found a uniform refusal to experiment or even entertain change. We conclude that old habits die hard. In and of itself, there is nothing surprising about that. However, when old habits are combined with unequal power relations between those seeking to design a different venue and

those seeking to conserve an older one, then discordancy dominates. We failed to reverse or even modulate this set of power relations. We received no aid, either internal or external, in our efforts. We did receive some sympathy from outside observers and colleagues.

Finally, both the Asilomar and the ELSI models were constructed with and understand themselves predominantly within a **bio- political** rationality. They take for granted that there is an object called "society." They take for granted that there are probability series in place that can serve as the basis for risk assessment. They take for granted that modern equipment will be satisfactory for contemporary situations. They take for granted that ramifications can be reduced to consequences and implications. They take for granted that there are available experts to perform these functions. We are certain that each of these claims is contestable.

- Ken Oye's MIT Human Practices orientation is emphatically invested in the status and relevance of existing expertise. The MIT approach was anchored in a bio-political framing that it excluded from examination. This obstinacy was upheld as the norm even in the face of high government officials who argued against the assumption that existing expertise was adequate to an emergent security situation. While cooperation was proposed between the Berkeley and MIT groups, as a **sauve qui peut** compromise, the proposal was sabotaged by Oye, who seemed to fear (with some justification, it is true) that any other framing than his own would undermine his orientation and delegitimate his trained incapacities.
- The NSF constitution of its new Centers required a commitment to engage in active liaisons with industrial partners with the goal of fiscal self- sufficiency within a decade. This requirement was relatively neglected during the first year of SynBERC's operations. During the second year, it began to operate effectively and efficiency when a director of Industry Liaison Relations, Leonard Katz, was hired. Katz's strengths, however, were also his weaknesses. He had worked in private industry for the bulk of his career. While admitting that there were other valuable things to undertake in scientific (and ethical) domains, his refrain when presented with a paper or an argument was always "will industry understand?"
- It has been Rabinow's experience with certain perhaps atypical sectors of the biotech industry that there is a broader and more flexible understanding of goals and strategies than the purely instrumental.
- Over half of the NSF site review team for the second-year review worked in private industry. At a closing session where the team presented its initial SWOT (strengths, weaknesses, opportunities, and threats) bullet points, Katz and others underscored that one of the SynBERC test beds—tumor-killing bacteria—did not meet standard industry criteria for specificity. Rabinow intervened at one point to wonder out loud, "Why, given the hundreds of billions of dollars that the biotech and pharmaceutical industries had spent on research and development for anti-cancer therapies, and given the scanty progress in curing cancer that had been achieved, should we not question existing industrial standards of specificity, research design and the like?" His remarks were greeted with the habitual silence.
- Similar forces were at work during the experiment conducted during the summer and fall of 2007 to integrate a Human Practices practitioner into an IGEM team. Remarkably enough, although predictable, this type of collaboration had never been attempted before. The experiment turned out to be a rather painful event. The courageous Berkeley undergrad representing Human Practices was forced to address only instrumental considerations (intellectual property). The bio-political and social consequences framing was brutally enforced to the extent that her slides were redone without her consent shortly before her presentation at IGEM. In a thoroughly unacceptable display of power, she was insulted in a preemptory manner in public by a PI who later apologized privately. Of course, given the circumstances, gender, and power relations, the rebuke should have been private and the apology public.
- The cost/benefit calculus put in place by ELSI can be formulated as follows: ELSI researchers, whether social scientists or ethicists, agreed to operate downstream and outside of the scientific research per se. The price to be paid for this positioning is that they remained in a cooperative rather than collaborative relation to the bio-sciences, and thereby could only contribute to their form at the level of after-the-fact regulations and the determination of "applications." The benefit of this positioning, however,

was a relative rebalancing of power relations, on the model of earlier bio-ethical interventions into human practices research. This model establishes a governing body for vetting and thereby overseeing scientific research on human subjects. Science must justify its ethical standing by demonstrating that it is operating within prescribed moral boundaries, boundaries which are assumed not to derive from the field of scientific work but are imposed from without. The ethical standing of science is guaranteed through the minimization of excess, not through reconstruction.

- The challenge is: how to maintain the relative downstream balance of power between ethics and science characteristic of the ELSI model, while operating in an upstream or midstream collaborative mode? Perhaps these goals cannot be reconciled.

9.1.2.1 Diagnosis

Without a different set of power relations (enforced from the outside or from more enlightened leadership on the inside) the current SynBERC venue is an inappropriate one to carry out the experiments in Human Practices we propose. The hope is that by adding other sites, outside of SynBERC, we might be able to continue working in a modified and reduced capacity in the original venue.

9.1.3 Lesson: Start-up Principles: Founders Are Not Managers.

It is a well-known maxim of start-up enterprises, drilled home by venture capitalists, that founders should not be able to serve as managers (or CEOs). The reasons that founders are good at founding enterprises is that they have big ideas, large visions, strong and well- protected egos, have received support and praise for long periods of time, and have often, but not always, accomplished impressive, if highly specific, scientific or technological breakthroughs. Founders tend to confuse their personal qualities and skills as well as the support and praise they have received throughout their careers with the qualities and skills required to transform their insights into research programs organized around standards of accountable progress toward instrumental goals. The very skills that launch a project may well be precisely those skills that can stand in the way of bringing it down to fruition given the quotidian drudgery, incessant attention to the accuracy of micro-detail, recurrent demand for compromise in goals, and the necessity of operating in an environment of sustained competitiveness. Such an environment encourages a degree of scrutiny to which founders are frequently unaccustomed.

As we have described, the pathways from manifestos to research programs can be more difficult to traverse than anticipated, especially by relatively inexperienced and acclaimed practitioners. In our experience with SynBERC (and the larger community of synthetic biologists and engineers), although traversing that threshold can prove difficult for particular individuals, it has not posed any especially major obstacle for the larger community of more and less advanced researchers who are not themselves committed to the details of the original manifesto. The community of synthetic biologists currently includes large numbers of undergraduates (IGEM), graduate students, post-docs, assistant professors, and so on up the professional ladder. What one team does not achieve, another may see as an opportunity for advancement and increased visibility in this competitive environment. As is typical in science, we have observed the pleasure and claims to higher status occasioned in saying that another team's view of, say, parts or devices, is over-rated or impractical, and then demonstrating how it could be done better. Better can mean less discursively neat but more appropriate to a specific experimental system.

One of the central characteristics of the way financial support has been apportioned in SynBERC is its egalitarianism. Each principle investigator receives a fixed sum according to a budget formula. One of the principle unintended ramifications of this formula is that no lab (with the exception of the Human Practices labs) receives enough money from SynBERC to support its activities in full or even in a major way. Hence the commitment of the PIs to the Center is based in something like equal parts good will as well as their investment in the growth and success of the field and brand. Based in part, that is, on a calculation of the benefits (scientific, technological, logistic, affective, symbolic, etc) that can be derived from an often minimal cooperation. The flip side of this arrangement is that none of the labs involved in SynBERC really depend on

it (again, with the exception of the Human Practices labs). When these structural conditions of low finance and low commitment, are combined with Keasling's hands-off management style and temperament as well as the unequal power relations in regard to Human Practices and the apparent willingness to reinforce those unequal relations both tacitly and actively—one can only conclude that major organizational changes are not on the agenda.

- Founders who had come to prominence by framing all aspects of the project resisted (and at times attempted to sabotage) the efforts of the Berkeley Human Practices Lab to provide a framing that was different than their own both in content and in its scientific legitimacy.
- The basic tactic deployed widely within SynBERC to delegitimate Berkeley Human Practices was to claim and to proclaim that it produced observations and insights that were not comprehensible. Blackberry and airline connections foremost in mind, such critics neglected to add that they considered it simply not worth the investment of time and mind to learn new terms and analytic approaches, even to come to terms with approaches that had been standard in disciplines, including those which their home institution had been pioneers in inventing. When pedagogy or collaboration requires change, the patterned response has been to assert dominance.
- The defense of their (unreflected upon) bio-political framing of social consequences, benefits to the population, normalization, and accelerated circulation served to reinforce the technocratic and charismatic formulae.
- Although we have distributed our written materials to anyone who wants to have them, we have not received a single substantive response, including from MIT Human Practices.
- Founders who moved the core of their interests and energies to other organizations (Amyris and JBEI) deployed a different mode of operation in those organizations than they did in SynBERC. Keasling said to us: "JBEI is not a 'virtual' center, we're not sending money out but getting researchers in, and paying for enough of their time that we can tell them what to do."

9.1.3.1 Diagnosis

A venue in which founders retain management power is unlikely to progress towards organizational innovation, agility and accountability. Without the functional equivalent of the venture capital overseers vigorously cajoling all involved to produce results or to adhere to a common set of audit standards, as would be the case in an industrial setting, little is likely to change.

9.1.4 Discordancy Two: Contestation and Secession

Faced with the obstacles of the entrenched (unrecognized and cathected) equipment and venue, the realization began to solidify that we were incapable of overcoming learned incapacities, or even making them topics of serious discussion. Human practices, whatever else we would like it to be, must provide conceptual analysis of emergent problems, so as to specify and reflect on their scientific and ethical significance. Just as biologists are trained to be alert to what is significant in bio-scientific results, a task of human practices, as we are trying to design it, involves techniques of discernment and analysis that facilitate collaboration by specifying and characterizing new problems. This is precisely where Mode 3 human practices departs from Mode 1. And this is precisely where our work was most assertively blocked.

We have been unable to make any serious progress in working with the SynBERC biologists to define what counts as significant Human Practices problems. Our multiple attempts to formulate and reformulate a core set of problems was almost invariably met with the demand that Human Practices concentrate on issues that biologists and engineers bring to the table, typically matters of intellectual property or public relations. Even in ELSI, whatever its other limitations, ethicists and human scientists were not put in the position of being consultants whose job is simply to answer questions posed by the biologists and engineers.

As we experienced our efforts blocked, it became clear that ethically and scientifically we were going to have to attempt something different. Active attempts to explain our approach inevitably devolved into

demands that we justify the worth of our efforts. A different form of contestation was called for. Given an available repertoire of concepts addressing the subject position of the anthropological observer, as well as those addressing power relations and networks, the time had come to consider alternate paths of action.

The development economist Albert Hirschmann had published an insightful little book in 1970 entitled **Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations and States**.[2] His characterization of strategies available to deal with "decline" or "blocked" situations is helpful in identifying the choices and options we had been considering as a pathway out of this discordant and unproductive situation. We added a fourth alternative to Hirschmann's list.

9.1.5 Lesson: Adjacent means proximate not internal.

Given the aforementioned conditions of habits, structures, rationalities and power relations, we had to begin developing a diagnosis of what was going on, then design and follow with a response that followed from that diagnosis. That response had to balance affective, tactical and strategic components. When it was clear that cooperation with the MIT Human Practices team was not going to be fruitful or even possible, we proposed a solution: we would have separated work into two distinct and basically autonomous approaches, with Berkeley being responsible for one set of issues (ethics, institutional innovation, ontology) and MIT another (intellectual property, policy assessment, risk analysis). There would be a third cluster of issues around bio-safety, bio-security, and bio-preparedness that we would share. This division of labor was rejected outright by Oye. It was not given the kind of support by Keasling that would have made it happen.

These responses were especially annoying as there was by the fall of 2007 an incessant demand to produce materials for the report to the NSF that would structure its second-year site visit. Oye wrote a large number of e-mails, left many phone messages, but produced little or no prose that fit the requirements. It eventually fell to Bennett to draft most of the material, a task that took close to a month. Oye objected again to a draft version that had met with approval in Berkeley, but he provided no specific alternatives. Finally, Keasling accepted Bennett's version verbatim but said that it would be best to tell Oye that he, Keasling, had written it. The Orwellian injustice of the whole situation was brought home to us when, in one of his whirlwind visits to Berkeley, Endy said that he had written his section of the report the night before, "almost an all nighter."

While there were vague suggestions floated during this period of time that Rabinow should be made head of Thrust IV, and repeated agreement that Oye was not producing what he needed to produce, when it came down to it these proposals were not implemented or even aired in public. Whether this was a tactic to keep us involved and working or not, we do not know. What we do know is that we were faced with an unproductive and deadlocked situation, a situation in which we did not have the possibility of putting into practice the kind of equipment we had designed. In sum, we were faced with a situation in which we saw no conditions that would lead to our own flourishing, not to mention our by now grandiose-sounding designs for a broader flourishing.

9.1.5.1 Diagnosis

We are experimenting with an adjacent position. Adjacent is defined as "situated near or close to something or each other, especially without touching." Rabinow has conceptualized the ways this positionality is pertinent and salient for the anthropology of the contemporary. There is no question that if the goal was to write an anthropological account of SynBERC this positionality would be ideal. However, the goal has always been something different than that: the design and implementation of collaborative equipment that could contribute to flourishing. Whether this stance of adjacency to SynBERC and in a proximate fashion to other Centers will prove feasible remains to be tested.

[2] Albert O. Hirschmann, **Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations and States** (Harvard University Press, 1970).

9.1.6 Lesson: Bite the hand that feeds you.

We had attempted various forms of intervention and all were met with the same response: do whatever you want to do as long as it does not cause trouble in public and as long as it does not oblige us to spend significant time or effort in accommodating it...that is, what all the other PIs do, why don't you do it? One might say that here "loyalty" was proposed and the price to be paid was a certain bad faith, but a bad faith that would allow us to continue the broad outlines of our work, albeit not within SynBERC directly.

We were faced with a variant of the dilemma Hirschmann describes of how to respond to a blocked situation. In Deweyian terms, such a response required more thought, by which he meant a reflective practice that intervenes in an indeterminate or discordant situation. But Dewey had little or no place in his toolkit for accounting for unequal power relations and ethical unconcern. Consequently, we considered resigning. Aside from the pride (in Aristotle's sense of a free citizen not voluntarily acquiescing to insults) involved in not giving in to an unjust solution, we were not sure what such a gesture would accomplish. Rabinow felt a strong ethical commitment to Bennett and other students whose participation in SynBERC had been exemplary and whose support depended on SynBERC. It took months of hesitation and irritation before we agreed that we could not continue to be stymied and compromised in our scientific life and ethical commitments, regardless of the fiscal price to be paid.

Put more positively, the contract proposed appeared to put us in a rather traditional anthropological position of observer. We could remain as participant observers as long as our participation was strictly limited and followed a rationality dictated by others and following in a mode we were trying to redesign.

- This condition of compromise and stasis reigned for most of the year. Increasingly, as time wore on, the requests to provide materials that would be useful to "the scientists and to industry" became more pronounced and insistent. We produced a diagnostic overview of synthetic biology (chapter x) that differed significantly from the manifestos that had accompanied the birth of the brand. It was received positively as a useful contribution: Katz and Keasling used it in their presentations to industry. It was deemed to be comprehensible, and Katz said that once he shifted away from the original manifesto language he was getting much better results. But this contribution on our part seems to have been soon forgotten and new demands of the same type arose.
- As far as we know, none of these demands to be useful to industry were made on Oye. His work on intellectual property and the idea that there would be an open-source patenting policy was held to be pertinent to some and irrelevant to others. Katz insisted that no one in industry would entertain such a policy. The companies that Endy and Keasling had been founders of certainly held patents. But no one questioned whether or not the topic was understandable. Actually, despite its surface fit, these proposals were either merely discursive or based in an older mode and venue.

Having considered the pros and cons of "exit" and "loyalty," the remaining response was "voice." We had voiced our concerns and our insights internally. During 2007, we devoted some effort to establishing external relations through which we could give voice to our understanding of how synthetic biology in general and SynBERC in particular were ramifying.

- During the latter part of 2007 and into 2008, Rabinow was contacted by a growing list of media (**Washington Post**, **San Jose Mercury News**, **Baltimore Sun**, **Canadian Public Radio**, **National Public Radio Science Friday**, etc). We were still operating with a "loyalty" mode and Rabinow was careful to find a manner of describing projects and ramifications that would support the broad goals of the enterprise without contributing to a mood of fear about the ramifications or consequences of cutting-edge science and technology. Hence he voiced no overt denunciatory criticism in public. However, even this mode produced a reaction. It was apparently becoming clear to Endy that as far as a larger audience was concerned, he was no longer the main person to frame the issues. And he became less than friendly to Berkeley Human Practices behind the scenes, from what we can gather. Voice and loyalty had found their limit.
- That blockage implied experimenting with a pathway combining voice and exit. Clearly, following that pathway would lead to a power conflict as well. Although it is perfectly possible to stymie or ignore

our efforts internally, if many of our insights and formulations were circulated in the media, the overall power dynamics could well take on a different form.

- In addition to outreach to the media, the Berkeley Human Practices Lab developed relationships with parallel organizational efforts underway in other NSF-funded centers, specifically nano-technology. The NSF had funded thirty such centers with a federal mandate to cultivate the field, to encourage strong relations with industry, and to include a robust social consequences or ELSI component. The Nanotechnology and Society Center at Arizona State University had the largest and most thought-through Science and Society component. We made contact with them and were well received. We organized a workshop together and have established a number of specific collaborative research projects. More are planned. Parallel relations have been established with Rice University. Some of these are being chronicled on the "On the Assembly of Things" blog on the ARC website.

The Year Two NSF Site Team Report, while not proposing any organizational or venue change for SynBERC as a whole or the Human Practices Thrust as a part, was very supportive of the Berkeley Human Practices Lab's efforts to "redefine the task and deliverables of ethics research."[3] As we were quite vocal with our overall criticisms during the site visit, perhaps growling at those who feed you can be productive in getting their attention.

9.1.6.1 Diagnosis

At this juncture in spring 2008, we are attempting to juggle "voice," "loyalty" and "adjacency." We are experimenting with broadening the framework within which issues of flourishing can be taken up. We are still entertaining the possibility that this adjacent position can provide a pathway in and out of SynBERC. In sum, we are attempting to "secede," that is to say, to avoid direct confrontation or simple exit by realigning a number of other sites into what might become a venue that could facilitate the experimentation with distributing aspects of our work in different sites so as to produce a form that might accommodate the significant categories and elements of our overall program.

9.2 Toward Recomposition

There can be little question that the initial situation of a nascent SynBERC and a year or more of efforts to establish Human Practices as a collaborative practice integral to the whole did not proceed as we had hoped it would. To use the analytic terms of John Dewey, we were unable to proceed from a situation of indetermination toward a more determinate form; one in which the reconstructive goal we were seeking to achieve could be given a formative role. Significantly, after the NSF site visit for year two, we concluded that we had moved from a situation of indeterminacy to a situation of determinacy, but those determinations were, given our objectives, discordant ones. On the one hand, this experimental motion proved to be the opposite of a successful resolution. On the other hand, the results are what they are, and as such are not without interest. In any case, it is essential if one wishes to initiate further motion to analyze and parse the indeterminate elements from the discordant ones.

Again following Dewey, it is worth remembering that a discordant situation is one ripe for inquiry and thinking. In that light, we can now identify shortcomings in skill on our part as well as both passive and active resistance (or even the sabotage) to our initial efforts on the part of others. In the best case, most skillfully handled, the lessons learned can function as topics opening up pathways that might prove fruitful for the design and composition of different and better forms. Perhaps that route is not possible, but establishing the limits and horizons of that danger is what experiment and experience are designed to test.

After the identification and analysis of discordant elements, the next step is to consider how to redesign parameters so as to proceed toward (re)composition. Such analysis should lead to an improved recursivity. An improved recursivity should lead to a remediated recomposition. A remediated recomposition might lead

[3] National Science Foundation, SynBERC, Fiscal Year 2008 Site Review Report.

to reconstruction. And reconstruction might make it clearer what the form of synthesis might one day be. The way to find out such things is to think, design, practice and evaluate what happens.

Chapter 10

Test Case. Trust but No Confidence: Benign Indifference or Malign Neglect in Synthetic Biology[1]

After more than a decade of anthropological observation and writing about genomics, post-genomics and bio-technology, I found myself, first by accident and then by design, as an official participant, a Principal Investigator, in a new venture in the biosciences, the synthetic biology engineering research center (SynBERC).

The accidental part was that I was initially only tangentially interested in synthetic biology. I had just finished a project on post-genomic molecular diagnostics and was not intending to pursue any other such projects. With some reluctance, I had accepted to do molecular diagnostics project because of a unique invitation to observe the early days of a new company, Celera Diagnostics, and a new field, post-genome-sequencing molecular diagnostics. The chief scientific officer of the company, Tom White, with whom I had worked on a previous book and who had become a friend, proposed that I follow the emergence of what they were quite confident was going to be a set of major discoveries. It was an offer I could not refuse for both personal and scientific reasons. I decided, however, to see if I could turn it into an experiment in the anthropology of the contemporary, a term and a program I had recently committed myself to inventing and developing. As described elsewhere, I set the challenge of attempting to do the research and to write a book within a year, before any definitive results in the company would have been achieved. I designed the challenge first as a methodological one, and second as a narrative one. In order to have a hope of attaining these goals, I knew I needed to collaborate, so I decided to undertake this experiment with a gifted undergraduate, Talia Dan Cohen.

During the course of this project, I was also spending quality time with a maverick molecular biologist and autodidact, Roger Brent, who directed an independent Center of Excellence in Computational Biology in downtown Berkeley. Roger and I turned our passionate exchanges into a new course, "Genomics and Citizenship," where we attempted to design a form for teaching Berkeley undergraduates the foundations of molecular biology as well as those of the anthropology of the contemporary. Aside from the course, which we taught three times, two other significant ramifications of my encounter with Brent are relevant here. First, Brent was convincing on the relevance of biosecurity, and his persuasive arguments led to a major project on the "Global Bio-politics of Security," carried out with Stephen Collier and Andrew Lakoff, who eventually took the lead on the topic. Second, and this finally leads up to the accidental part of my relation to synthetic biology, Brent introduced me to Drew Endy, a young engineer, a friend and former colleague of Brent, then teaching at MIT. Drew was the visionary: dreaming and proselytizing about turning biology into an engineering discipline, via a new field, synthetic biology.

[1] This content is available online at <http://cnx.org/content/m18828/1.1/>.

Endy invited me to be one of the speakers at the First International Conference on Synthetic Biology at MIT; I delivered a talk on the "Ecology of Ignorance," a term I took from Luhmann and which referred to our contemporary conditions in which a post-planning world of contingency and emergence required an observational mode close to the practices and focused on short- and middle-term ramifications. Such a mode and its associated ethos could not have been further removed from the rhetoric of coming radical transformation that Endy had polished into a very successful set of presentations and grant proposals. I also used the term ecology of ignorance to refer to the fact that there was a large and to my mind ever-growing deficit in the overall global landscape of knowledge, particularly among the biosciences, and cutting edge humanities. Bioscientists, among others, are ever more technically competent, and ever more pressured into mastering more and more technical tools and sub-disciplines but had less and less time for anything else. In my view, the production of ignorance in the elite American academy was systematic and successful: countering that trend had been one of the main goals of the course Brent and I had developed. The reception of the talk was puzzled, as per my intention. The reception, however, was also cordial; a few people expressed interest in what I had said, and the others simply seemed to take it as another sub-specialty in which they had no competence. They knew they were living in ecology of knowledge in which there were going to be large areas about which they were simply going to remain ignorant; that compartmentalization is a fundamental part of their education and practice. As there were few other social scientists or humanists present, I was spared either their approval or opprobrium. Some journalists expressed mild interest but did not follow up; the venture capitalists present were too busy chasing the bio-scientists to pay heed either way.

In the following months, I began to pay attention to synthetic biology, especially its interfaces and ramifications with biosecurity issues as my contribution to the Global Biopolitics project. So, when the Second International Conference on Synthetic Biology, held in Berkeley in June 2006, rolled around, I accepted Endy's invitation to give another presentation. This presentation was on the concept of "preparedness" in a situation of relative ignorance as to risks and dangers. By this point, the National Science Foundation had funded SynBERC handsomely, at least from an anthropologist's perspective. Through the chain of events summarized in the Invitation, I found myself, along with MIT professor Ken Oye, co-leader of the Human Practices Thrust.

Rather abruptly, I found myself moving from an anthropological observer to becoming an official participant. This accidental turn of events opened the horizon of a design phase. Brent had convinced me that there were genuine, significant, and long-lasting issues of concern, especially for the future of the sciences in a democracy, and that I had an obligation to think about how things were developing. My acquaintance with the issues of ethics (or bio-ethics) associated with the genome sequencing and mapping projects had been articulated in my research on the French genome project, where these issues had taken center stage, but in a form quite different than the one that had dominated in the United States. In that light, I knew that I had strong intellectual hesitations about the worthiness of transferring the ethics approaches that had been developed around the sequencing projects to the post-genomic developments. This is not the place to spell those out, as I have done so elsewhere; what is relevant here is only that I was familiar and dissatisfied with the ethical and social issues as currently articulated. Again, as explained in the Invitation, before fully accepting the position of a Principal Investigator and co-leader, I insisted that the relative relevance of prior models of "ethics and society" be taken up as an explicit component of the research program. With that in mind, I went to Washington where I explained my understanding of the lay of the land to the NSF officials who were funding the Center. They concurred that something new was required and were supportive of my efforts to design an approach in which we might be able to articulate such a new understanding. After some thought, we decided to rename the Thrust "Human Practices."

It should be underlined from the outset that I found the other PIs in SynBERC to be fervently engaged in their work, that their work was for the most part fascinating and adventurous. They were dispositionally friendly, if extremely busy, like almost all American professionals at the top of their game. They were, however, sporadically wary, a reaction which I had encountered frequently over the years in other research projects. Wariness was usually a sign of caution about not being intruded upon. I was familiar as well as comfortable with doing the work required for establishing some degree of mutual familiarity, comfort and reassurance. The work of overcoming wariness had largely consisted in waiting out the seemingly

pre-programmed clichéd jokes about using them as guinea pigs and observing them under the microscope and patiently attending to the few individuals whose curiosity—and at times doubts about what they were doing—made them candidates to become prime informants and collaborators.

Things unfolded at SynBERC in a similar fashion. However, I was not engaged in this project as an anthropological observer whose goal was to gain knowledge and write a book. I was a Principal Investigator whose role was to participate formally as an equal. My role was to deliver remediative proposals about synthetic biology both within the Center and without. What form those deliverables might take was unknown. Thus, within a traditional anthropological endeavor, the general acceptance and indifference by the majority of the bio-scientists would have been fine, but under these new job conditions they were unacceptable.

By the summer of 2008, after almost two years of engagement as a Principal Investigator, I found myself being quite unsure and increasingly uneasy about exactly where I stood—ethically, conceptually, and affectively—in relation to SynBERC's informal organization (generally distributed as to function but ultimately centralized as to power) and its proclaimed entrepreneurial mode of practice. Almost two years into the project, years that were filled with a troubled mix of persistent frustration as well as ample stimulation, the internal pressure to clarify the state of affairs weighed heavily upon my lab mates at the Berkeley Human Practices Lab and me. What follows is an attempt to articulate that discomfort conceptually in the hope that such conceptual clarification might open up a pragmatic way forward, one that was both rigorous and ethical.

The reasons to pursue this enterprise is based on my informed judgment that:

1. Moving beyond the overstatements characteristic of its manifesto stage, synthetic biology is beginning to demonstrate its capacity for intervention in biological processes, including some that are clearly beneficial, such as Keasling's artemesinin project, where a costly anti-malaria molecule originally found in a Chinese yew tree is produced in yeast, lowering its cost and availability.
2. The majority of the bio-scientists involved are enthusiastic and earnest while being inextricably mired in the world of careers and commerce, as is practically everyone in the elite scientific departments of the American academy. The framing and pursuit of this endeavor should not be left to them alone.
3. It is worth bearing the expected accusations of complicity in order to achieve an in-depth evaluation of how the above-mentioned capacities and critical limitations are in fact developing.
4. Anthropologists of the Contemporary are singularly situated to carry out this type of inquiry and reflection.
5. Today, undertaking this participant-observer endeavor means accepting a true risk in the sense that it is not currently calculable as to where the field, its practitioners, its opponents, and its Human Practices component are ramifying.
6. In addition to all of this, as laid out in our diagnosis of Lessons Learned, in Chapter 8, as of 2008 we were in a much clearer position as to the limits of our capacities and incapacities within SynBERC.

My involvement therefore is scientific, ethical and, in a distant way, political. For the first time in my career, my role as Principal Investigator provides me with funds to support graduate students. Working in a public institution, however prestigious, support for graduate students, especially non-American ones, is perpetually endangered. To have such funds available for a number of years ties me to SynBERC and gives me pause not so much about criticizing them but about simply exiting from a frustrating situation of neglect and indifference.

In sum, as spelled out in Lessons Learned, I have been faced with Albert Hirschmann's classic set of choices: exit, voice, or loyalty. I am clear that if my research is foreclosed I would exit and pay the price of losing support for my graduate students. In fact, if all I wanted to do was carry out a traditional anthropological project, the conditions would be close to optimal both for carrying out the research and for establishing independence. Voice and loyalty therefore are the duo of alternatives to confront. I am vocal about what I take to be SynBERC's shortcomings, but in a situation of benign indifference, voice, initially at least, has had little impact. Consequently, in a complex and unexpected fashion, provisional loyalty (tied to self-interest as well as an informed sense of beneficial scientific and technical advance at the heart of SynBERC) has become the main option. But what, for a critical anthropologist and citizen whose

job description is to address himself to the ramifications of this young field, does this matrix of conflicting strategies look like?

Thus, the dual challenge is: How to practice anthropology and ethics as a member of a collaborative research center? The anthropological challenge turns on how to transform traditional observational practices, albeit situated and existential ones, into participatory ones. The ethical challenge turns on the question of whether or not synthetic biology would prove itself to be worthwhile interpersonally, scientifically, and ethically. The latter challenge, of course, is more than an observational one, and therefore constitutes a type of risk.

10.1 Concept Work

A year previously, in an attempt to orient ourselves conceptually and ethically, Gaymon Bennett and I had decided that in order to produce a defensible orientation and an objective means of evaluation of what was going on in synthetic biology as well as the best mode of approaching it—not just as observers but equally as participants—we needed to produce a schematic analytic that would give us the **capacity** to identify the significant issues both within SynBERC and beyond. We felt it to be our obligation to separate out the numerous petty personality issues that always arise in any organization (but that nonetheless can be all too real and obstructive) from the presumably more enduring structural ones. We hoped that once we made headway in that project we would be better able to take up the original task we had accepted when we agreed to participate in SynBERC: to invent, design and implement an appropriately innovative and responsible form of ethical and human scientific practice.

During 2007, as our work advanced, we became increasingly confident that the elaborate analytic scheme we were producing was better characterized as a diagnostic tool (rather than as a formal analytic with universal pretentions).[2] Consequently, the book-length document that we developed over the course of a year is called **Ars Synthetica: Design of Human Practices**.[3]**Design** provides a multi-level grid of topics and schemas. We have found this combination to be surprisingly and rewardingly accurate when put to the empirical test in a variety of experimental settings that we designed to verify its internal coherence and its external pertinence. Prominent on the agenda of conceptual topics was how to provide a schema of the relations of the emergent biosciences with longstanding but volatile biopolitical rationality and its associated **apparatuses**. We knew that the terms **biopower** and **biopolitics** were being over-generalized and under-conceptualized by academic theorists. We have also observed that the **norms** and **metric** associated with a biopolitical rationality and its attendant apparatuses have been taken for granted as simply things of the world by many of the bioscientists; for example they take it for a given that potential maximization of the health of populations provides a measure of the worth of their enterprise. We had (and continue to have) good scientific reasons to argue that such a grid of interpretation, a "perspective rather than a concept," as Nikolas Rose puts it, seriously limited the appreciation of the significance of other **figures**, **apparatuses** and **assemblages** at play in the world today; for example, human dignity or human flourishing.[4] We concluded that such muddling, confusion of categories, levels, and objects was one of the principle reasons for the pervasive ontological indeterminacies and ethical discordances with which we were confronted on a daily basis.

10.1.1 Pragmatics

Conceptually we have been gratified by the results of our labor. Pragmatically, we decided that our central task during 2008 was to invent a mode of practice in which we could put these results to work. The challenge was: how to transform our practice from that of a traditional anthropological observer to that of a (second-order) participant, a new subject position? The initial results of this experiment have been largely negative. Explaining what we were doing or how we were approaching our challenge of inventing an innovative form of

[2] Thanks to James Faubion for this suggestion and for his arguments in favor of its adoption.

[3] Available on: www-anthropos-lab.net.

[4] Nikolas Rose, **The Politics of Life Itself** (Princeton: Princeton University Press, 2007), 54.

what we decided to name Human Practices (to complement and supplement the innovative post-disciplinary biology), however, either to the biologists and engineers involved in the Center, or to the bureaucrats from the NSF who provide the funding and periodically reviewed the Center, or to the proverbial person on the street (or in the next seat on JetBlue), has proved to be extremely frustrating. We are fully aware that as of summer 2008 we have not succeeded. The question—"Where do you stand in regard to synthetic biology?"—continues to arise as an issue to which civic, scientific, and ethical import is attributed by critics, supporters, and participants alike.

Walking home from my office one day, dissatisfied and unconvinced that the issue of positionality actually was the problem, it occurred to me that a related but slightly different formulation might prove more fruitful: "**Should one trust these guys**?" Without much forethought, and in a common-sense, citizen-like mode, I knew that my answer would be "certainly not." After all, I knew all too well that transparency in decision-making was not the hallmark of SynBERC; nor was equality of access to information, influence, and input into strategy or, for that matter, gossip. Not surprisingly, at SynBERC there was an inner circle, an old boys' club (with perhaps one woman in it). The information shared with all of the PIs was a belated and at best partial accounting and consultation about many issues such as planning events, meeting times, intellectual property, decision-making, transparency on procedures and the like. In and of- tself, there is nothing scandalous about this state of affairs; elites function by controlling information flow, limiting access to decision-making processes, and emphasizing speed and efficiency rather than the more ponderous deliberation and formal procedures that an open and democratic form requires. Many of the decisions made were relatively petty, and if one insisted, one could find out what happened. In a word, the situation was more banal than evil.

Political power, I have often taught in my seminars, is above all a question of: access to and control of information; the ability to take part in informal decision-making; and the capacity of mobilizing a constituency (often of higher-level power brokers). Having learned from Pierre Bourdieu about academic power relations, and Luc Boltanski about recent changes in the managerial strategies of capitalism, I understood that this lack of transparency was not uniquely a calculated strategy directed at excluding those of us not in the biosciences but rather a habitual way of dealing with information and subordinates.[5] That being said, conceptual clarity goes only so far and this exclusion was irksome, given that I was a principal investigator in the project.

So, the "Where do I stand?" query became twofold: do I trust them? And do I trust the enterprise of synthetic biology? I was reluctant to give a blunt "no" for an answer. Hence, in the summer of 2008, where did I stand conceptually? On the one hand, this lack of a comfortable position, an already formed position as to the truth or falsity, worth or value, good or evil, utility or futility of what was emerging in synthetic biology was troubling and not well received by either critics or supporters. On the other hand, clearly it made sense in an emergent field set within an uncertain but extraordinarily dynamic situation of a global scale, that the best way forward—scientifically and ethically—was to focus on the very conditions producing our discomfort and our unmoored position. As mentioned, we had made considerable progress on the conceptual front, but the ethical challenges have proved to be more intractable. How, then, to proceed?[6]

I have not been and am still not comfortable with the categorical opposition to biotechnology. Sydney Brenner's proclamation that the twenty-first century would be the "century of biology" was compelling to me both because so many discoveries and inventions were taking place and because so little was actually understood about the nature of living systems. Not supporting research seemed unacceptable, especially in such an anti-intellectual country as the United States. That being said, many of the criticisms leveled by

[5]Pierre Bourdieu, **Homo Academicus** (Paris: Éditions de Minuit, 1984). Luc Boltanski and Eve Chiapello, **Le Nouvel esprit du capitalism**, (Paris: Éditions Gallimard, 1999).

[6]On the one hand, formally, our mandate from the National Science Foundation, vague as it was, consisted in an unspecified responsibility to ascertain whether things in SynBERC, and synthetic biology more generally, were being done right, especially as concerns matters of ethics and security. On the other hand, I found, and continue to find, that several of the projects of synthetic biology excite my curiosity and provide a deep and steady stream of edification about the malleability and limitations of living beings and their milieus. In sum, there was clearly a danger of cooptation, complicity. There was clearly a danger that the anthropological possibility of being an in-close observer of a significant emergent formation would be missed and never be documented. There was clearly a danger that a refusal to participate would prove to be not the price to be paid for truth but the elimination of the possibility of understanding.

critics—including lack of transparency, over-reaching patents, hyped claims, seeming conflicts of interest, and the like—clearly have some merit. It has seemed to me that many opponents, however, leave no room for a detailed and nuanced understanding of what synthetic biology is accomplishing and failing to accomplish, discursively and scientifically. Although I remain irritated with the overblown, adolescent hype about the revolutionary wonders synthetic biology is about to bring forth in areas of health, security, and the environment, I am simultaneously skeptical of the imprecise and self-serving responses of its most prominent critics.

In sum, on the one hand, continuing to work in SynBERC without publicly criticizing the project (or at least expressing concern and urging caution) posed the danger of cooptation and eventual complicity with as-yet-unknown wrongs that might be committed by a powerful organization. Such disinclination to prejudge assured a near-certainty of accusations of sins by an array of critics both within the academy and beyond. These dangers seemed to me to go with the terrain. On the other hand, premature withdrawal might wipe out a unique opportunity to be an in-close observer of a significant emergent formation. As an anthropologist, I was reluctant to foreclose that possibility. Finally, and here is where the situation and the challenge diverged from standard anthropological practice, there was a risk that the opportunity to participate actively in how SynBERC and synthetic biology ramified would be forfeited. In a word, here is where an anthropology of the contemporary might contribute to an ethics of inquiry, care and flourishing.

10.1.1.1 Confronting the Quandary: From Predicament to Dilemma to Paradox

> *Predicament: a difficult, unpleasant, or embarrassing situation from which there is no clear or easy way out.*
>
> *Dilemma: a situation in which somebody must choose one or two or more unsatisfactory alternatives." Or "in logic, a form of reasoning that, although valid, leads to two undesirable alternatives.*
>
> *Paradox: a statement, proposition, or situation that seems to be absurd or contradictory, but in fact is or may be true.*

I was in a quandary: what was the responsible path to follow? The often petty blockages and frustrations of SynBERC were alternatively troubling or boring, simply another set of minor annoyances in life's daily drudge as one stumbles one's way midst the milieu of the impediments of multiple bureaucracies. Each complaint—why were we not consulted on the meeting date? Who decided on that agenda? Why weren't we told about that change?—was met with either silence, denial, or a brush-off. It was clear that we were painting ourselves into a corner, gaining a reputation as trouble-makers. Trouble-makers, of course, are exactly the kind of people you don't want to include in your informal, minor, often hasty decision-making. However, w to make of these micro-practices, trivial as they seemed to be (or were categorized as being), kept resurfacing as a kind of affective and conceptual predicament. Each instance seemed minor; the aggregate of these incidents less so.

Walking home from my office another day, it occurred to me that perhaps once again shifting a blocked situation into a conceptual dilemma at least might make it possible to think about the overall situation in a fresh light. On the conceptual plane, the way to resolve a dilemma is to change one or the other of the premises that were structuring the dilemma and leading to the mutually undesirable alternatives. Our undesirable alternatives consisted in letting each one of the petty snubs or exclusions go or in drawing attention to them with the result that we increasingly were susceptible to being categorized as "difficult," or, even to quote the most amusing epithet, "bleak." As we did not have the political power to force a change in the situation, all we could do was to think our way around it.

It was here that Niklas Luhmann provided some conceptual aid, a set of terms—familiarity, confidence, trust—as well as a rather unusual interpretation of them as a recursive series, that proved to be both insightful and helpful in transforming the predicament into a dilemma that at least could be turned into a thought experiment. The conclusion, and I will try to explain how I got to it in a moment, is that the question "But do you trust them?" needed to be refined and rephrased. A better approach, one that unsettled the

seemingly self-evident alternatives and conceptually freed-up the dilemma, consisted in framing the situation not as a set of dichotomous alternatives but rather as a recursive series.

- Are you familiar with the situation in an intimate manner?
- Do you have confidence that things are proceeding in a plausible manner?
- Do you trust yourself and others to act well in this situation?

Such a series made it possible to imagine more than two responses. Posed in this fashion, it became clear that there were at least three distinct positions, which we knew already, but the reason these positions were distinct yet connected lay in the series and the possible order of the valences at each step. Logically there were three variables and two valences, or 32 slots. Of these 6 possibilities, four were easily identifiable in the situation at hand.

- The answer of many if not all opponents was: No, no, no.
- Some of the scientific opponents could answer: Yes, no, no.
- The proponents uniformly answered: Yes, yes, yes.
- My answer, I have gradually come to understand, is: Yes, No, Yes.

I was familiar with much (but not all) of the basic structure and practice of what was taking shape. Therefore, the challenge is to explain how it is that having become familiar with synthetic biology and biologists by dint of intellectual curiosity, ethical commitment, and official position with the Center, that partial familiarity has not produced confidence; and how it is and why it is that I have come to risk trust that is not predicated on prior confidence. The situation does not produce confidence in part because domains of practice in which decisions were being made were blocked from becoming familiar; of course, other principle investigators, bio-scientists, were not in the decision-making circle either, without being bothered by the situation, as what they wanted from SynBERC was some financial support and little more. That being said, the lack of confidence in the way the organization was being run did not preclude a priori having trust in the larger enterprise. That syllogism, while paradoxical, makes sense once one gives a particular meaning to the series "familiarity, confidence, trust."

The latter claim opens up several connections relevant to anthropology and ethics. For instance, one of the imperatives of anthropological method is to establish familiarity with the people about whom the inquiry is, or might be, centered. The pursuit of such familiarity, by definition never completed, seemingly always receding and requiring more than cognitive capacities, is one of the hallmarks of what makes an inquiry anthropological as distinct from the other human sciences. The price to be paid for attaining whatever degree of familiarity one can achieve is the long months or years of fieldwork: the anthropological badge of character; the **askesis** required to attain access to the knowledge the discipline values. If anthropologists are the miniature painters of the social sciences, then the ordinary, the routine, the micro and the nuance must be on the palette.[7]

Another credo of anthropology is that it is only by establishing such familiarity, however imperfect, that the anthropologist earns a degree of confidence in what he is doing, as well as the capacity to do it. Without some familiarity, there can be no confidence that one is heading in the right direction: without some reciprocal confidence of those with whom one is working, anthropological work is, at best, thorny.

10.2 Problem Space: Familiarity, Confidence, Trust

The systems theorist Niklas Luhmann in his short article, "Familiarity, Trust, Confidence: Problems and Alternatives," provides a set of distinctions that are helpful in clarifying the problem under consideration.[8] His brusque and dryly ironic declarations open a space of thinking, allowing for a larger set of analytic

[7] See, Paul Rabinow, **Reflections on Fieldwork in Morocco**, 30th anniversary edition (Berkeley: University of California Press, 2007) (orig. 1977), and **Symbolic Domination: Cultural Form and Historical Change in Morocco** (Chicago: University of Chicago Press, 1974).

[8] Niklas Luhmann, "Familiarity, Trust, Confidence: Problems and Alternatives,"

distinctions that can be used to move beyond what have seemed to be possibilities that were all unsatisfactory. For example, here are a few declarative sentences from Luhmann: "Familiarity is an unavoidable fact of life; trust is a solution for a specific **problem** of risk." Or: "We develop **forms** to account for the hidden side of things." The inevitability of familiarity sounds ominous given its fate-like quality; trust sounds like a good thing to engage in as it is the path to solving problems. Whatever Luhmann means exactly by these terms, we can be sure that they will not be taken up individually, given his well-known systems approach but rather as elements in a series, a series with systematic variations of the relations among and between the terms.

Luhmann's first assertion is that the forms we humans have developed to account for the hidden side of things are symbols. Symbols do not refer to things already in the world, they are not signs; rather, symbols are forms that perform the function of allowing the unfamiliar to be incorporated into the familiar. Although the familiar may be unavoidable, while facilitating some things it hides others. Furthermore, Luhmann's distinctions are analytic ones, and empirically, as he says, how the unfamiliar is rendered familiar in a specific case is an empirical question.

Luhmann identifies symbols performing these functions as religious or at least having had a religious origin; he seems to flirt with a functionalist evolutionary approach in which religion is historically paramount and temporally prior. In humanity's early days, the symbolic work of making a dangerous, largely unknown and uncontrollable universe familiar was handled through the magic of symbols. At times, Luhmann seems to back away from such an epochal or evolutionary approach. Slightly later, however, he returns to the epochal framing, arguing that in "modernity" technology has functionally replaced religion. As I have argued elsewhere, Luhmann's Germanic epochal thinking, if taken literally, undermines his systems approach, turning it into a realist sociology, a position Luhmann at times distances himself from, turning it into one way of giving form. So let's do Luhmann the favor of ignoring this line of his reasoning.

Shifting from an evolutionary frame to a systems frame, Luhmann asserts: "Symbols...are forms of self-reference using the self-reference of form." This means that the way one enters into an environment is through the form of symbolic incorporation of the unfamiliar into the familiar. It is clear that these forms can be more or less effective, more or less beneficial, and more or less costly. The cost of their formation and their maintenance is an issue that would be profitable to pursue. There are monetary costs; there are efficiency costs in terms of human or environmental ramifications; there are ethical trade-offs in terms of what is more or less good for those concerned. And since those concerned are almost always disparate, these trade-offs become issues of negotiation and contestation.[9] Thus, familiarity is a logical baseline; without it, there can be no series. That claim does not mean that familiarity is always stable. Even in a historical time when familiarity supposedly was the widespread reality, it was not immutable or invulnerable. "Trust and confidence are placed within a familiar world by symbolic representation and thereby remain sensitive to symbolic events which may suddenly destroy the basis for their existence."

10.2.1 Confidence and Trust

Having analytically situated familiarity, Luhmann shifts his attention to two dependent terms: confidence and trust. Like familiarity, these are terms of self-reference but their form is not symbolic and the form's function is not to make the unfamiliar familiar. Confidence and trust are action terms. They are distinguished initially by a difference between tacit (taken for granted, habitual) action versus explicit decision-making. Thus, in a mode of the self-reference of confidence: if events prove disappointing, then there is an **attribution** to **external** factors. In the mode of trust: the cause of consequences refers to an **internal** attribution. The self-conscious and calculating subject is internal to the form.

In society (Luhmann's a-historical contrast term to environment), the normal condition is confidence; an expectation that things will work the way they are expected to. If I ride a tramway, to use Max Weber's

[9] The hidden side of things may not be unknown but merely not come into play. There are many mechanisms to keep a range of issues "unfamiliar" and absorb them into familiar routines and practices so as to keep them unfamiliar. One example is the rather blanket "I don't understand," and then knowing smiles to keep the unfamiliar terms at a distance. And when pushed, threats come into play. Such tactics—they are not conscious strategies, by and large—are perhaps in their more benign form (albeit with important ramifications) examples of the laziness and cowardliness that Kant referred to as one of the central impediments to the pathway toward Enlightenment.

example, I am confident that it will run, and run safely.[10] That expectation includes the possibility of nefarious events happening as long as the cause of those events can be attributed to external factors. If the bus breaks down, I am confident it will be fixed by someone who knows how to fix it. Things may well be dangerous but it is not my responsibility to take care of them as I did not cause them to happen; I have confidence that experts are available with the requisite knowledge, skill, and authority. Or, alternatively, no experts are available to repair things, but the dangers are still external and not within my control; lightning strikes a bus, but it is not for that reason that I stop riding buses. Hence the form of self-reference for confidence is bringing routine/disappointment into the routine.

Trust, contrastively, operates via internal attribution. Trust "**is only required if a bad outcome would make you regret your action**." Trust depends not on danger but on risk. Trust requires an internal calculation of external risk; there is a circular relation between action and risk. "**Risk is at once in and out of action: it is the way action refers to itself. Risk represents a re-entry of the difference between controllable and uncontrollable into the controllable**." Hence the form of self-reference for trust is bringing the controllable/uncontrollable into the **controllable**.

There are other forms in which internal attributions are possible (just as there are other forms that include other external attributions). For example, trust can be distinguished from rational calculation in which one calculates favorable odds beforehand with a specified degree of assurance. Thus, the distinction of trust and confidence "**does not refer to questions of probability or improbability**." The reason for this form is that trust is a question of attribution, of an action as to whether or not the right action was taken. It is not a question of the objectivity of the external situation. And trust must include the risk of a bad outcome resulting from my actions.

Given Luhmann's systems theoretical approach, it follows that changes in familiarity will logically impact confidence and trust. Familiarity does not always simply disappear but can lose its previous social scope, scale and standing. A decline in the scope and scale of familiarity can lead to a crisis of confidence, although not its disappearance, as no social system can function at degree zero of confidence. But as trust, to a degree, depends on confidence, delimited spheres of confidence will impact trust. Such a feedback loop is insidious, especially in modern societies that are beholden to liberal subjects and dependent on the growth of risk-taking spheres of actions. Luhmann writes, "At the same time, the structural and operational properties of such a system may erode confidence and thereby undermine one of the essential conditions of trust." Lack of confidence leads to alienation and retreat into smaller local worlds, as well as nostalgia for a simpler time. Lack of trust simply leads to a withdrawal. That being said, the shriveling of confidence does not automatically reduce trust. In fact, Luhmann argues, the logic of political and economic liberalism, as opposed to other regimes, weights expectations in favor of trust over confidence. However, Luhmann writes, "Given the conditions of modernity—contingency, risk, etc. –we are likely to enter sooner or later into the vicious circle of not risking trust, losing possibilities of rational action, losing confidence in the system, and so on, thus being that much less prepared to risk trust at all. We may then continue to live with a new type of anxiety about the future outcome of present decisions, and with a general suspicion of dishonest dealings."[11] The later condition, it seems to me, is characteristic of many of the critics of disciplines like synthetic biology. It is perfectly understandable even if not perfectly satisfactory.

10.2.2 Ramifications

Technologies of communication (literacy, the printing press) have changed the conditions of familiarity. These technologies have radically altered the way we deal with the unfamiliar. Familiarity, Luhmann claims, survives only as a private milieu, by which he means that in terms of the overall conditions of society, familiarity does not permeate or provide a form-giving function for the whole. Since that claim is contestable historically (perhaps it never did), perhaps it is better to speak of **privatized** conditions of familiarity.

[10] Max Weber, "Science as a Vocation," in C. Wright Mills and H.H. Gerth, **From Max Weber** (New York: Oxford University Press, 1946), 139.

[11] Finally, he argues that a major challenge is to link the macro and the micro. It is worth entertaining that the series familiarity, confidence, trust + responsibility might provide a pathway between the micro and the macro beyond but inclusive of emergent biosciences.

Rather than reify a domain of the private, we can take up "privatization" as a form-giving process. For example, Steven Shapin argues in his book **A Social History of Truth** that the actual peer group of working scientists is currently and has been historically quite limited in size.[12] Although scientific sub-specialties certainly sustain multiple connecting points to other scientists, on a specific topic the number of people directly concerned as well as the inter-relations among them is small. Specialists apparently want to be familiar with each other and will expend considerable effort to establish and maintain such relationships (hence one explanation for the vast amount of travel that prominent and not-so-prominent researchers undertake). "Keep your competitors close at hand" might have been something Machiavelli said, but it is certainly an imperative in the lifestyle of leading bio-scientists. It is worth remarking that relations of familiarity do not entail friendships or even amity.

On another register, day-to-day work in the lab establishes a kind of **familiarity**—albeit, again, a privatized one. This familiarity is built on the daily activity of extensive hours at the bench (especially for younger researchers), which include a great deal of time to chat and observe as the experimental work unfolds. To the degree that the familiarity is established and sustained, it facilitates a form of **confidence** that things today and tomorrow will remain reliable or can be repaired. And it is on the basis of the twinned form of familiarity/confidence that a specific kind of **trust**, an ability to take specific risks and act on them, becomes possible. For example, whom to trust among one's competitors, is a prime topic in scientific banter and strategy; significantly more important, in my experience, among bio-scientists than among human scientists. Finally, the lab meeting and scientific conferences are important institutions in initiating, testing, and sustaining the triad of terms and their milieu.

One of the achievements of the sciences in general, the biosciences more particularly, and the emergent inter-domains such as synthetic biology specifically, has been their ability to: construct and privatize zones of familiarity; to develop and enforce practices that build specific forms of confidence in the everyday order of scientific life; and to inculcate and reward a range of specialists who are expert at risk-taking in their own highly specific domains. The pre-eminent achievement of this apparatus and its equipmental platform has been to facilitate movement from the multitude of micro-situations in which many of the elements have been standardized (lab machines, lab procedures, lab notebooks, lab meetings, lab scheduling, etc.) to a range of normalized macro-situations of varying scales by inventing and stabilizing pathways and forms. That is to say, the biosciences in a series of historical waves ranging from the discovery of the structure of the DNA molecule on through the Human Genome Sequencing Project and, it now seems, synthetic biology, have been successful in developing forms that compartmentalize and maintain strongly demarcated boundaries between the domains marked as the external world (on which it is dependent for money, political support, training facilities, and many other things) and its own well-policed and well-demarcated internal domains. It is a major historical achievement to have developed the forms that have refigured and re-energized the series familiarity-confidence-trust into mighty machines to make futures.

10.3 Conclusion: Risking Knowing

Within SynBERC, the dispositions of the bench scientists and their scientific managers, the project directors and senior PIs, lead them to conclude that the human sciences should serve them as public relations specialists, disseminating their achievements and potential contributions. This view of things is simply insulting. It is less satisfactory than the ELSI model developed during the Human Genome Sequence Project. In that form, the human scientists or ethical or legal specialists were contractually obliged to remain external and downstream of the scientific and technical developments, but at least they had the duty of drawing attention to what they considered to be ethical or legal or social limits to acceptable research and development. For the ELSI practitioner, spending time discussing those limits and their foundations, however imaginary much of the content might be and however lacking in the capacity to verify and test such limits remains, such

[12] Steven Shapin, **A Social History of Truth: Civility and Science in Seventeenth-century England** (Chicago: Chicago University Press, 1994), 414-15. Shapin develops these and other themes in his **The Scientific Life: A Moral History of a Late Modern Vocation** (Chicago: Chicago University Press, 2008).

watchdog and/or policy activity certainly is better than issuing the equivalent of tarted-up press releases or posing abstract or imaginary ethical dilemmas.

Beyond public relations and nerdy mind games about speculative futures, however, there exists an all-too-ready acceptance of the legitimacy of those human scientists claiming to be experts (for example, in bio-security), available to provide first-order solutions. As has been argued at length in the **Diagnostic**, such a position is dangerous and fundamentally illegitimate in an emergent field whose capacities and ramifications are, by definition, not known. Those who claim to know already are deluding themselves and others. The roots of this type of delusion arise from the common fallacy whereby analogies are taken literally, conflating lessons drawn from past experiences with the current one. There are no experts in the emergent. Obviously, this claim does not mean that past expertise has no role or importance, only that it must be rethought for a quite different context.

After reading an earlier draft of the essay, a friend wrote:

> *Are you sure you really trust these guys? Your argument doesn't seem quite to arrive at such a conclusion and has one or two major qualifications along the way as well. Perhaps it's my misimpression, but I don't take away from your discussion of how people in power and specifically synthetic biologists (and those of their high circles) in power typically operate any grounds for trusting them, but rather the opposite, since even if they operate predictably, part of what is predictable is they sometimes resort to the unpredictable at least as a tactical maneuver.*
>
> *Then there's the matter of being able to count on them to (intend to) "do the right thing." You're suggesting—in your extending of trust to them—that you do count on them to do so—or at the very least to regret making a mistake or committing a moral wrong should that come to pass. OK: but what you say in leading up to that apparent point doesn't really offer your reader much of a basis to participate in your gesture. The guys sound like a rather instrumentalistic lot who might not give a whit if their intentions went awry or they caused harm counter to their intentions. This reader in any event needs more data of a positive sort before he's willing to join you. What am I missing?*

He is not missing anything. These questions and hesitations are all valid. Synthetic biologists have not provided a convincing mode of self-presentation that would instill good will with their critics. And they have not succeeded in instilling confidence as to the transparency of their organizational form in those of us familiar with it. As of 2008, these sociological facts do not seem to trouble the field's innovators and leaders. Although such facts are disturbing, they are not, in my view, definitive. They constitute the reasons for withholding confidence as well as what is ordinarily understood as trust. However, in my interpretation of Luhmann's idiosyncratic vocabulary, trust means risk-taking, not the cool calculation of the most plausible alternatives or an affective bond determined by familiarity. Perhaps it is familiarity with the milieu and the overall project that encourages me to follow the risky alternative. Is that the wisest way to proceed?

Trust, understood as a practice of risk that is not operating according to a metric of calculative probability, nor necessarily in accord with affective bonds, is at the heart of the anthropological enterprise. Who, after all, on the basis of rational actor theory, would spend such long periods of time hanging out, observing other people's labor and boredom, hoping that one had chosen the right site of inquiry, in order to have the opportunity to write a book that several hundred people (or eventually several thousand) would read? Thus, it seems to me that one has to trust that the practice is itself inherently worthwhile: that conceptual invention and clarification, ascetic exercise of the will in the pursuit of knowledge and insight, and forced training in listening, looking, and passivity will yield affective dividends for one's soul, one's friends, and that small motley of future students and readers. Having engaged in that practice for several decades, it seemed worth suffering the proverbial slings and arrows of academic insult, the pervasive indifference of policymakers, the mildly condescending tolerance of the bio-scientists, the trained incapacities of fellow social scientists, to risk something different. The dangers of traditional anthropology after a certain point are all too familiar and neither very grave nor interesting. The risks, I am relatively confident, are obscure, and therein lies the challenge.

In sum, a form of risk-taking is at the heart of the anthropological enterprise. In traditional anthropology, it makes no sense to conclude that one should or should not trust the Tikopia. In an anthropology of the contemporary, especially one engaged as a participant as well as an observer, one might well reach a number of diverse and nuanced evaluations, ones that are the product of the inquiry but ones whose metrics and forms as a practice exceed anthropological method per se. How to think through and practice this supplement is, to make the claim one last time, exciting and risky.

Anthropological inquiry taken up as an ethical practice of collaboration as well as discrimination and discernment poses a challenge and constitutes a problem. It poses a challenge because mainstream anthropology has not developed proven methods to undertake work in this mode, largely leaving issues of ethics absent or tacit. It constitutes a problem because it is not clear how Human Practices can be made an integral part of an enterprise such as SynBERC. It is also problematic as to how the inclusion of a Human Practices component would catalyze better practice. Thus, the ethical and anthropological stakes of the challenge and the problem are risky.

How could ethics be made integral with the practice of anthropology? One building block of such an assemblage is the conviction that, like inquiry in traditional anthropology, the invention of an ethical metric and practice in the anthropology of the contemporary is itself inherently worthwhile. Such a presupposition would be less hazardous if trust were predicated on confidence, understood as the result of calculations about how well the future can be controlled and dangers avoided. However, when engaged in Human Practices, consisting of this relatively untested combination of ethics and anthropology, the question is not: Do we trust the technical ability or moral character of the researchers to manage or control the future or even to discern good and evil? Rather, the question is: To what extent will this collaborative enterprise contribute to flourishing? Said another way: Is this enterprise worth risking trust for? In that light, trust is a reflective practice and not a calculation or a possession.

Hence, confidence in the actors or the organization, per se, is not a necessary predicate of trust, although familiarity with their practices would seem to be. Rather, an essential predicate of trust as risk is a conviction in the worth of inquiry per se. Regardless of the technical successes, failures, achievements or mistakes of synthetic biology, inquiry about it is worthwhile. In order to conduct such inquiry as a mode of ethical engagement, one must adopt a mode of uncertainty about the sufficiency of expertise and experimentation with regard to questions of value and worth. It is in the space of uncertainty and experimentation oriented by a metric of flourishing that it becomes possible for an ethics to become a practice of inquiry rather than a discourse of values and expertise. And once ethics becomes a practice of inquiry, the practitioner enters a problem space in which collaboration as well as discrimination and discernment comes to the fore. How such foregrounding might lead to an increase of capacity for reconstruction and remediation is the challenge and the problem.

Chapter 11

Recapitulation. In Search of a Venue: Biopower and Synthetic Anthropos[1]

"The **polis** comes into existence, originating in the needs of life, and continuing in existence for the sake of the life well lived." Aristotle, **Politics**, Book I, Ch.2.

Our principal lesson learned is that we are in need of a remediated venue. Recall that in our diagnostic a **venue** is a facility. Among other things, it facilitates the composition of equipment. Additionally, a venue facilitates or enables ethical formation insofar as equipment is put to work, made operational, both within the venue and beyond. The principal lesson learned, in other words, is that we are in need of a venue or venues that will facilitate both the composition of equipment and its associated ethical practice.

Strikingly, after having spent some time evaluating our experiment and experiences, we find ourselves once again faced with questions similar to those we posed at the outset of our undertaking. For example, what is the **object** of our ethical engagement? What are the problems and modes to which and by which we should orient our thinking? What is the **metric**, the **ratio**, by way of which we calibrate our work? And what is the **purpose** of this form of practice? Today, returning to these initial questions, the difference is that we are capable of responding in a more refined, chastened, and exacting manner. Currently, we have at hand a repertoire of equipmental elements, the results of our experiments and experiences, as well as tested practical wisdom for discriminating which objects and which actions are worthwhile and which are not. We also know now that we are in need of a venue, and that its construction and assemblage today constitutes our primary challenge.

Movement toward the invention and synthesis of a more appropriate venue, we now understand, requires the **remediation** of both the substance and the form of our inquiries and above all of their relations and interfaces. We defined remediation as consisting of two salient features: a change of medium and an improvement. We have since become clearer on the steps one would have to take in order to develop practices wherein a change of medium can produce improvement, relative to a given metric, object, and purpose.

The steps can be laid out in a series, to be taken up in a recursive manner:

1. **recapitulation**: array elements so as to identify indeterminacy and discordancy;
2. **rectification**: recompose elements as redeemable;
3. **ramification**: establish pathways from one medium to another;
4. **reconstruction**: collaborate toward ethically superior forms.

As of mid-2008, we have taken up the first three steps. To the extent that we are able to design and compose a venue more appropriate to our work and ethical commitments, the pathway to step four is apparent; where exactly it will lead remains to be explored. In this chapter, we recapitulate a central aspect of the situation in order to clarify analytically one significant vector of interference.

[1] This content is available online at <http://cnx.org/content/m18820/1.1/>.

11.1 Recapitulation 1: Toward Synthetic Anthropos?

This exercise in recapitulation begins with a return to **synthetic anthropos**. Our diagnostic, recall, is composed of **three figures** and their **equipmental correlates**. The diagnostic includes two well-recognized, if often misinterpreted, figures, **biopower** and **human dignity**. It also includes an emerging constellation of elements that are currently being brought into relation to one another and may well be coalescing into a third figure. Provisionally, we have named this emergent configuration **synthetic anthropos**. The term is a placeholder. It draws attention to the ways in which **contemporary** problems are being taken up through the production of objects as well as the redesign and reconfiguration of pathways. The diagnostic was originally designed with the aspiration of facilitating the work of distinguishing, characterizing, and, where possible, contributing to the **emergence** of synthetic anthropos and its equipmental correlates. It can then serve to assess whether and how such equipment was worthwhile given the purpose of flourishing.

In 2006, a key factor in our electing to participate in SynBERC was that it promised to be a venue for scientific and ethical experimentation emerging in an adjacent relation to, but clearly distinguishable from, either biopolitical or humanitarian apparatuses. On the scientific front, we took synthetic biology to be potentially exemplary of key ontological and organizational features of the post-genomic life sciences: a reconstructive mode of engaging problems, an opening to flourishing as an ethical metric, an affinity for emergent assemblages, and a focus on the construction of pathways and thereby new biological forms. Likewise, on the equipmental front, we took synthetic biology to be potentially exemplary of post-genomic efforts to rethink prior **methods** of ethical engagement, methods which had been designed as cooperative, downstream, expert-oriented, and regulatory. We saw the challenge as transforming these methods to become collaborative, upstream, experimental, and remediative.

Although our work was oriented to the goals, practices and experiences of the synthetic biology community, our efforts were calibrated to a **metric of flourishing** (**eudaemonia**). Although we lacked a precise conceptualization of what contemporary flourishing might consist in, we had initial indications that the term was both heuristic and suitable to the design parameters and a daily practice that we hoped would contribute to a form of life.

Flourishing must be distinguished from technical optimization: as a **metric**, technical optimization presumes that our capacities are known in advance. A striking feature of synthetic biology was precisely the proposition that through re-design and re-composition living systems could be made to function differently, and, hopefully better, i.e., new capacities could be produced through the re-stylization of old materials. Flourishing is also distinguished from uncontrolled growth, progressivism, or the undirected maximization of existing capacities. Finally, flourishing is distinguished from instrumental or personal gain.

Positively, flourishing as a metric extends to the kind of human being one is personally, vocationally, and communally, as well as the venues within which such human flourishing becomes possible. Synthetic biology was neither avant-garde nor revolutionary; it was calibrated to the re-assemblage of natural systems and their components to solve targeted design problems. Our question, then, was: How might synthetic biology be made to contribute more, rather than less, to flourishing?

The challenge of flourishing in synthetic biology, it seemed to us, could only be effectively taken up in a **collaborative** mode. The problem spaces in which synthetic biology was emerging, (and which its most media-oriented proponents promised to revolutionize) ranged over medicine, energy, security, and the environment. The challenges characteristic of these problem spaces are more than technical, though their technical dimensions are certainly significant. As such, the goods promised by synthetic biology required interfacing technical advances with other human practices considerations. Indeed, a principal justification offered to NSF for funding SynBERC was the proposal that the potential of biological engineering could not be actualized without significant re-assemblage of existing organizational and experimental practices. The problems taken up by synthetic biology transected existing university disciplines and exceeded the purview of existing forms of expertise. Work on this problem space required conceptualizing interfaces among and between experts, labs, funding streams, and institutions so as to bring together a range of actors, know-how, and resources into a concentrated, coordinated, and productive assemblage. SynBERC proposed to facilitate such strategic interfaces.

The prior work of SynBERC director Jay Keasling was taken to be a proof of principle of such a collabo-

rative venue. Keasling's artemesinin project had demonstrated the productive potential of a venue in which techniques of synthetic biology could be made efficient and synergistic in confronting real-world problems. This productive potential depended on the design and construction of strategic relations among the Gates Foundation, One World Health, multiple university labs, and a private company, Amyris Biotechnologies. A key feature of the artemesinin project was its overall design as a research and delivery pathway, consisting of a series of key juncture points at which work accomplished in one lab or institution was passed on to another. The design of such juncture points required recognition of the capacities and limitations of each sub-venue so as to facilitate movement toward overall solution of the scientific and delivery challenges at hand.

In our technical vocabulary, such a venue requires the production of an **agile assemblage**, accomplished by way of **leveraging** the expertise and resources of otherwise heterogeneous **specialists**. Additionally, the range of **specialists** and their mode of collaboration are not defined in rigid terms. Rather, it is designed for coordinated and strategic work on a specified problem, with the idea that elements of the assemblage could be disarticulated or re-articulated as work was either blocked or completed.

A crucial feature of the artemesinin project was that it was problem-centered. On one level, the specific work undertaken was non-generalizable, i.e., the funding structure, research plans, and outcomes were focused on the problem of producing and delivering a molecule of interest at a cost low enough to make the molecule available to those who need it most. The flexibility and functionality of the organization was facilitated in part by this limited purview.

Limited in its focus, this problem-centered approach can be seen to exemplify a more general **reconstructive mode of veridiction**. The truth claims produced and taken seriously in the enterprise were those that could be put to the test in the experimental and pragmatic situation at hand, and that might subsequently be reused in reworked form. A principal hurdle for the project was the construction of a scalable pathway for the chemical precursor to artemesinin. This precursor could then be used as a platform for subsequent work on biofuels. In both cases, the underlying bio-chemistry was conditioned by an ethos—malaria in the first place, the energy crisis in the second. As such, although technical virtuosity and prowess are significant capacities within this **mode of veridiction**, such capacities only enter fully into the play of true and false when they contribute to and are conditioned by problems specified as part of a wider ethos.

Given this immediate backdrop, we anticipated that SynBERC would be a venue whose form, ethical metric, and modes of practice might be inventive and experimental. Our goal was to help design a new venue for bringing the biosciences and the human sciences into a mutually collaborative and enriching relationship, a relationship designed to facilitate a remediation of the currently existing relations between knowledge and care in terms of mutual flourishing. The means to inquire and explore to what extent these new relationships could be fruitful consisted in the invention and design of **Human Practices**. In sum, we thought SynBERC could be a venue characterized by the above elements and that these elements could be assembled into a practice worth pursuing.

11.2 Recapitulation 2: Biopower & Biopolitics

Our initial diagnosis of synthetic biology was deficient and overly sanguine, as such initial assessments often are in emergent and experimental situations. Our efforts to contribute to the formation of synthetic biology by way of human practices equipment has been received by some as threatening and disruptive, by others as incomprehensible, and by others as simply having little or no importance. Therefore, we have found ourselves consistently blocked either actively or passively. Although there are personality issues involved (as there always are), and there have been local complications and conjunctures (e.g., the winning of the BP monies and the DOE Joint Bio-energy Institute at Berkeley), we will focus here on what we take to be the principle obstacle: prominent sectors within SynBERC are being fashioned and oriented according to a metric (and dispositional set) that, to the degree that it is conceptually coherent or reflected upon (which is minimal), must be characterized as one of biopower and biopolitics.

The National Science Foundation's support of SynBERC was predicated in part on the success of the artemesinin project. Keasling had demonstrated an ability to bring together and productively interface a range of actors and institutions. SynBERC's organization and objectives, however, differed in consequential

respects from this earlier project. An initial design requirement concerned the coordination of existing disciplinary and experimental practices (chemists approach problems differently from molecular biologists). The logic of the strategic plan followed the parts-based approach to synthetic biology. The goal of this approach, recall, is to render biology into a fully standardized engineering discipline on the analogy of electrical or computer engineering. The means of achieving this goal is the production of a registry of standardized and modularized biological parts that can be added together (on a linear model) to form functional devices, which in turn are combined into "systems" within cellular chassis. Parts-devices-chassis—one design approach to the challenges of synthetic biology, among others—was made into the guiding principle for organizing SynBERC research.

It is clear that, following our conceptual and diagnostic categories, SynBERC's strategic plan offered an organizational model characteristic of traditional biopolitical, that is to say **governmental**,venues. To be successful, this strategy for organizing a research venue requires a stable venue in which large amounts of material, both produced and collected by a team of dedicated technicians, can be gathered, sorted, and distributed in an ongoing fashion. In other words, the parts-based approach requires a governmental parts fabrication facility. It comes as no surprise that the chief advocates of this design and composition approach have been negotiating for several years to establish such a parts-fab, looking to the large national labs. To date the parts-based approach is yet to be proven credible to a degree that would mobilize sufficient funding for an undertaking of this scale. Regardless, the purpose of such a fab would be to do for biological engineering what Texas Instruments did for electrical engineering after World War II: provide an exhaustive catalogue of standard, interchangeable, and context-independent parts for the additive composition of biological systems.

All of this suggests an affinity, if not an identity, between biopolitical equipment and the parts-based approach to synthetic biology. Much like the **biopolitical venues** of the nineteenth and twentieth centuries, in which **technocrats** worked with **probabilistic series** in order to accomplish **normalization** in social fields such as health and welfare, the fabrication of standardized parts for general use in biological engineering requires a venue in which long-term stability and continuity can be institutionalized. A principal hurdle to the success of synthetic biology according to the parts-based approach is that biological design and composition today remains too idiosyncratic and local. Practices and materials are not standardized across labs and institutions. The credo remains that challenges associated with the nonlinearity and context-dependence of living systems can be overcome through the combination of strict rationalization and modularization as well as standardization and abstraction. A **governmental venue** could work to overcome the fragmentation and irregularity of current practices through a long-term process of standardizing orders from individuals and labs, fashioning those parts according to specified standards, and adding them to an expanding pool of fully interchangeable, vetted, and well-characterized parts.

Of course, all of this begs the question of the extent to which the parts-based approach is technologically and scientifically feasible. At present the parts-based approach remains more manifesto than research program. Although the biological research program at SynBERC is organized officially according to the parts-devices-chassis model, to date few of the SynBERC PIs employ this approach in any strict sense. As such, the existing venues for parts-based work are the MIT-hosted registry of standardized parts and the annual iGEM (international genetically engineered machine) competition. Even in the case of the parts registry and the iGEM competition, the question of the extent to which biological complexity and dynamism can be black-boxed remains open. Researchers at Virginia Tech, for example, have shown that only a handful of the parts catalogued in the registry are context-independent in anything like the BioBricks vision. The parts-based approach will need to demonstrate the feasibility of a fully standardized engineering approach on the model of computer engineering before a governmental parts-fab is likely to be constructed and put into operation. And unless such a fab is put to work, the question of whether it would succeed, or better how and to what degree it would succeed and to what it degree it would discover limits, cannot be answered.[2]

[2]Over the past several years the parts-based approach to synthetic biology has frequently served as the basic manifesto for synthetic biology in the United States, and, through the iGEM competition, to a lesser degree in Europe and elsewhere. In the specific case of SynBERC it has provided the rationale for the organization of research and for the articulation of core objectives. It is telling that the core SynBERC researchers, with one or two exceptions, have yet to adopt the parts-based approach in their labs. Not surprisingly, this disjuncture between manifesto and research has been the source of difficulties in presenting SynBERC's research for review. Despite the fact that the parts-based approach is not widely practiced, it nevertheless continues

The parts-based approach may yet demonstrate its worth, although it will likely be in a position to do so only if it is capable of incorporating the insights and demonstrations of other research strategies. To a degree, living systems may be susceptible to being reduced to a collection of standard interchangeable parts; further experimentation will answer this question. In such a case, a specific type of specialist will be required. This **specialist** will function on the model of the **social technocrat**. Recall that in the **composition** of biopolitical equipment actors are needed who are capable of interfacing disparate modules (i.e., **modes of practice**, **serious speech acts**, and **affects**) and composing them into equipment. Analytically, specialists who compose biopolitical equipment as **social technocrats** can be distinguished from **social technicians** in the sense that technocrats are the managers of technicians and technologies, while technicians are charged with the production of the verified reductions that constitute the elements in a probabilistic series. In a similar way, the fabrication facilities called for by the parts-based approach need specialists to manage the work of collecting designed biological units and the rendering of those units into standard interchangeable parts. Said another way, **biological technocrats** are needed, who are charged with the task of equipmental invention, oversight, and management of a biopolitical type (but not the details of its technical implementation per se). Such technocrats can be called "technicians of general ideas." The general ideas in this case consist of facilities for the de-contextualizing of genetic sequences and the fashioning of those sequences into interchangeable parts.

In biopolitical equipment the **mode of composition** is **planning**. Planning distinguishes the way in which equipmental modules are worked on such that their interfaces can be designed and such that they can be synthesized into a biopolitical equipmental platform. In this mode of composition, the first set of **upstream design parameters** derives from the constraints of a field of normalization. In a similar way, the first upstream design parameter in the parts-based approach to synthetic biology derives from the constraints implied by the challenge of standardization. That is to say, planning is a mode of composing equipmental modules such that the nonlinear, mutable, and context-dependent features of living systems can be effectively and successfully ignored. This black-boxing is accomplished not through conceptualization or experimentation, but through the rigorous imposition of design and composition standards across research venues. **Downstream parameters** consist of the challenge of fashioning parts in such a way that they will function effectively to solve specific cases but simultaneously will be capable of functioning in a range of other cases. That is, biopolitical compositions must be designed and synthesized so that they will be able to function as biopolitical platforms.

11.3 Recapitulation 3: Mode One and its Discontents

The predominance of biopolitical elements in the parts-based manifesto goes some way to explaining why it is that a Human Practices approach to synthetic biology undertaken in a Mode One manner continues to be taken as plausible. Mode One experts are oriented to the maximization of means-ends relations. In our diagnosis of the situation, such an approach falsely draws its assurance from its conceit that it can take for granted the issue of what currently counts as a significant problem. For example, BioBricks, operating on analogies from electrical engineering and oriented toward the creation of governmental venues, routinely makes confident proclamations that amount to claiming that the most important challenges and goals in synthetic biology can be and in fact are known in advance of experimentation and testing.

A constant refrain from Human Practice advocates of Mode One, as well as from the funders of synthetic biology, is that the principal focus of Human Practices research should be security. The hoped-for outcome of this work would consist of guidelines for the regulation of synthetic biology in such a way as to minimize adverse security events in the contemporary political milieu. The question today is: to what extent is

to infuse the rhetoric and rationale for much research. If the character of the parts-based approach is basically biopolitical, the question should be asked to what extent research programs that diverge from the parts-based approach fall outside of that figure. Such a question can only be answered through inquiry. Our preliminary examinations, as we detailed in the last section, indicate that other approaches—the systems approach in particular—fall outside of the biopolitical. The venues called for by these approaches are hybrid assemblages characterized by multi-institutional and multi-funder leveraging, as well as agility in the arrangement of partnerships and the selection of specific problems.

such an approach appropriate and worthwhile? To date, Mode One work on security has been framed in terms of the challenge of risk assessment. What kinds and levels of risks does synthetic biology present, and what kinds of regulations can be put in place in view of those risks? A central—though insufficiently examined—supposition of Mode One experts is that they are capable of conceptualizing dangers, both known and unknown, as risks that can subsequently be assessed with appropriate rigor and plausibility. In our view, the existence of such a capability is very much in question.

Few deny that synthetic biology, to the extent that it makes biology easier to engineer, introduces new dangerous actions and actors into the post-9/11 political milieu. The question of whether or not, as of today, such dangers can be assessed as risks, however, remains an open one. That question depends in part on the ability of Mode One specialists to figure synthetic biology through the terms of biopower, that is, as a field of probabilities, conceptualized in a verificational mode, and made available to techniques of normalization.

Following Niklas Luhmann, it is useful to distinguish dangers from risks.[3] Dangers are empirical factors that exist in the world in a scientifically under-examined state. Strictly speaking, dangers are inchoate in a veridictional sense, which is to say lacking a conceptual structure to order them, and hence they do not operate in the domain of legitimate truth claims. It is only once dangers are conceptualized and enter into a grid of knowledge that technically they become risks. Risks, unlike dangers, can be scientifically assessed. The relative likelihood of a series unfolding in a particular manner can then be determined, and strategies for minimization and maximization elaborated.

There are, of course, different ways of thinking about dangers, and therefore different ways of turning them into risks. The biopolitical mode is probabilistic. This mode is the way proposed by Mode One experts. On the most refined readings, security-related events in synthetic biology are conceived in terms of the ratio between probability and consequence. Events of interest are taken to be of low probability but of high consequence. The question is: how is such a judgment made? How can it be known whether or not the probability of events is low or high? Such judgments, again strictly speaking, can only be made in relation to a multiplicity of actual events. It is only when there have been multiple events categorized and classified that they can be taken up as a series. It is in relation to this series that claims of probability can be systematically derived. This probabilistic mode arose from insurance in which long statistical series were established and from which probabilistic accounts were constructed.[4] Specific sectors of these probabilistic series could then be assigned risk values and insurance premiums could be calculated.

The challenge for Mode One experts is not only to establish probabilistic series, but also to formulate techniques and technologies—equipment—for intervening in those series. Here **normalization** enters in. Probabilistic series can only be established within a structured field of relations. This means that a metric is needed for determining what things qualify. Once that metric is established, then things can be picked out as elements, associated, displayed, and coordinated as a **relational field**. In order to achieve the end of security through regulation, the elements picked out will need to have the minimal characteristic of being susceptible to being normed.[5]

If Mode One experts are able to normalize distributed fields of risks in relation to synthetic biology, they will need to engage in a **verificationalist** mode of reasoning, which, to date, they have been unable to do. This mode of veridiction takes seriously those truth claims which can be verified through the reduction of particulars to calculable regularities or patterns. Verification, recall, means both "to substantiate," that is, to make into cases (this is the hermeneutic side of verification) and to "prove the truth of something" (this is the positivist side). If Mode One experts become capable of reducing particular events in synthetic biology (as well as relevant events in the political milieu in which synthetic biology is developing) to calculable regularities or patterns, they will thereby be able to established probabilistic series as well as distribution

[3] Niklas Luhmann, **Risk: A Sociological Theory** (New York: Aldine Transaction, 2005).

[4] Ian Hacking, **The Emergence of Probability: A Philosophical Study of Early Ideas about Probability, Induction and Statistical Inference** (Cambridge: Cambridge University Press, 2006); Alain Desrosieres, **The Politics of Large Numbers: A History of Statistical Reasoning** (Cambridge, MA: Harvard University Press, 1998).

[5] Recall that normalization designates a project to order aspects of things according to regular distributions. Norms constitute the grounds for normalization. If the elements picked out as a danger and as a risk are social, then the project of normalization is also normative. Values are assigned to different distributions of risk, and social interventions can be designed to affect these different distributions.

values. In this way they will be able to determine the prescriptive norms for social intervention.

11.3.1 In sum

To date, a shortcoming of most regulatory proposals in synthetic biology is that they lack the probabilistic series and risk values in relation to which meaningful equipmental proposals in this mode could be proposed, i.e., the proposals lack core modules of biopolitical equipment. Most problematically, they lack verified reductions—the type of serious speech acts characteristic of verification. Mode One experts in synthetic biology are not yet capable of converting dangers into risks. Indeed, they do not yet have standards for picking out what counts as dangerous with any analytic power. Finally, even if all of the requirements to qualify as knowledge were to be met, if the assessment of risks cannot be composed into regulatory equipment, the consequences for SynBERC and related undertakings would be minimal.

11.4 Conclusion: Interferences

As of today, the question of the worth of fashioning synthetic biology in a biopolitical mode or figuration cannot be fully answered. The critical limitations of the parts-based approach in synthetic biology cannot be scientifically assessed until a venue is constructed in which such an approach can be effectively tested. Likewise, the critical limitations of Mode One in a biopolitical mode for resolving the equipmental discordancy in synthetic biology cannot be fully determined until BioBricks becomes a full-fledged research program, with all that implies in terms of venue, specialists, and mode of composition.

Many of the critical limitations can certainly be anticipated, as we have shown in our analysis of research programs and human practices modes. It is plausible to hold that such **verified reductions** may never be produced. If commonly accepted speculations about dangers prove correct and security events involving one aspect or another of synthetic biology are of the type "low likelihood/high consequence," there may never be a minimum number of actual events required in order to create a series in relation to which high and low probabilities can be calculated.

In the meantime, there are important initiatives underway outside of SynBERC that attempt to compensate for this lack of actual events by creating hybrid modes that straddle Mode One and Mode Two. For example, members of the E.U. research initiative **Synbiosafe** are conducting hundreds of interviews with biologists concerning their views of safety and security.[6] One of the aims of these interviews is to determine the relative conscientiousness or awareness of biologists relative to questions of security and synthetic biology. The data they are amassing is certainly susceptible to verification, and as such can be made into a field of normalization. Such a field, however, will not be useful for the regulation and minimization of **security**-related events, per se. Rather; it will be useful for establishing norms and distribution values relevant for designing educational and other consciousness-raising equipment. In other words, the verified reductions produced by the Synbiosafe researchers will contribute to the problem of security only indirectly: they will tell us the extent to which current biologists take the problem of safety and security seriously. Presumably, increasing the number of biologists who do take these issues serious will affect the likelihood of a dangerous event occurring, although such likelihood—to make the point again—still could not be calculated.[7]

[6] See http://www.synbiosafe.eu/ (<http://www.synbiosafe.eu/>)

[7] Given that many of the elements of synthetic biology can be characterized as biopolitical, one strategy would simply be to take synthetic biology up in a biopolitical frame, and deal exclusively with these elements for the time being, or at least until their scientific and equipmental limits can be more firmly determined. Such a strategy might suggest itself when we consider that, read against other contemporary analysts, our concept of biopower is defined in rather exact and limited terms. The effect (intending to be sure) of these limits is to analytically place much of what is happening in synthetic biology outside of the figure of biopower. But perhaps such distinction is analytically too refined, and as a result insensitive to features—scientific and equipmental—that a broader reading of biopower might provide. Our strict definition of biopower was itself strategic. We noted that the terms "biopower" and "biopolitics" are being used in a growing number of ways, most of which seem to us misleading and misguided, either because they are too epochal (i.e. everything is biopower) and thereby explain nothing by explaining too much, or they are too rigid and therefore not capable of recursive rectification in relation to the materials of inquiry. Given the multiplicity of figures and their re-assemblage in the contemporary world, the need to limit our definition of biopower and show its relative connections to other figural and equipmental complexes seemed warranted. If our definition of biopower is

11.4.1 To recapitulate

The figure of biopower consists of a minimal series of elements: a verificational mode of veridiction, a metric of normalization, a probabilistic ontological mode, and its object and anchor point is the relation populations-bodies. Nowhere in synthetic biology, as of today, are populations and bodies the object of concern. Probabilistic series are not the predominant ontological mode, although as work progresses a form of probabilistic reasoning may emerge. Although one could imagine a scenario in which normalization becomes a goal of synthetic biology, current work drives more toward regularization and eventual standardization. Veridictionally, despite the efforts of the BioBricks foundation and their "registry of standardized parts," experimental work being conducted under the aegis of synthetic biology has not been able to reduce particulars to calculable regularities or patterns; unlike biopower, it is thus not verificationalist, in the strict sense. The crucial analytic point here is that while aspects of synthetic biology exhibit features similar to the figure of biopower, much of what is going on falls outside of that figure. Synthetic biology, even at its most biopolitical, consists of a re-stylization of the elements of biopower with different objects, different ontological modes, and different metrics.

Thus, much of what is happening both in synthetic biology (more generally) as well as in SynBERC exceeds the figure of biopower. What this means is that SynBERC is a venue at odds with itself twice over. In the first place, it draws its official self-understanding and organizational model from the predominant synthetic biology manifesto—the parts-based approach. Meanwhile, the actual research programs in the SynBERC laboratories (and other synthetic biology laboratories) are ramifying in ways that diverge from the ontological suppositions of that manifesto. A similar and related tension marks Human Practices. If problems ensue when one attempts to use previous sets of ethical equipment on objects for which they are not suited, then the unresolved ontological question contributes in a significant fashion to a state of ethical stasis. Ethical **stasis** under the present conditions might well be relatively harmless—mere incoherence—or such stasis might contribute to a situation in which dispositions, forms, and practices are maximized and strengthened that will obscure the identification of problems and consequently contribute to blocking or foreclosing the pathways to remediating contemporary forms.[8]

insufficient, it is certainly not because it fails on the first count: whatever else, it is not epochal. But perhaps it fails on the second. Our definition was formulated on ideal typical series for orienting inquiry, a series that works by decomposing complex wholes into modular categories so as to show the logic of the relations among those categories. Perhaps the categories are too few or the logic of the set too strict. Perhaps our concept needs loosening.

[8]Stasis: a state in which there is neither motion nor development, often resulting from opposing forces balancing each other. Greek thinkers, like Thucydides, used the term **stasis** to refer to a state of incipient or simmering warfare or hostilities.

Chapter 12

Rectification and Ramification. Toward Ars Synthetica[1]

In common usage, rectification means to put something right. In chemistry, rectification refers to a process of refinement through distillation. Our anticipation is that rectification will expedite experimental reorientation consisting of strategies for re-design and re-composition.

Rectification begins with a return to **synthetic anthropos**. Our diagnostic, recall, is composed of three figures (two actual and one virtual) and their equipmental correlates. The diagnostic includes two well-recognized, if often misinterpreted figures, **biopower** and **human dignity**. It also includes an emerging constellation of elements that are currently being brought into relation to one another, and may well be coalescing into a third figure. Provisionally, we have named this emergent configuration **synthetic anthropos**. The term is a placeholder. It draws attention to the ways in which **contemporary** problems are being taken up through the production of objects as well as the redesign and reconfiguration of pathways. The diagnostic was originally designed to facilitate the work of distinguishing, characterizing, and, where possible, contributing to the **emergence** of synthetic anthropos and its equipmental correlates.

As of 2008, in light of our initial experimentation, we are taking up synthetic anthropos less as an actual figure coalescing in the world, and more as a virtual figure in need of form. As a virtual figure, synthetic anthropos functions as a series of scientific and ethical design parameters and modes of composition. The design parameters facilitate critique and construction by throwing into relief **externalities** and **critical limitations**, and by showing where and how those externalities and critical limitations are contributing to scientific indeterminacy and ethical discordancy. They facilitate clarification, more precise adjacency, and a sharper orientation to secession in relation to existing configurations of indeterminacy and discordancy. Most importantly, they facilitate the work of re-imagining and re-constructing pathways toward better equipment and better venues.

For the time being, **synthetic anthropos** consists of a design challenge set within a compositional mode. In a compositional mode, the design parameters of **synthetic anthropos** should facilitate the work of transforming our lessons learned into modules suitable for new equipment. Subsequently, it should enable us to synthesize those modules into a more productive practice. To this end, our immediate priority is less discovering **synthetic anthropos** as an object of study and more about rendering **synthetic anthropos** as an object of composition, with all that entails, above all the challenge of constructing a venue capable of facilitating such work. In short, today we are in search of the elements, relations, objects, and modes required compositionally for **synthetic anthropos**. We are in search of **Ars Synthetica**.

[1] This content is available online at <http://cnx.org/content/m18821/1.1/>.

12.1 Ontological Indeterminacy, Equipmental Discordancy

Clarity about indeterminacy and discordancy facilitates the work of putting things right through an analogical process of distillation. Careful attention to sites of indeterminacy and discordancy has helped us clarify key diagnostic outcomes of our experiments to date. Such clarification facilitates rectification. But what, more precisely, are **indeterminacy** and **discordancy**?

Indeterminacy is a question of knowing and thinking. Such work may take place in a situation that requires a scientific form for its eventual determination. Indeterminacy is a scientific question insofar as rectification of indeterminacy requires recursive experimentation within various defined modes of veridiction and inquiry. In addition, indeterminacy can also be taken up as an ontological problem. In synthetic biology, indeterminacy is an ontological problem insofar as objects, relations, and forms are being invented; that is to say that indetermination is being given determinate form through the production of new objects. It is worth noting, following Ian Hacking, that such objects, relations and forms can be those of human practices as well as protein scaffolding and the like.[2] A human practices lab or a tumor-killing bacterium are both things of the world either actually, potentially, or virtually. How they are formed, endure, and function are properly questions of ontology subject not only to philosophic speculation and clarification but to anthropological inquiry of both a first and second order sort.

Following Dewey, we hold that moving from indeterminacy to greater determination should be conducted in a mode of reconstruction; such work is by its very nature ethical if it is being done correctly. After our initial year of orientation, diagnosis, and inquiry, we conclude that currently at least some types of reconstructive work are being blocked by unreflective attempts to figure synthetic biology in terms characteristic of, and appropriate to, biopower. Such blockage results in more indetermination—the "parts" strategy does not produce the results it seeks—or a discordant situation. Taken up as a problem of reconstruction, contemporary inquiry requires an approach that understands and takes into account the sufficiency and insufficiency of biopolitical modes of being, their modes of veridiction and jurisdiction, as well as the venues in which they are facilitated.

Discordancy is a question of alignment and discrimination. Such work may take place in a situation that requires ethical formation for its possible rectification. Discordancy is a question of ethics in so far as rectification of discordancy requires recursive discernment of ethical practices within defined modes of jurisdiction. Common sources of discordancy include the un-aligned interface of multiple ethical modes, or the interface of an ethical mode and objects, relations, and forms which call for adjustment. In addition, discordancy can also be taken up as an equipmental problem. In the case of human practices, discordancy is an equipmental problem in so far as objects in a relational field are taken up so as to form them into a practice, i.e. coherent, internally consistent, and metrically calibrated. That is to say, discordancy is being worked on to the end of non-discordancy through the discrimination and organization of practices that govern the object (relation) according to a specified metric. Thus, for example, the work of biopolitical equipment composed to achieve normalization of populations and bodies becomes discordant when it attempts to work over objects fashioned in other relational fields (e.g., forms-pathways), or, when the attempt is made to put biopolitical equipment into operation alongside equipment designed to protect dignity. Such discordancy can be rectified through second-order observation of the appropriate limits and interfaces between equipment and objects, as well as between equipmental types.

From the outset we recognized that a central ethical challenge consists in interfacing equipment to appropriate objects. It bears repeating that "appropriate" here ranges over elective affinity, mutual consistency, coherence, and co-operability. In this sense, discordancy is a problem of inappropriate equipment. Discordancy ensues when one attempts to use previous sets of ethical equipment on the objects for which they are not suited.

Given these conditions, we observe (in Luhmann's sense) that the problem of discordancy we have encountered can be best addressed as a set of challenges that are practical, specifically equipmental. They are equipmental in that, given the ontological status of specific problem spaces, certain elements need to be picked out and composed into means for working on specified objects for specified ends. It is practical in

[2] Ian Hacking, **Historical Ontology** (Cambridge, MA: Harvard University Press, 2004).

that equipment must not only be designed, but its composition and operation facilitated. Our diagnostic work indicates that previous ethical equipment was fashioned in relation to particular metrics, problems, and objects. It follows that changes lie ahead.

12.2 Ars Synthetica: Toward a Venue

Unless we have a venue to work in, pragmatically speaking, we can't take up either the equipmental or the ontological problem. It is important to remember that the task of recomposing venues does not mean that the goal of our work is the production of venues. The **purpose** of our work remains **flourishing**; and the composition of equipment that contributes to flourishing. This work cannot be facilitated without an appropriate venue. Hence, venue design and construction, through the means of a synthetic art, at this conjuncture is paramount. If human practices is going to move toward determinacy and non-discordancy, we need a venue; in order to establish a venue that will facilitate our work, we need to specify and experiment with what the **Ars Synthetica** consists in; then we may be able to turn this array into a practice.

Ars Synthetica is the compositional mode we will work in as we attempt to invent such a venue. Given our goal of the redesign of equipment so as to make it appropriate for an imagined venue, we take the precaution here of reviewing (one last time) a series of slippages that have contributed to blocking or obscuring pathways towards better forms of collaboration, inquiry and ethical action. By so doing, we will have concluded this stage of diagnosis and re-orientation and thus we will be in a position to undertake new work of design, composition and inquiry.

The following are prominent on the list of misunderstandings or contradictions leading to significant blockages in our ability to pursue our project.

- The gap between a self-styled cutting-edge mode of bench science work and the retrograde understanding of the human sciences (including that of some of its experts).
- The results of the first set of experiments in Human Practices that demonstrated the error in attempting to identify a venue with a site. This mistake on our part parallels the misuse of analogy as identification as opposed to a simile that we observed among others in "From Manifestos to Research Programs." Although we identified this metonymic mistake in the practice of others, we seem to have made a similar sloppy move ourselves. Consequently, we have re-examined how this misplaced literalness (that the site of SynBERC could also be a comprehensible venue for Human Practices) resulted in an increased indeterminacy and discordancy.

Having diagnosed the situation, we can begin the process of design again. Before doing so, the required last step consists in identifying some of the key viable elements of the situation at hand, and re-ordering them so that they become available for a renewed attempt at composition. We do this work by drawing a lesson learned from a discipline that confronted a challenge of changing its venue, and did so without consolidating a new one; and we contrast this open situation with that of another field—bioethics—where a successful venue constructed for one set of problems at one historical conjuncture provides insights both into what a contemporary venue looks like and how stasis limits the range, scale, and applicability of even worthwhile venues.

12.2.1 Recent Past: Anthropology

During the 1980s, a growing body of literature (and a smaller body of practice) within the discipline of anthropology began to question, challenge, and eventually experiment with new forms of orientation, inquiry, and presentation. The brunt of this challenge was directed against the reigning understanding of: (a) the temporality of the object of study (the ethnographic present); (b) the form of presentation in which results were presented (the monograph); and (c) the method of inquiry (fieldwork). The challenge to these traditional orientations was exemplified and catalyzed by James Clifford and George Marcus' **Writing Culture: on the Politics and Poetics of Ethnography** (1986). Two decades later, assessments of the results of

this uncoordinated and multivalent experiment or experience are mixed.[3] Nonetheless, to summarize a problematical set of results, it is fair to conclude that:

1. The concept and utility of the "ethnographic present" has been discredited and eliminated to a significant degree ,at least within the discipline of anthropology. The idea that bounded and timeless societies and cultures are the proper object of study of anthropology (or anybody else) has few scholarly defenders and only a lingering set of practitioners. That being said, the rest of the analytic tool kit that was developed in order to study the object of investigation cast as bounded and timeless societies and cultures has remained largely in place. Hence there continues to be a disjunction between what anthropologists are attempting to do today in their research and the tools and assumptions that linger on from other formations.
2. After a wave of experimental, mainly first-person-oriented accounts that have largely exhausted the genre's potential and dissipated the hopes for a revolutionary renewal of writing, no stable form, either in writing or other media or mixed media, has stabilized as an alternative to the monograph. Given the reductions in scholarly publishing, this blockage will continue to pose significant obstacles to understanding and to the remediation of the discipline. Until and unless the traditional monograph (the "tenure book") loses its primacy as the **sine qua non** for evaluating a career (as it has in other disciplines), form and inquiry are likely to remain in an unproductive stasis.
3. "Fieldwork," although still largely under-conceptualized and insufficiently evaluated as a method of knowledge production, has seen, at least incipiently, some promising innovations. Chief among those innovations is the program proposed by George Marcus of "multi-sited ethnography" or a "multi-sited imaginary."[4] At one level, Marcus' proposal is straightforward: given that we no longer can proceed as if the object of anthropology was a single culture or society, located in the ethnographic present, then it follows that bringing in a more dynamic understanding of temporality (frequently through the use of history) and of complexity (often through an expanded tropology) are required if the discipline is to retain claims to legitimacy. Addressing how to conceptualize and inquire into the near future (supplementing and complementing historical and archaeological investigations) and squarely facing the need for collaboration in the face of contemporary situations are currently beginning to be confronted. Although much more work is required to conceptualize, frame, fund, and practice multi-sited work, the orientation obviously has its merits.

Multi-sited venues must be composed; they do not exist ready-made waiting to be found or occupied. To do the work we required, furthermore, they must be composed in a contemporary mode—a stylization of existing of old and new elements interfaced in a different way so as to produce a better form. Thus, it is not a matter of "over-coming bio-power" or "neglecting human dignity" or "what's left of life" but on diagnosis, inquiry, remediation, and eventual reconstruction of the objects, pathways, and forms in their existing, potential, and virtual interfaces, interferences, and synergies.

12.2.2 Recent Past: Bio-Ethics

In other disciplines, including bio-ethics, this malaise about the object, the form of presentation, and the mode of inquiry remains understated and muted. We are convinced, however, that this more settled (or perhaps complacent) situation within bio-ethics is likely to be challenged in coming years. As this work will be central to our next engagements (and as we intend to write about the issues more extensively in another piece), we only mention bio-ethics here as an example of a formerly successful venue in need of rectification.

The successful venue construction and equipmental operations in recent American bio-ethics is an important historical achievement. The successful venue construction in the European Union and its particular equipment is an important historical achievement. Both venues and their associated equipment have provided distinctive solutions within a field of specific problems, both have been given a form that claims generality

[3] Paul Rabinow, George Marcus, James Faubion, Tobias Rees, **Designs for an Anthropology of the Contemporary** (Durham: Duke University Press, 2008).

[4] George Marcus, **Ethnography Through Thick or Thin** (Princeton: Princeton University Press, 1998).

or universality. From a second-order perspective, however, it is striking that these solutions and forms are not the same. For example, one centers on dignity and the other on autonomy; one operates at a national and trans-national level in quasi-governmental venues, the other is more local, etc.[5]

Given that in both instances, bio-ethics included: (a) the articulation of universal norms or general principles which have never been coordinated in a collaborative fashion beyond the particular venue for which they were fashioned and given that their conflicting claims to generality or universality are unlikely to ever be joined; (b) the fact that the journal article, the commission report, and the opinion piece were the founding forms of both and continue to hold sway, it is unlikely that a more flexible, conjunctural and casuistic genre or set of genres for narration and contestation is likely to be well received across venues; (c) the implantation in governmental facilities as the venue for bio-ethics work to be carried out; more **agile assemblages** are unlikely to be welcomed. Hence, we predict with **vigorous assurance** that like the biopolitical formations and equipment we discussed previously, there are indeterminacies and discordances on the horizon for the practitioners of bio-ethics.

Bioethics rendered the relation of venue to equipment invisible or tacit. As such, as changes have taken place ontologically, its practitioners have not shown a strong inclination to animate new, more appropriate, and effective equipment. Furthermore it is no surprise that major investments in the construction of new facilities for such animation have not gained prominence. Thus, in cameo, we have here an example of the construction of a significant venue that worked well for operationalizing equipment of one type; however, its very strength has limited its ability to adapt to and operationalize other equipmental types. In that light, as the objects under consideration are becoming indeterminate (the parts, devices, and the like produced by synthetic biology rather than genes or stem cells), it is not surprising that familiar bioethical equipment has begun to show signs of discordancy.

12.3 Ramification: Human Practices, Toward a multi-sited Venue

As we have seen, the objects at issue in Human Practices work are themselves temporally dynamic; they take on their significance not just from the biological functionality (and that too is inherently dynamic), but from their ramifications in a broader set of interfaces and situations. Equally, the challenge of what form to give to research results in a Human Practices frame has remained nascent—PowerPoint presentations and site visit reports, while acceptable to the biologists, chemists, engineers, and government officials, clearly do not even begin to approach a serious attempt to capture and convey the dynamics and significance of the task at hand. Finally, the attempt to invent and practice Thrust IV within the venue of SynBERC has been stymied; although there are certainly specific individual and local reasons for that blockage, there are more general implications as well that would remain pertinent even if the local actors were more accommodating or accomplished.[6]

Whatever the **venue** of human practices in synthetic biology is going to be, it is clear that it will not be located in one organization, that the range of issues involved will be distributed broadly and differentially, and that the ramifications of insights, discoveries and blockages will have to be monitored and pursued in a dynamic fashion. In this light, the very shortcomings of a particular organization or its actors can point to a questioning as to whether these are more or less accidental deficiencies, initial stages in a recursive process, or catalysts for others, elsewhere, to do better.

12.3.1 Redesign: Interfacing Modules

How to design human practices to interface with some subset of specific sites and functions so as to establish pathways is precisely the challenge we take up as we proceed into our next phase of work and lives. Many

[5] There is a large literature on all of these topics. On the general issues see Jonsen, Defendre etc. On the question of different solutions to a common problematization, see Paul Rabinow, **French DNA: Trouble in Purgatory** (Chicago: Chicago University Press, 1999).

[6] See Alexander Kelle on the generality of this non-responsiveness, "Synthetic Biology and Biosecurity Awareness in Europe," http://www.synbiosafe.eu/uploads///pdf/Synbiosafe-Biosecurity_awareness_in_Europe_Kelle.pdf (<http://www.synbiosafe.eu/uploads///pdf/Synbiosafe-Biosecurity_awareness_in_Europe_Kelle.pdf>) .

of these pathways will establish connections with sites whose work is coherently cast in either Mode One or Mode Two terms. Several of these sites have built and/or crafted venues that are appropriate to their mode of work, that is to say, that facilitates it. Human Practices is vigilantly not attempting to duplicate the work or mode of work of these other sites although we have much to learn from them in terms of how they identify problems, craft solutions, give form to their efforts, and become aware of their own externalities and critical limitations. The task that faces us is to (a) undertake a process of orientation and inquiry so as to establish which facilities and modes are having success and are open to collaboration; (b) conceptualizing what a second-order approach would look like taken down to the level of smaller scale elements rather than comprehensive or unified domains; and (c) designing a strategy for constructing a type of equipment that would function within such a dynamic, multi-sited, multi-order strategy.

During the first eighteen months of our work at SynBERC, we have identified the following sites and possible pathways for collaboration. We can divide these pathways into groups. The first group consists in work that is already underway and over which we have a relatively large degree of control in terms of access and capacity to intervene. The second group consists in other venues and people with whom we have established a working relationship but not formalized it. Although we are confident that constructing pathways to these other sites will be possible and will be welcomed, by June 2008 only preliminary explorations have been undertaken. A third site where we intend for the most explicitly and comprehensively synthetic work to be undertaken is a website currently under construction. A primary goal of this website will be to move from indetermination to greater determination through the production of new synthetic objects.

12.3.2 Group A: Design Sites for Ontological Composition

Several aspects of our previous efforts can readily be taken up as elements of a remediated multi-sited venue with only minor improvements and re-orientations. All three of these interconnected undertakings are primarily located in Berkeley. Two of these sites are adjacent to SynBERC and consequently require only modest re-orientation and invention. We already have established good relations with a third site, second order observation of two SynBERC labs, and simply need to be pursued in the coming year. Rectification of elements, objects, and practices as well as recursively oriented attention to an engaged practice of second-order participation will be the focus of our attention and concern.

12.3.2.1 Ontological Inquiry: Laboratories

From the outset, ontology has been one of the two central topics (along with ethics) that Berkeley Human Practices Lab had proposed to concentrate on. By ontology we meant simply that a central principle and claim of synthetic biology has been that it would bring new things into the world. The study of things has traditionally been called ontology in philosophy; the name has migrated into genomics in such venues as the Gene Ontology group. Despite that fact, an insistent refusal to entertain this term is a social fact in SynBERC. Hence we have decided to conduct fieldwork in an anthropology of the contemporary mode in at least two of the SynBERC labs and perhaps recruit others to do the same elsewhere. We have chosen one of the test beds—the tumor-killing bacteria project—led by Chris Andersen, and perhaps the most scientifically advanced and complicated lab, that of Adam Arkin. Arkin's lab is working with the "systems" approach while establishing connections to medical, environmental, and security issues. These inquiries will constitute the main attempt at direct connectivity with the research programs at SynBERC.[7] We also anticipate with a certain degree of confidence, given what we know already, that interesting ramifications are quite likely to take place.

[7] Among others, see the laboratory websites of: J. Christopher Anderson https://andersonlab.qb3.berkeley.edu/ (<https://andersonlab.qb3.berkeley.edu/>); Adam Arkin, http://genomics.lbl.gov/ (<http://genomics.lbl.gov/>); Tanja Kortemme, http://web.ucsf.edu/dbps/faculty/pages/kortemme.html (<http://web.ucsf.edu/dbps/faculty/pages/kortemme.html>)

12.3.2.2 Conceptual Collaboration: ARC

As we have found little opportunity or encouragement to engage in collaborative conceptual work within SynBERC, we will re-invest in the already existing ARC site, with the intent of developing a form in order to enrich the conceptual repertoire already existing and that which remains to be invented within what we understand to be the broader field of reproblematization taking shape today. The completion of several other projects underway for some time by ARC principals, and the changing scholarly positions of several of these participants (Lakoff, Kelty, Rees, and Lemov), makes it an opportune conjuncture to re-think and possible redesign elements of ARC. Chris Kelty is currently reworking the website to make it more functional and inviting.

Whatever indeterminacy or discordancy arises, ARC provides a collaborative venue that arose to find a form for dealing with significant issues outside of the existing disciplines and organizational structures. No work of orientation as to why we should proceed will be required, and we anticipate a growing degree of synergy in the coming year. Leveraging the strengths of ARC and interfacing it more actively with SynBERC but equally, if not more importantly, with the other sites under consideration here, will be a primary objective.

12.3.3 Group B: Compositional Practice: Equipmental Forms and Venues

Our mandate from the NSF was to invent and implement a post-ELSI set of inquiries and reflections in the light of the fact that the global situation of science and technology appears to have significant differences today from what it had several decades ago. The rise of the Internet, the globalization of capitalism, the articulation of world-class science centers outside of Europe, the prominence of security issues, and the like, would have fundamentally challenged the nature of the ethical undertaking, especially the scientific calling (**Beruf**).

We entered a domain that gave the appearance to many of its practitioners as settled but which, from our perspective, requires major work of rethinking, remediation, and reconstruction. As these ethical concerns are in flux, we anticipate an exhilarating but hazardous set of undertakings. These conditions all point to the necessity of collaboration.

12.3.3.1 Ethical Formations (mode) 1: Professional Virtue Ethics

Within the professional bioethics community, it seems to us that the branch with the most promise for synergistic interfacing is virtue ethics. Virtue ethics tend not to be abstract and/or universal as an inviolable principle. Virtue ethics are at least tacitly oriented to practice. The roots of virtue ethics in Aristotle are, of course, found in the gradual development of dispositions through pedagogy, experience, and **agon** encounters. Thus, even if the foundations for virtue ethics that Aristotle laid down are no longer appropriate today and have been subject to extended scrutiny and critique, nonetheless this branch of ethics continues to generate thought that resonates with Mode Three.

There is also at least some nascent experimentation with venue construction and design of equipment among certain practitioners and theorists of virtue ethics. George Khufsh, for example, who directs a Center of Bioethics at the University of South Carolina, has developed interesting ideas in this genre. Of special interest is his insistence that federal agencies funding post-ELSI organizations like the nanotech centers or synthetic biology have so far been negligent in articulating performance standards for ethical experimentation and implementation. The division of labor model will not work unless there is some mutual practice that is taken up and put to work.

We have much to learn from Khusfh on how he thinks such a program could be designed and evaluated. We would be especially interested in interfacing with him around the issue of the construction of equipmental platforms. Given our diagnosis that the bio-ethical equipment designed first for medical ethics and subsequently for ELSI has inherent externalities and critical limitations beyond the scope of their original sites, we think we have both conceptual and practical things to learn and contribute from such an exchange.

12.3.3.2 Ethical Formations (mode) 2: Nanotechnology & Responsibility

The most elaborated and sustained work of a post-ELSI sort has gone on in the domain of nanotechnology. We have already briefly discussed the Real Time Technology Assessment of the Nanotech and Society group at Arizona State University. We have developed several arrangements for cooperative work in the coming year: Rabinow will attend a Gordon Conference that David Guston has organized; Anthony Stavrianakis has agreed to interface his research on developments of synthetic biology in Europe with those of Erik Fisher at ASU. Our most ambitious project, funding permitting, will be work on preparedness scenarios for synthetic biology. This work will include an initial training and pedagogy set of sessions with people from ASU who have done a good deal of scenario work in several different modes.

Conceptually, the work of Christopher Kelty (formerly of Rice but now at UCLA), a contributor to ARC, has articulated and chronicled a mode of interaction between the nanotech material scientists and social scientists around the concept (and symbol) of "responsible science." This innovative site has shown that even when there is a good deal of resistance to the introduction of human sciences questions or methods, political pressures (in this case from the environmental movement) can force the issue. The result has been a shift from responsible science as largely external and symbolic to the beginnings of an articulation of both an epistemological and ontological set of elements that are being constructed into an object in such a manner that no radical split or obligatory cooperative mode is necessitated. We intend to follow these developments closely and, if possible, introduce some parallel work with synthetic biologists. It may well be that the rise of strong opposition to biofuels might provide the site for such work.

12.3.3.3 Ethical Formations (mode) 3: Synthetic Anthropos

At the broadest level, critical reflection and thinking about what kind of practice ethics should be today is taking place in different forms, at least discursively. How to link and ramify classical philosophical formulations with bioethical equipment and contemporary venues is a problem that we are certain is a significant one but is as yet not widely recognized in a conceptually coherent fashion. One site in which substantial work on these topics is being undertaken is at Rice University. James Faubion is exploring the analytics of contemporary ethics. He and other colleagues at Rice are beginning a project on new sites of inter-disciplinary collaboration both in the United States and the European Union. We will be working with Faubion in the context of ARC. Additionally, we envision specific collaboration on the broadest level of framing of the situation of ethics and **anthropos** today.

12.3.4 Group C: Toward Remediation: http://ars-synthetica.net

Although SynBERC does have a website, at least in our experience, it has not functioned in a dynamic and inviting fashion. We are aware that the wiki has served its purpose (to a degree) of sharing lab work. During the first two years, the site has not been a central attractor for debate, discussion, and exploration. Exactly why that has been the case is not clear and would merit further reflection. It is entirely possible that with minimal effort the SynBERC website could and should be improved.

12.3.5 Media: Ars Synthetica, Berkeley Human Practices Website

Rabinow is on the advisory board of the UC Berkeley Townsend Center for the Humanities, which is currently making a major effort (as is the case elsewhere) to coordinate, refine, and improve the disparate web resources that exist for the humanities and qualitative social sciences. This effort includes awareness that there is resistance in the humanities to changes in production, research, venues, and publications. However, there is a growing consensus in humanities centers both in the US and abroad of the necessity to find salutary interfaces with digital media if these disciplines are to continue to exist, not to mention thrive, in the twenty-first century.

At an advisory board meeting, the Center's Director introduced to us a young contributor to these efforts at Berkeley, Noah Wittman. Noah has been active in the Berkeley OKAPI project (Open Knowledge and the

Public Interest) and had experience experimenting with online forums for science and democratic exchange. He seemed well positioned to help Berkeley Human Practices develop a semi-autonomous web site that would enable us to experiment both conceptually and in terms of scope and media with a number of topics to which we assigned a great importance but which we felt stymied in elaborating within SynBERC for all the reasons we have been exploring.

During the summer of 2008 we will begin collaborative work on this website. Our aim is to develop a well-designed and conceptually clear online platform beyond the prominent mode of vulgarization of scientific knowledge as "bringing the truth to the people." The reaction within SynBERC has been supportive and enthusiastic. We anticipate active collaboration with those members of SynBERC who are so disposed. We are clear, however, that SynBERC does not own or control the project. Thus we are hopeful that some of the major structural blockages and irritations that we have encountered at SynBERC will no longer plague us. This venue will be the first experiment in quasi-autonomy: adjacent, collaborative, interactive, but limited in its scope scientifically.

12.4 Reconsider

Our experiment concerns the relations among and between knowledge, thought, and care, as well as the different forms and venues within which these relations might be brought together and assembled. Our commitment is anthropological, a combination of disciplined conceptual work and empirical inquiry. Our challenge is to produce knowledge in such a way that the work involved enhances us ethically, politically, and ontologically. Such a project obliges us to think. Thinking no doubt involves the work of "freeing-up" possibilities: demonstrating contingency precisely where necessity is expected. But in zones where contingency has become dominant, where heterogeneous truth claims abound, where stable relations have become unstable, and elements old and new are being re-assembled, thinking must shift modes. Thinking in such a case involves the work of contributing to the form of the near future, scientifically and ethically. Such form-giving, we are persuaded, should be oriented, guided, and evaluated by the hope and goal, the metric, of mutual flourishing. That today we have barely any idea of what such flourishing might consist in only underscores the urgency and joy of undertaking the challenge.

It follows that our challenge is to invent and to practice new forms of inquiry, writing, and ethics for anthropology and her sister sciences and to invite others to do likewise. The dominant knowledge production practices, institutions, and venues for providing an understanding of things human in the twenty-first century are derisory when measured against the ethical, political, and ontological significance of such work. Thinking requires sustained work on the self, with all this requires in terms of adjustments in modes of reasoning and the venues whose mandates are to foster thought. The human sciences are at an ethical impasse: how to connect knowledge of things human to care of things human. To use the classical term, the human sciences are in need of **paraskeue**—equipment. To restate the challenge: anthropology and her sister sciences are in need of new forms of inquiry and equipment. In that light, we have taken up the experimental work of imagining, designing and putting into practice one mode of remediating the conditions of contemporary human scientific knowledge production, dissemination, and critique. Such a mode is currently being put "to the test of reality, of contemporary reality, both to grasp the points where change is possible and desirable, and to determine the precise form this change should take."[8] It is an experimental mode: an anthropology of the contemporary.

Progressing in this direction entails changing the metrics and forms of current practices, habits, and affects. Above all, it entails recursive experimentation and learning of a collaborative sort. In its initial stages, **experimentation** simply means trying out different configurations of inquiry, critique, and co-labor and then evaluating those practices and their results in a manner such that one can learn from these experiences. **Recursive** means punctual assessment and re-configuration of those efforts. **Collaboration** means inventing new forms of work that redistribute individual and collective contributions and limitations. Redistribution alone, of course, is insufficient: such work must be **remediative**; it must remedy significant

[8] Michel Foucault, "What is Enlightenment?" in Paul Rabinow, ed., **Ethics: Subjectivity and Truth** (New York: The New Press, 1997), 316.

dimensions of current pathologies through diagnostic analysis of the current state of things, followed by the design and practice of pathways operating in a different mode and in a modified medium. Such pathways are designed so as not to inflame the wounds of **ressentiment** which plague the academy through more **ressentiment**. Rather, they are designed to realize the hope and goal of mutual enrichment, of flourishing, as we have already suggested. Here we are merely insisting that the question of what constitutes a good life today, and the contribution of the life sciences and the human sciences to that form of life, must be vigilantly posed and re-posed.

Index of Keywords and Terms

Keywords are listed by the section with that keyword (page numbers are in parentheses). Keywords do not necessarily appear in the text of the page. They are merely associated with that section. *Ex.* apples, § 1.1 (1) **Terms** are referenced by the page they appear on. *Ex.* apples, 1

A Anthropology, § 1(1)

B Bioethics, § 1(1)
Biology, § 1(1)
Biosecurity, § 1(1)

C Center, § 1(1)

D diagnostic, 12

E ELSI, § 1(1)
Engineering, § 1(1)
Ethics, § 1(1)

P Post-Genomics, § 1(1)

R Research, § 1(1)

S Synthetic, § 1(1)

T tk, § 2(11), § 3(21), § 4(47), § 5(73), § 6(75), § 7(83), § 8(99), § 9(113), § 10(123), § 11(135), § 12(143)

V Venue, § 1(1)

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