Introduction

to the seminar "Goethe, Faust, and Science"

I. The Concept of the Course

It will be worthwhile to begin with a few words about the concept of this seminar and, in particular, its connection to UT Environmental Semester. Certainly, it is not hard to see connections between the Faust story and environmental issues, for Dr. Faust, the man who sacrifices his soul for material well-being and enjoyment, is easily interpreted as a symbol of modern industry, technology, and economy, which use knowledge to dominate nature for our benefit. Many new technologies, from atomic energy to genetic engineering to the internet, seem to have the characteristics of a Faustian bargain, and we dwellers in the First and Second Worlds are often described as Faustian men and women. However, Goethe's insights into our relation with nature go much deeper.

Although best known as a novelist, dramatist, and poet, Goethe considered his scientific work to be more important than his literary activities, but his conception of science was quite different from ours, for his approach to nature was *empathetic*, *participatory*, and *holistic* rather than *analytic*, *observational*, and *reductive*. As a result Goethean science has emerged as a possible foundation for a twenty-first century renewal of natural science and as a basis for an environmentally-sensitive technology.

Goethe's approach to natural science also permeates his epic drama, *Faust*, on which he worked for more than 60 years. It is relevant to environmental concerns because, in addition to the theme of the Faustian bargain, it also depicts Faust's evolving relationship with the feminine, both immanent and transcendent, and thus suggests a different, post-patriarchal orientation for science and technology.

Therefore, in this seminar we will read selections from Goethe's *Faust* (in English) and from his scientific writings, and weave around them a critical dialogue about our relationship to nature, science, and technology, now and in the future. Among the Faustian technologies we will consider are nanotechnology, artificial intelligence, and germ-line genetic engineering.

It is also interesting that there were environmentalist and feminist issues in the background of the Faust legend even before Goethe got a hold of it. Therefore, to help you to understand the context of the Faust story, I make a few remarks about the philosophy of nature in the sixteenth and seventeenth centuries, just after the historical Dr. Faustus lived and the legend began.

II. The New Philosophy and the Death of Nature

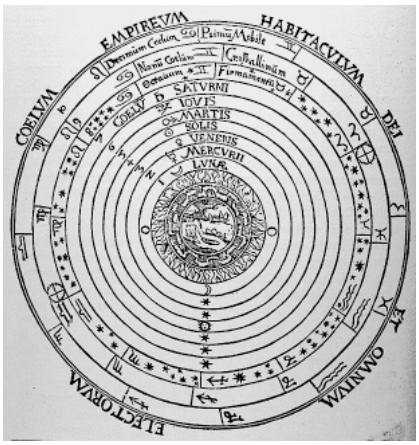
The sixteenth and seventeenth centuries saw a competition between three philosophies of nature, which provide the a context for Goethe's *Faust* as well as for his approach to nature and philosophy of science. I will refer to these as the *Aristotelian-Thomistic cosmology*, the *magical philosophy*, and the *mechanical philosophy*.

A. The Aristotelian-Thomistic Cosmology

In the second half of the thirteenth century, St. Thomas Aquinas modified the ancient cosmology of Aristotle so that it was consistent with church dogma, and established it as the principal cosmology of the Western Christian church.

1. View of Nature

The resulting Aristotelian-Thomistic cosmology may be summarized as follows. The Earth is stationary at the center of the cosmos. It is surrounded by nine celestial spheres (see figure). Moving out from the Earth, the first seven correspond to the then-known "planets" ("wanderers") in order of decreasing apparent speed (Moon, Mercury, Venus, Sun, Mars, Jupiter, Saturn). The eighth sphere corresponds to the fixed stars (that is, the constellations), which all rotate together. The ninth is the "crystalline sphere," which is sometimes identified with the tenth sphere, or *Primum Mobile* (Prime Mover), which imparts motion to all the inner spheres (except the Earth, which does not move).



These nine (or ten) spheres are all material, that is, subject to the laws of physics as Aristotelians understood them. Outside of the material universe was the *Empyreum*, where God, the angels, and the elect dwelt; this was conceived as a realm outside of time and space and therefore not subject to physical law. Thus, we have a cosmos correlated with a value hierarchy: from eternal God on high, we descend through the pristine and regularly rotating spheres of the Prime Mover and fixed stars, down through the spheres of the (somewhat erratically) wandering planets, to our Earth, a realm of generation and corruption and a battleground of good and evil. Hell, of course, was placed at the center of the Earth. Thus the universe was *diabolicentric* as well as *geocentric*, with an implication that the earth is irremediably tainted by evil. In particular, there was a qualitative distinction between the superior and orderly heavens and the imperfect and inferior Earthly realm.

2. Matter and Form

This view of the universe was consistent the Aristotelian theory of *form* and *matter*. According to it, matter, as the primary stuff of the physical universe, is unformed and possesses no qualities of its own. It is rather the neutral ground in which qualities and properties may inhere. Since it is formless and propertyless, it is fundamentally chaotic and irrational. (This featureless substrate is sometimes called *prime matter — prima materia —* to distinguish it from the ordinary matter we see around us.)

On the other hand, the world derives its orderliness from abstract, eternal Forms or Ideas (often understood as ideas in the mind of God). It is these Forms that impart definite qualities or properties to prime matter, and that govern orderly change in the material realm. Thus, the eternal, unchanging Forms are the source of order and rationality in the universe. Things in the universe are ordered, rational, and comprehensible to the extent that governing Form dominates the recalcitrant Matter in them.

We may see these degrees of order in the cosmos as a whole, for the eternal, unchanging *Forms* or *Ideas* reside in the mind of God in the Empyreum, a realm of pure Form. Via the Prime Mover, these Forms govern the very ordered rotation of the starry heavens, and the somewhat more erratic motion of the planets. The celestial bodies exhibit orderly motion because they are composed of a subtle, spiritual, *aetherial* matter. Earthly things, in contrast, are composed of four grosser elements (earth, water, air, fire), the matter of which is less conformable to the eternal, divine Ideas. Therefore, earthly processes are less

ordered, more imperfect, and more chaotic than those in the heavens. Since earthly things are resistant to the eternal Forms, they are impermanent, and so all things on earth "come to be and pass away" (generation and corruption). In general, everything in Nature is considered to be an inevitably imperfect mixture of a rational formal component and an irrational material component.

3. View of Women

The Aristotelian-Thomistic cosmology is correlated with a view of women.

a. Sex & Reproduction

Aristotelians explained sexual reproduction in terms of form and matter. Since the foetus grew (increased materially) in the mother's womb, and was nourished by the mother both before and after birth, the mother was understood to provide the matter of the baby. (Here the etymological roots of *mater*, *materia*, *matrix* may be noted.) On the other hand, since the child resembles the father, and since the volume of semen is small, it was supposed that the father provides the form of the child. (The fact that the child also resembles the mother was either ignored or accounted for in other ways.) There is, of course, an element of truth in this account, for the sole function of the sperm is to transport the DNA encoding the genes — the genetic *form* — of the father. Also, the mother, not the father, provides the matter by which the foetus grows. However, it is incorrect in that it ignores the fact that the mother also contributes *form* (via her DNA) to the child.

Another implication of the Aristotelian theory follows from the contrast between, on one hand, the forms or ideas, which are associated with the mind and rationality, as a source of purposeful thought, free will, and action, and, on the other, gross matter, associated with the body as the cause of irrationality and disorder. Thus the father is the source of the child's immortal soul, whereas the mother merely provides the corruptible body. (In accord with this view, menstrual fluid was considered defective semen, lacking soul.) Therefore, according to the common dualistic assumptions of Western thought, the father contributes the more important (theologically, the *only* important) part of the child.

Ideally, according to Aristotle, a male child would result from conception, but if the *matter* (provided by the mother) were especially resistant to the human *form* imparted by the father, a female child would result (which was considered, therefore, an incompletely formed male).

The Aristotelians held that form does not desire itself (or anything else), since it is not defective, but that matter is inherently incomplete, and so it naturally seeks form, in order to become complete and, insofar as it is possible for material things, perfect. Thus there is a natural movement or process by which each body seeks its own form.

Not coincidentally, Aristotle compared matter seeking form with a woman's desire for man. (It is worth noting that from antiquity to early modern times, it was widely believed that women were more interested in sex than men.) On the one hand, this view of female sexuality contributed to church doctrine according to which Eve was responsible for the Fall in the Garden of Eden, and a continuing source of temptation for man (considered as the more spiritual of the sexes). On the other, this seeking after form was considered the source of human striving after the divine (often expressed in terms of erotic desire); the Christian version was the Mother Church's devotion to God the Father.

b. Psychology

The Aristotelian-Thomistic view of reality had implications for male and female psychology. Since in man, the domination of matter by form is more complete than in woman, by nature man is more rational, self-controlled, and spiritual, focused upward on heaven, while woman is more irrational, emotional, and lustful, focused downward on the body. This implies that man is superior to women in the faculties

considered most important in politics and economics, and that women are best treated as overgrown children. (The implication may go in both directions: The assumed inferiority of women may have reinforced those philosophical beliefs that implied it; cf Hillman, *Myth of Analysis*, Pt. 3.)

c. Macrocosmic Analogy

From the foregoing, it is not at all hard to understand why Aristotle said that the Earth is female whereas the heavens are male (*Gen. An.* 716a). Of course, this built upon ancient mythological traditions in which earth goddesses (e.g., Gaia) are female, and the chief sky god is male (e.g., Zeus, Jupiter). Further, in both Greek and Latin the word for *Nature*, that is, the mixed realm of form and matter beneath the eternal and divine Empyreum, is a feminine noun (Lat. *Natura*, Grk. *Physis*). Thus we still speak of "Mother Nature."

d. Conclusion

And so we discover an important connection between how women are viewed and how Nature is viewed, and we will find corresponding correlations between how a society treats women and how it treats nature.

5. Decline of Aristotelian-Thomistic Cosmology

The Aristotelian-Thomistic cosmology included the Ptolemaic model of the solar system, according to which all the "planets," including the sun, rotated around a stationary earth. Nevertheless, Aquinas and others were unhappy with the complexity of the Ptolemaic system (they thought God would have done things more simply), and so it was considered a probable, but not a necessary part of the cosmological system. Indeed, the Ptolemaic model was challenged in the sixteenth and early seventeenth centuries by the astronomical observations and theories of Copernicus, Kepler, and Galileo, which led to its eventual abandonment. However, we can see that there was much more at stake than the motion of planets distant from the earth.

B. The Magical Philosophy

1. The Ancient Theology

a. Origins

In 1439 the Council of Florence was held in the hope of healing the millennium-long split between the eastern and western Christian churches. Among the attendees from the east was George Gemistos (c.1360–1452), who called himself "Plethon," a Greek scholar of Platonic philosophy, who lectured on the superiority of Platonic to Aristotelian philosophy. These lectures so impressed Cosimo de' Medici (1389–1463) that he resolved to found a Platonic Academy in Florence, and when he accomplished it in 1462, he placed a young scholar, Marsilio Ficino (1433–99), in charge. His first job was to translate the works of Plato into Latin, which he did, making them accessible to western scholars for the first time in many centuries. However, before Ficino had completed this task, Cosimo acquired a manuscript of writings attributed to a legendary sage, Hermes Trismegistos. He was so excited by this text, that he ordered Ficino to interrupt the translation of Plato and to devote all his attention to the Hermetic Corpus. These texts were discovered to be similar in outlook to the more esoteric writings of the later Platonic philosophers, whom scholars call the *Neo-Platonists*. Ficino made these texts and translations available in the west for the first time in many centuries.

At this time the supposed author of the Hermetic texts, Hermes Trismegistos, was supposed to have been a contemporary, or even a predecessor, of Moses, and therefore that the Hermetic texts represented the original, pure, and universal "ancient theology" (*prisca theologia*) given to humanity by God. Later textual

analysis (Isaac Casaubon, 1614) showed that the Hermetic corpus was not this old (dating rather to between the third century BCE and the first CE), but previously they were believed to be divine revelations of immense importance.

b. Divine & Living Nature and the World Soul

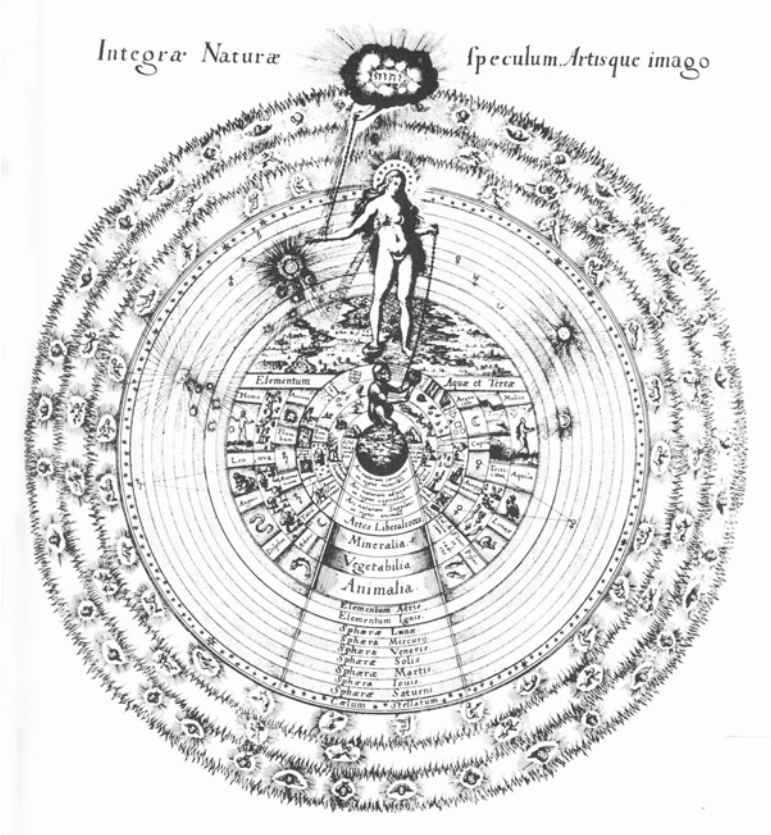
Common to most versions of the Ancient Theology was a Neo-Platonic world-view, which may be summarized as follows.

i. The Macrocosm

As in Aristotelian philosophy, the things in the world can be analyzed in terms of form and matter. However, in contrast to Aristotelianism, in which the forms are believed to exist only in material objects, Platonism asserts that the forms exist primarily in an archetypal realm of idealized Forms; often the archetypal Forms are conceived of as Ideas in the mind of God. The Ideas are indeed eternal for the realm of Forms is outside of time and space.

Abstract, mathematical numbers are the most familiar examples of eternal, archetypal Forms. Also, the ordinary objects of our world are pale and imperfect images or shadows of the eternal Forms. For example, you and I are two different images of the eternal Form of *Human being*, and this particular dog Rover is an image of the Idea of *Dog*. It is by participation in the Forms that things are what they are (e.g. that Rover is a dog), that is, things have their *being* by participation in the Forms. Whereas the Forms, in the realm of Being, are eternal and unchanging, material things exist in the realm of Becoming, wherein things come to be and pass away (e.g., as material beings, we are born, transform through time, and die).

To establish this connection between material objects and the immaterial Forms a sort of bridge is required, a mean connecting the two extremes, and in Neo-Platonic philosophy this is provided by the World Soul, whose function is to manifest the non-temporal, non-spatial Forms in the material world of space and time. To put it differently, if the realm of Forms is an abstract, eternal system of Ideas in the mind of God, then the World Soul thinks the Ideas sequentially (as we think) and uses them to inform and govern motion and change in the material world. That is, there is (1) a World Mind (the Mind of God), eternal, outside of space and time; (2) a World Body, the material universe, extended in space and time; and (3) a World Soul, which binds the two together, ordering material change in accord with the eternal Ideas (see figure).



ii. The Microcosm

This is the structure of the *Macrocosm*, the universe at large, which is mirrored in the *Microcosm* (small universe) of the individual human, for we too have an immortal mind or spirit, a material body, and a soul, which connects the first two. (Sometimes the words "soul" and "spirit" are used with exactly the opposite sense!)

iii. Feminine Nature

For a number of reasons, which will become clearer as we progress through this course, the World Soul has been perceived as feminine; as already mentioned, the notion of "Mother Nature" is very common. To give just one example of how human sexuality has been projected onto cosmology, we may speak of the Ideas or Forms of God the Father being implanted like seed in the womb of Mother Nature, who then gives birth to our material world. We can also see here a parallel to the Aristotelian-Thomistic worldview: the superior, male World Mind corresponds to the immortal spirit, a realm of abstract Ideas, whereas the subordinate, female World Soul nurtures the changeable World Body. Similarly, whereas woman has a creative body, which creates by means of matter, man has a creative mind, which creates by means of ideas and words. So there are social and political issues also implicit in this idea of Nature.

iv. Divine, Living Nature

It is important to notice that although, according to Hermetic philosophy, Nature is considered subordinate to God the Father, she is nevertheless divine. That is, everything is understood to be connected in a "Great Chain of Being" that extends from the archetypal Ideas, through the World Soul, into the material objects than manifest them. As a consequence every material thing is understood as an emanation of God, and therefore, to the limits possible for its kind, each thing in nature is divine. Further, just as the human body is alive by virtue of being infused with a vital soul, so also the World Body is alive by virtue of the World Soul. Therefore, according to the Hermetic philosophy, the natural world is neither inert, nonliving matter nor diabolical, but rather a living, divine emanation of God. Only human egotism prevents us from recognizing that all Nature is, to some extent, sentient. As we shall see, such a perspective led to a different orientation toward Nature than did the other philosophies.

2. The Renaissance Magus

a. Occult Qualities & Magic

One implication of the Hermetic philosophy is that these chains of emanation establish hidden connections between things. For example, objects that participate in the same Form have an "occult" (hidden) "sympathy." Thus, by the *doctrine of signatures*, herbs could be selected according to their appearance (form) and used to treat a disease according to their sympathies (e.g., a plant with solar sympathies, such as sunflower, might be used to draw down sunny warmth to balance the excessive cold-dryness of melancholy). (Hermetic texts were often criticized for their obscurity, a consequence of the symbolic character of many of these sympathies. This obscurity was also intended to restrict potentially dangerous knowledge to the wise and morally pure.)

Therefore Hermetic philosophers came to understand the universe as a vast, intricate network of occult sympathies and antipathies, with vertical linkages between the levels of the earth, the heavens, the World Soul, and the archetypal Ideas, and horizontal linkages within each of these levels. Manipulation of these hidden connections provided a basis for magical practice, and suggested that the natural world might be manipulated to achieve some purpose (good or evil).

b. Empiricism

One consequence of the occult character of the sympathies and antipathies was that they were difficult to determine by reason alone. Therefore, in contrast to the scholastic Aristotelian-Thomistic philosophy and the mechanical philosophy (which we'll discuss shortly), in which all truths were supposed to be discoverable by pure reason, the magical philosophers resorted to empirical methods, to experiments, for they thought that reason would be inadequate to discover the hidden connections. (In this they were following in the empirical footsteps of other practitioners, such as doctors, herbalists, and farmers, whose orientation as more practical than speculative.) The empirical approach of the magicians was an important contribution to the later development of experimental science.

c. Natural Magic

Among the practitioners of Hermetic philosophy, we may distinguish several kinds of magician. *Natural magicians* employed the occult sympathies and antipathies for strictly practical purposes, such as healing diseases (of the soul as well as of the body), protection, finding things (e.g. lost or stolen objects, treasure), and (in practical alchemy) making gold. No doubt many of these people were charlatans, but sincere natural magicians laid much of the foundation of later experimental sciences, including pharmacology, metallurgy, chemistry, and astronomy. Indeed, although their theoretical framework has been abandoned by modern science, the aims and methods of the natural magicians was not very different from those of modern technologists (although they tended to treat Nature with more respect, for they experienced her as divine). Both seek *power* over nature. (Aristotelian philosophers, in contrast, did not seek power over Nature.)

d. Spiritual Magic

Natural magic is so called because it limited its concern to the occult forces *within* nature. Other magicians did not limit themselves to the horizontal sympathies within natural realm, but were also interested in connections to the higher realms. That is, magical rites involving material objects and processes could use *vertical* sympathies to establish connections with celestial beings and angels, an art often called *spiritual magic*. (The archetypal Ideas were understood as angels in the Jewish, Christian, and Moslem magical traditions.) That is, the *signatures* of things in the natural world were signs, put here for us by God, to facilitate our communication with the divine realm, in particular, for the invocation of angelic beings.

Sometimes such divine aid was sought for practical purposes no different from those of the natural magicians (e.g. healing). However these magicians also used their art for purely spiritual purposes, such as having divine visions, becoming more Christ-like, knowing the will of God, and righting the spiritual imbalances of the community. In this the practitioners of spiritual magic were much closer to the original meaning of "magician," for the ancient Persian *Magus* was a wise and highly respected priest-magician. Even alchemy had a spiritual side, and some alchemists were quite explicit in saying that their goal was not to transmute "vulgar" (common) lead into "vulgar" gold. but to transmute the inner lead of the soul into spiritual gold.

e. Renaissance Magi

Clearly, the boundary between practitioners of natural magic and those of spiritual magic was not firm, and individual magicians might do more or less of each, depending on their goals, training, talents, and employment. In any case, beginning in the fifteenth century there appear a number of *Renaissance magi*, typically well-educated practitioners of magic, often with university and ecclesiastical connections, and often providing magical services to the state. Among the well-known Renaissance magi were Marsilio Ficino (1433–99), his student Pico della Mirandola (1463–94), Johann Trithemius (1462–1519), Cornelius Agrippa (1486–1535), Paracelsus (1493–1541), and John Dee (1527–1608), who was the personal wizard and astrologer of Queen Elizabeth I! Although for the most part they were pious and well-intentioned, they

were often suspected of diabolical activity as a consequence of their reputed power and of the occult forces with which they operated. The Faust legend, and especially Goethe's version of it, draws on the character of the Renaissance magus (especially Agrippa).

3. Threat to Christian Faith

The church considered the magical philosophy a "threat to Christian faith" for several reasons.

a. Magic vs. Miracles

The first was that, by boast or reputation, magicians were supposed to be able to accomplish feats comparable to the miracles of Jesus. Indeed, Trithemius reported that the historical Faust was claiming that "the miracles of Christ the Savior were not so wonderful, that he himself could do all the things that Christ had done, as often and whenever he wished." Since the miracles of Jesus were offered as proof of his divinity and of the truth of the gospels, the similar miraculous accomplishments of the magicians were supposed to undermine Christian faith. Perhaps Jesus was not the son of God, but just a clever magician…

b. Demonic Magic

Another reason that the church attacked the magical philosophy was the danger of demonic magic. First there was the risk that one might accidentally contact a demon rather than an angelic spirit, or that the Devil might deceive one into doing so, and thus a well-meaning magician might inadvertently do evil; even practitioners of spiritual magic acknowledged this danger and took precautions to avoid it. Further, natural magic was inherently dangerous, since it involved commerce with elemental and planetary, rather than angelic, spirits, and therefore was tainted with imperfections of matter. It was not even conceded that God permitted humans to engage in angelic magic.

The second problem was the temptation to do diabolical magic willingly, to sell one's soul to the Devil. Against this possibility, the story of Faust was offered as a cautionary tale. (Indeed Agrippa had the reputation of being a black magician, although his writings do not support that opinion.) Thus it was argued that any effective magic must be Satanic, because the last genuine miracle was the Resurrection; since it had established the truth of the Christian religion, no further miracles were necessary, and God did not allow them. Thus the church purged itself of all magic (although the apparent "magic" of transubstantiation and religious relics posed continuing problems). The natural world was devoid of occult properties.

4. The Witchcraze

a. Introduction

In connection with the magical philosophy we must mention the "witchcraze" of the sixteenth and seventeenth centuries (1550–1650). Although almost all cultures have had some concept of witches (which, in this context may be defined as a person — often a woman — who uses magic to work evil on individuals and the community), and have taken action against people perceived to be witches, the European witchcraze was unprecedented in its virulence: recent scholarship estimates that 40 to 50 thousand people — mostly women — were executed, often in cruel ways, and frequently following horrific torture. It was also unique for persecuting witches for *being* witches, regardless of whether they were accused of working evil, or even if their actions had good intentions and outcomes. A full discussion of the origins and progress of the witchcraze is outside the scope of this course, but the following observations are relevant.

b. Theological Causes

The existence of witches had not always been taken for granted; indeed previously belief in the existence of witches had been considered heretical! However, by 1600 the existence of Satanic witchcraft was supported by the church, because denying the *power* of Satan and the demons might lead to denying the *existence* of Satan, which might lead to atheism. Or, to put it the other way, if the existence of God and the angels are accepted, why shouldn't the existence of Satan and the demons be granted? For this argument to work, it was necessary to deny the reality of natural magic, for then, if witches succeeded in their potions and spells (regardless of whether the result was good or evil), it must be through the agency of Satan and the demons. So argued, for example, Kramer and Sprenger, the authors of the infamous *Malleus Maleficarum* (*Hammer of Witches*), the most popular witch-hunters' manual.

The witch-hunters also argued that Satan could not accomplish his evil except with the willing participation of humans, especially women, for they were assumed to be more susceptible to moral extremes, but especially depravity, because of their weaker rationality and their greater attachment to the body. Thus, Kramer and Sprenger asserted, "All witchcraft comes from carnal lust, which is in women insatiable." They claimed that women were less interested in motherhood than in sex, which Satan provided the witches through orgiastic sabbats. Therefore also midwives were accused of conspiring to kill babies to provide raw materials for Satanic magic. (We may be reminded of contemporary debates about abortion and stem-cell research.)

c. Social Causes

In addition to the continuing, church-sanctioned belief in Satanic witchcraft, social factors contributed to the witchcraze, and persecution of witches was most common in politically unstable areas or in regions of religious conflict.

Beginning in the twelfth century there had been a spread of heretical sects, many of which welcomed women and granted them more autonomy than was typical in medieval society. In this way women became linked with heresy, and when the Inquisition was established in 1230, old peasant women living alone were often its target.

The plague of the fourteenth century had decimated large areas of Europe and led to social instability and further proliferation of heretical sects. Of course plague, famine, and other disasters and miseries were attributed to the action of Satan and his demons, who were supposed to work especially through women, as the weaker sex and more susceptible to carnal temptations. By blaming witches, the ruling classes placed the cause of poor people's misery within the ranks of of the poor themselves, and ensured the peasantry's dependence on the ruling classes for their protection, thus defusing peasant revolts.

It's also worth remarking that in the fifteenth and sixteenth centuries female healers were often in competition with doctors, who promoted the professionalization of medicine and petitioned governing bodies to make the unlicensed practice of medicine illegal. (Women could not study medicine in the universities, which were restricted to men preparing for the priesthood.) On one hand, these professional physicians were often ineffective in their cures, but on the other, if an illiterate peasant women was successful in curing someone, that was taken as evidence she had collaborated with the Devil. (How else could she have done it?) Ironically, the good witch was considered more culpable than the evil one, for the good witch, through her cures and other benefactions, made Satanic witchcraft more attractive. Therefore, even good witches were condemned to death.

d. Magicians' Objections to Witch Hunting

Several of the Hermetic magicians, including Agrippa and his student Johann Weyer (1515?–88), argued against witch hunting or defended individual witches, which only further darkened their own reputations.

Ironically, they argued that ignorant peasant women were incapable of mastering the subtleties and complexities of natural magic! Others defenders argued that witches were innocent dupes of the Devil, who was able to predict what was going to happen naturally, and then convince witches that they had caused it, and therefore they argued that the witches should be treated more leniently. Also, Weyer and others argued that torture was an ineffective method of extracting the truth, for the obvious reason that victims would confess to almost anything to escape the excruciating pain. Nevertheless, the use of torture continued until the spread of accusations began to touch influential men.

Magicians themselves were not safe from the Inquisition; for example, 1600 saw both the burning of the Hermetic magician Giordano Bruno (1548–1600) (with his tongue staked so that he could not utter heresies) and the torture of Tommaso Campanella (1568–1639), which continued until 1603, and who escaped execution only by pretending madness for the next 27 years of his imprisonment.

e. The End of the "Great Hunt"

The end of the "Great Hunt" (as the witch persecution was called) has been attributed to stabilization of the power base of the privileged classes, the adoption of the mechanical philosophy (discussed next), and the intention to exploit nature for human benefit (see Easlea, 1980, for a detailed argument). As we will see, the mechanical philosophy required the existence of God and immaterial souls, and therefore witch hunting was not needed to provide evidence of their existence and bolster Christian faith.

C. The Mechanical Philosophy

1. Inanimate Matter

An alternative, *mechanical philosophy*, was developed by Gassendi (1592–1655) and especially by Descartes (1596–1650).

According to the mechanical philosophers, all the properties of matter are *secondary* — and therefore fundamentally illusory — except for size, shape, and motion, the only *primary* properties. That is, the material world is conceived of as bits of quality-less *stuff*, defined only by its shape, position, and motion in collision with other such bits. There is no "action at a distance." Sound familiar? It's very much like the contemporary scientific view of matter. (Long-distance interactions are explained in terms of local interaction with *fields*, but the existence of fields is observable only through the motion of particles.) Therefore, matter is fundamentally inert and void of any interesting quality; certainly it has no occult properties or sympathies, such as supposed in natural magic. As Descartes (*Pr. Phil.*, Pt. 4, §187) said, "there exist no occult forces in stones or plants, no amazing and marvelous sympathies and antipathies, in fact there exist nothing in the whole of nature which cannot be explained in terms of purely corporeal causes, totally devoid of mind and thought." On the other hand, we have the obvious experience of our own minds, and so Descartes found it necessary to postulate the existence of mind as well matter, a position known as Cartesian dualism, the theory that there are two fundamentally different "stuffs": animate mind and inanimate matter. It has been claimed that this vision of a "lifeless, barren world ... was a revolution in male thought of the most momentous significance," and it was "a proposal of such breath-taking audacity and implausibility that it cries out for explanation" (Easlea 1980, 150).

2. Consistency with Religion

One part of the explanation is that is was perceived to be less of a threat to established religion. Whereas the magical philosophy gave *natural* explanations for Biblical miracles, the mechanical philosophy left them unexplained, and therefore it was not viewed as a threat to Christian faith. Indeed, since the age of miracles is passed, there is no reason suppose that God or the angels interfere with the mechanical operation of the material world. Even if miracles did still occur, that would just be further evidence for the

existence of God. The mechanical philosophy was uncommitted about the existence of demons, who would in any case be limited by the laws of physics, but their existence was not essential to its support of Christianity. (Therefore the mechanical philosophy did not oblige the church to argue for the existence of witches in order to prove the possibility of immaterial spirits.) Further, since matter was by definition inert, it was apparent that the soul (at least its conscious, reasoning part) must be immaterial, a position consistent with religious dogma. Since animals were not supposed to have immortal souls, with the same hopes and fears for the afterlife as we have, Cartesian philosophy had the further implication that animals are effectively complex machines, and therefore that their apparent suffering is illusory. When Cartesians were criticized for their cruel vivisection experiments, they replied that their accusers had not outgrown their childish sensibilities.

3. Problems of Spontaneous Generation and Human Birth

According to the Cartesian philosophy, matter, in the absence of an immaterial soul, is inert, but living nature poses problems for this view. A principal one was that Cartesians were unable to give a detailed mechanical account of animal life, including the complexities of (apparently) intelligent animal behavior. (Indeed, this remains an unsolved scientific problem to this day.) Another problem was *spontaneous generation*, the idea, generally accepted at that time, that life can arise spontaneously out of non-living matter (e.g., maggots in decaying meat), and the related problem of the origin of parasites in animals. Eventually (1688) it was shown that spontaneous generation does not, in fact, occur, but parasites remained a problem (often ignored).

A more serious problem was how a complexly structured embryo develops from an apparently simple egg. The difficulty was that, according to Cartesian philosophy, mechanical processes could lead to the increase or elimination of parts already present, but they could not lead the emergence of new, complex structures. Therefore Cartesians developed the astonishing doctrine of *preformation*: the complete adult is already preformed in the germ cell, and that preformed individual contains preformed germ cells, which in turn contain the preformed children of that individual, and so on. Thus God, at the beginning of the world, had created the preformed bodies of all life until the end of time, as nested, preformed children inside the germ cells of preformed adults. As a consequence, the mechanical philosophy required and implied the existence of God (a point in its favor, from the Church's perspective, compared to the magical philosophy). Although there was empirical evidence against preformationism (e.g. regeneration in crayfish), it was ignored because preformationism seemed to be the only theory consistent with Cartesian philosophy.

One complication of preformationism that could not be ignored was the male and female contributions to reproduction (again). One faction claimed that only sperm contained preformed bodies, so "Adam carried all men in his seed." (Amazingly, demonstrating again how theory can condition observation, early microscopists saw tiny human shapes in sperm!) Other philosophers thought that the mother's eggs contained the preformed bodies, thus granting women a role in reproduction, although merely as an uncreative vessel and nurse, but then they had difficulty explaining the necessity of sperm. According to this view, God had relieved males of the burden of reproduction and the cares of the earth so they could devote their attention to the mechanical exploitation of nature.

4. The Creative Body vs. the Creative Word

The mechanical philosophy continued the erosion of the belief in female creativity. While Neo-Platonism and Hermetic philosophy stressed the importance of female Nature uniting the realm of Ideas with primal matter and giving birth to our world, Cartesian philosophy divided existence into male active mind and female inert matter, that is, God the Father and the corrupt Earth, which He had created by His Word. Further, the role of the individual woman in reproduction was reduced to that of an uncreative vessel and source of nourishment, with the embryos preformed by God at the creation, and the immortal soul coming from Him by way of the father's sperm. Woman could be said to be creative only in the inferior sense of supporting the growth of the preformed embryo, whereas man provided essence of humanity, the rational

mind and immortal soul, the creative word (idea) in another form. Finally, at a social level, the material creativity of the peasantry and middle classes was denigrated in comparison to the intellectual creativity of the privileged classes (and especially Cartesian philosophers!). In all cases the creative body was considered inferior to the creative word, and the superiority of the word was proved by its ability to dominate Nature, for "knowledge is power" (Bacon).

In pre-industrial societies ruling-class males had demonstrated their superiority, over subordinate males as well as women, by their greater physical strength. In the emerging capitalist societies, with their denial of the inherent value of the body and sexuality, men displayed their superiority in their intellectual accomplishments and in ambitious projects for exploiting the natural world.

5. Power Over & Possession of Nature

a. Mechanical Appropriation of Nature

According to the mechanical philosophy, matter is completely inert, and so Nature does not deserve any special consideration or reverence, and certainly one should not view it with awe like a goddess. As Descartes remarked, "Know that by nature I do not understand some goddess or some other sort of imaginary power. I employ the word to signify matter itself." Further, mankind should have no compunction in appropriating Nature (including any plants or animals) for their purposes or in mastering it by mechanical means. Since matter is merely soulless stuff, there need be no limits to the exploitation of Nature, and Boyle said, "the veneration, wherewith men are imbued for what they call nature, has been a discouraging impediment to the empire of man over the inferior creatures of God." Descartes promised that, through his philosophy, we would become "masters and possessors of nature."

Now, the magical philosophy also promised control over the material world, but it was restrained by its reverence for Nature. In common with the Aristotelian philosophers, they believed that knowledge of nature, in the context of a just social order, would help to free humanity from misery and to ensure peace and plenty, in cooperation with nature, for all, but humankind was viewed as just one part among many in the cosmic organism. The mechanical philosophy, however, shifted man's primary relation to Nature, from the reverent contemplation, appreciation, and cooperation of the other two philosophies, to limitless domination and exploitation.

Further, according to the mechanical philosophy, the mastery of nature requires only mechanical operations — fundamentally just putting objects together or separating them — and makes no use of occult properties or ceremonies, nor risks demonic involvement. Therefore, the church had no objection to the appropriation of nature by mechanical means.

b. Cartesian Clarity

Cartesian philosophers contrasted the clarity of their conceptions and principles with complex symbolism of magical philosophy, since according to mechanical philosophy everything in nature not involving the human mind could be reduced to size, shape, and motion, to mechanisms easy to visualize concretely. Cartesian clarity put Hermeticism at a disadvantage, discrediting its philosophy and indirectly undermining the social and religious ideas with which it was associated.

Their mechanistic philosophers claimed that there are no ultimate mysteries in nature, which is fundamentally comprehensible; awe and reverence are misplaced. In this way the Cartesians exorcised the spirits from nature and disenchanted the world.

c. Empiricism vs. Male Reason

We have seen that the mechanical philosophy has an implicit values system, at least from a theological perspective. Matter is inert, nonliving, and fundamentally worthless; the immaterial mind, the faculty of reason, is the supreme value, for it is the immortal part of the soul. Thus the mechanical philosophy was supposed to be discovered by cold, hard reason (remember Descartes' "I think therefore I am"?), which for profound psychological, as well as social, reasons has been considered masculine (Hillman, *Myth. Anal*., Pt. 3). Further, in the emerging capitalist societies of early modern Europe, abstract reason was considered the province, primarily, of privileged, well-educated males. For example, the Cartesian-Catholic philosopher Malebranche (1638–1715) argued that only men's brains have the "vigor and reach necessary to penetrate to the core of things." (Again, man's superiority over woman – and domination of feminine Nature — was justified by his ability to "penetrate"!) Indeed, some Cartesian philosophers suggested that women, and even most men, should be considered soulless automata (like animals), due to their apparent lack of intellectual capacity.

6. Compelling Nature to Answer

In fact, although Cartesianism was attractive as a philosophy, it was not so good at explaining natural phenomena in detail, and it became apparent that mastery of nature would be difficult through the application of mechanical philosophy as a purely rational discipline. Therefore Francis Bacon (1561–1626) proposed a methodology of *non-magical empiricism*, which applied the empirical methods of magical philosophy in a mechanical context. He hoped to legitimate man's domination of nature by arguing that it was not prohibited by the Bible and that it could be accomplished by lawful (i.e., non-magical, non-demonic) means. (In contrast, even non-demonic magic was illegitimate because it was too easy: according to Bacon, mastery of nature was to be achieved by the "sweat of our brows," that is, by arduous, incremental experimental investigation.)

Bacon argued that "nature exhibits herself more clearly under the trials and vexations of art then when left to herself." That is, Nature will not yield to gentle questioning, but must be compelled to answer by ordeals and tortures (like those inflicted on witches!). His metaphors are certainly not coincidental. The experimental method will permit the "true sons of knowledge," he said, "to penetrate further," to pass through "the outer courts of nature" and "find a way at length into her inner chamber," allowing men to find the "secrets still locked in Nature's bosom." The method is sure, and will allow men, not just to exert "gentle guidance over nature's course," but to "conquer and subdue her, to shake her to her foundations." So also Henry Oldenburg (1615?–77), the first secretary of the Royal Society, announced that its business was to raise "a Masculine Philosophy." Experimental science will lead men, Bacon said, to "Nature with all her children to bind her to your service and make her your slave." Thus would be established the "Dominion of Man over the Universe."

Bacon was not alone in his opinion of man's proper relation to nature. For example, the alchemist Thomas Vaughan (1622–66) thought that the natural magician would penetrate to the center of Nature, so that she would cry out that he had "almost broken her Seal, and exposed her naked to the World." The Cartesian turned Neo-Platonist Henry More (1614–87) replied that such a "chaste and discreet Lady" could not be "lewdly prostituted" by "immodest hands." He taunted, "Thou has not laid Madam Nature so naked as thou supposest, only thou hast, I am afraid, dream't uncleanly, and so hast polluted so many sheets of paper with thy Nocturnal Conundrums..." (*Observations*, 66).

Robert Boyle (1627–91) had been a Hermetic philosopher and alchemist, who aided Hermetic and Rosicrucian refugees from the continent between 1645 and 1652. Later he abandoned the magical philosophy and became a pioneer of modern chemistry by applying its experimental method. After his conversion to mechanical philosophy, he opined, "the veneration, wherewith men are imbued for what they call Nature, has been a discouraging impediment to the empire of man over the inferior creatures of God" (Boyle, *Inquiry into the Vulgarly Received Notion of Nature*). With perfect consistency, in his role as Governor of the New England Company, he tried to disabuse the Native Americans of "their ridiculous

Notions about the workings of Nature" and the "fond and superstitious practices those Errors engaged them to." So long, he said, as men "look upon her as such a venerable thing, some make a kind of scruple of conscience to endeavor so to emulate any of her works, as to excel them."

7. The Newtonian Synthesis

One of the problems that the mechanical philosophy had trouble solving was the nature of weight, for it seemed to imply the existence of "spooky" action at a distance (i.e., a hidden force, like an occult sympathy). Indeed, when Newton (1642–1727) developed the first successful scientific theory of gravity, it was not strictly according to the rules of the mechanical philosophy. Therefore mechanistic philosophers criticized the idea of gravitational attraction as an occult force, a charge against which Newton defended himself with his famous statement, "I do not make hypotheses." By this he meant that he made no claims about the existence of hidden gravitational forces, only that the motion of objects could be described *as though* such forces existed! We may view this as a sort of disingenuous doublespeak, and Newton's critics saw through it too, but it was difficult to oppose the quantitative success of Newton's theory of gravity.

Privately, Newton believed that inert matter could *not* act at a distance and that universal gravity demonstrated God's active presence in the world (in contrast to the mechanical philosophy) — though without the mediation of a (female) soul — and Newtonian theologians used gravity as evidence for God and a justification for the existing social order.

In Newton's theory of gravitation, and also in his theory of optics, we can see another characteristic of his approach to science, which was to account for visible phenomena (e.g., falling objects, planetary motion, color) in terms of quantifiable but imperceptible properties (gravitational force, wavelength of light). Statements about these unobservable properties were indirectly confirmed or refuted by means of *crucial experiments*. As we will see, Goethe objected to this theory-laden approach, which he considered remote from the immediate experience of nature and ungrounded in it.

Although he kept it hidden during his lifetime, we know from Newton's notebooks that he was a lifelong student and practitioner of alchemy. (Indeed, there is forensic evidence that his personality oddities were a result of mercury poisoning, a hazard for practicing alchemists at that time.) John Maynard Keynes said Newton was "not the first of the age of reason" but rather "the last of the magicians" and when Newton said that he "stood on the shoulders of giants," he was referring to the sages of the Ancient Theology, including Hermes Trismegistus and Pythagoras. From Pythagorean philosophy in particular he took the idea that Nature is governed to mathematical principles, and that the hidden, fundamental nature of the universe is mathematical (the view also of modern physicists). Indeed, in Newton we find all the elements of contemporary scientific philosophy, which explains and exploits the natural world by means of mathematical principles governing objects, forces, and properties invisible to ordinary perception.

D. Social Factors

In England especially, at the time of the Civil War (1642–6), the ruling classes were threatened by the new philosophies and felt trapped between the twin threats of atheism and sectarian "enthusiasm." On the one hand, atheism undermined the divine sanction of the nobility and the threat of divine retribution for rebellion. On the other hand, radical sects, inspired by new religious and philosophical ideas, such as those of Paracelsus and the Rosicrucians, were promoting, on the basis of divine inspiration ("enthusiasm"), new, subversive social movements, typically democratic or socialist in orientation, and therefore a threat to the privileged classes.

Further, although Hermetic philosophy was not atheistic, it was more heretical than Cartesian philosophy, was allied to the folk beliefs of the poor and uneducated, and had subversive connotations. For example, Paracelsus was a social dissenter who supported the peasantry and advocated the redistribution of wealth; he was criticized for curing the poor for free but charging members of the privileged classes large fees.

The Rosicrucian Manifestos (1614–16), which proclaimed a new, utopian society based on Hermetic and alchemical principles, were indebted to Paracelsus' ideas. Also, Thomas Campanella had promoted insurrection against the Spanish rulers of Naples in order to establish a utopian state based on Hermetic principles. Therefore some intellectuals abandoned the magical philosophy not for philosophical reasons, but because they did not want to be associated with many of its adherents, who were socially embarrassing outsiders. The mechanical philosophy was welcomed as a way between Scylla and Charybdis of atheism and enthusiasm, which also sanctioned the appropriation of nature by the (male) ruling class.

III. Background on Goethe

A. Goethe and his *Faust*

I am not going to provide detailed biographical information on Goethe, which is easily available (see also the links on the seminar webpage), but I will make just a few remarks to put his life in context.

Johann Wolfgang von Goethe was born in Frankfort-am-Main in 1749 and studied law, under his father's insistence, at Leipzig from 1765–8, during which time he also wrote his first two plays. His studies were interrupted by an illness (on which, more below), and after his recovery he went to Stassbourg in 1770 to continue his law studies (but he also explored anatomy, antiquities, and alchemy). He was a literary critic until 1776, when he accepted a post with the young Duke August of Weimar. He was a valuable public servant, and conducted a geological survey of the region, which further developed his scientific interests (see below). He also produced novels, poetry, and plays.

Goethe began work on *Faust* in 1773 and after extensive revisions, he published a part of it in 1790. With Schiller's urging, he completed Part I in 1806 and it was published in 1808. Although some of Part II had already been written, he continued to work on it the rest of his life. Finally, in August, 1831 Goethe wrapped up his completed manuscript of *Faust*, handed to his secretary Eckermann, and gave him instructions on how it was to be edited and published after his death. Goethe told him, "I am now finished my life's true work, anything I do further and whether I do it or not, is all the same!" He was dead within a year.

B. Goethe the Alchemist

Goethe tells us that he began to study alchemy with a Fräulein von Klettenberg in 1768, when he was at home in Frankfort from Leipzig University to recuperate from an illness (perhaps depression). His interest may have been awakened by a "Universal Medicine," which was administered by an alchemist friend of von Klettenberg and to which Goethe credited his cure. (Von Klettenberg and this Dr. Metz were members of a Pietistic circle associated with the Moravian Brethren, a heretical sect.) At that time he read a number of alchemical and Hermetic texts (which were widely available in Frankfort) and began practical alchemical experiments (directed toward healing rather than transmutation). These continued over the next year, but we read no more about them after he went to the University of Strasbourg in 1770. Nevertheless, these experiments left a lifelong impression on him, and we know that he continued his "mystico-religious chemical pursuits" (as he called them), in part as an antidote to the dry pedantry of the universities. (Faust

expresses the same sentiment in his first scene in the drama.) Furthermore, alchemy provided for Goethe a structure of ideas, which we recurs throughout his scientific work as well as *Faust*.

C. Goethe's Scientific Work

Although best known as a novelist, dramatist, and poet, Goethe considered his scientific work to be more important than his literary activities. Already in the 1780s, when Goethe was in his 30s, he was studying geology, botany, and anatomy. Some of these investigations were connected with his post as overseer of mines with the Duke of Weimar.

Goethe assembled large collections of minerals and plants and made contributions to a number of scientific disciplines. For example, in 1784 he discovered the intermaxillary bone in humans, which others had denied, but which was evidence universal patterns among mammals. In 1790 he published his *Metamorphosis of Plants*, which identified essential developmental patterns in plants. The following year he published his first work in optics, which initiated a life-long study of the subject; his *Theory of Colors* (1810) is especially important for understanding the human experience of color, and we'll discuss it in this course. (In connection with this and his other research in optics, Goethe sharply criticized Newton's methods.) Throughout his life, he continued to conduct research in all these areas as well as in zoology and meteorology. (Some of Goethe's scientific interests are apparent in his *Faust*.)

Goethe's scientific work has been criticized by scientists, even in his own lifetime, but as we'll see, it has been misunderstood because it is based on different conceptions of what science *ought* to be. In recent decades there has been an increasing interest in Goethe's philosophy of science, which is a consequence of a growing recognition of the limitations and deficiencies of current science and technology, which might be ameliorated by some of his ideas.

IV. Faust: History and Legend

A. The Historical Faust

1. George Sabellicus, the Younger Faustus

In 1507 the abbot of Spanheim monastery, Johannes Trithemius (1462–1516), himself a magician whose story may have contributed to the Faust legend (see "Sources for the Legendary Faust" below), wrote to an astrologer friend concerning a magician whose calling card was, “George Sabellicus, the younger Faustus, the chief of necromancers, astrologer, the second magus, palmist, diviner with earth and fire, second in the art of divination with water.” Trithemius writes that he is a complete fraud and charlatan, and accuses him of various crimes. However, it is not irrelevant that at this very time Trithemius was attempting to defend himself from the charge of being a magician, and so it was essential to distinguish his own activities from those of the notorious Faustus.

Tritheim does seem to be referring to the Faustus around whom the legends arose, but it also raises the interesting question of who the “elder Faustus” might be. We may detect feigned modesty in Faustus' calling card: calling himself "the second magus" makes him second only to Zoraster, the legendary "first magus" (and a key figure in the Ancient Theology); likewise, "second in the art of divination with water" places him just below Numa Pompilius, an early king of Rome who was supposed to have originated this art. The name *Sabellicus* (Lat.) means Sabine, and was probably adopted as a good name for a magus, for the land of the Sabines was notorious for witchcraft in the ancient world; Numa was a Sabine. *Faustus* (Lat.) means lucky, favorable, auspicious, and was appropriate for his occupation as a fortune-teller. In German, *Faust* means fist, but this appears only in later sources and is unlikely to be the original form of his name. (Baron, 1978)

2. Other mentions of Faustus

Over the succeeding 30 years we can trace the progress of a figure variously called “Georg Faustus,” “Johann Faustus,” or—most often—just “Doctor Faustus,” through various letters and city records, for example when he is paid for a service, such as casting a horoscope, but more frequently when he is chased from some town. (The name "Johann" seems to be a mistake, which has replaced the correct name in the legend, especially after Goethe wrote his *Faust*.) He was also known to Luther (who did much to create the legendary Faustus) and the Protestant Humanist Philip Melanchthon (1497–1560).

As may be reconstructed from these reports, Faustus was born near Heidelberg about 1466, studied scholastic philosophy at the University of Heidelberg, and received his Masters there in 1487 (in record time and near the top of his class). At that time, the university was a hotbed of Renaissance humanism, especially in the form of the Neo-Platonism and Hermeticism of Ficino and Pico; astrology, magic, and occult studies were popular. Baron (1978, 49) observes that a characteristic of the humanist movement was "the close relationship between occult science and the *studia humanitas*." Faustus was probably dead by 1539, but all direct accounts of his death are filled with legendary material, and so of doubtful reliability.

Apparently Dr. Faustus' magic was respected by members of the clergy and nobility, and to some extent by scholars, although they denounced him in public; he had both supporters and critics among the well-known people of the time.

3. Beginnings of the Legend

In reports written after the death of Faustus it is often difficult to separate truth from fiction. For example, these records state that while he was lecturing on Homer in the university at Erfurt, he is supposed to have conjured up the heroes of the Trojan War, an event which also occurs in Goethe's drama. However, he may have accomplished this perfectly naturally by means of a "magic lantern," projecting the images on smoke (as may be implied in Goethe's description). Certainly, Faustus bragged of many skills and feats and wove a legend around himself, perhaps even claiming, for example, that he was the devil's brother-in-law. Although an account of a 1537 conversation with Luther states that Faustus did make this claim, there is no direct historical evidence of it, and the early sources do not connect him with the devil. Nevertheless his calling card did boast of his skill as a black magician (*negromanticus*).

In 1548 a Protestant clergyman, Johannes Gast, claimed to have dined with Faustus, although the context is a collection of entertaining after-dinner stories, and it is unlikely to be true. He wrote that Faustus had with him a demon in the form of a dog, who also sometimes took the form of a servant (cf. Goethe's Mephistopheles). He also wrote that Faustus was eventually strangled by the devil, who has served him

Within a generation of Faust's death (i.e., the 1560s and ‘70s), at the same time the witchcraze was beginning, the Faust legend began to grow, and a number of collections of Faust stories circulated. Most of these tales were traditional and had been told of other sorcerers in the past, but they developed, especially under the influence of Luther, to have a moral: all magic is diabolical and will result in eternal damnation. The publication of the *Faustbuch* (1587, see below), which codified many aspects of the Faust legend, coincided with the peak of German witch burnings.

B. Sources for the Legendary Faust

Baron (1978, 80) claims, “There is hardly a passage in the [*Faustbuch*] that cannot be related to a closely corresponding passage in Luther's works.” Although Luther's widely reprinted writings may be the proximate source, stories about other magicians contributed to the legend of Dr. Faustus, which became a kind of *summa* of all the morality tales teaching the evils of magic.

1. Simon Magus (c. 67 CE)

The story of Simon Magus (*Acts* viii: 9–24) may have inspired parts of the Faust legend. Indeed Melanchthon explicitly compared the two, when he said that Faustus was dashed to the ground and severely injured when he tried to fly at Venice, just as had Simon Magus when Peter prayed that he would fall. Also, both Simon and Goethe's Faust had a relation with a semi-divine woman called Helen, as we will discuss when we come to that part of the drama. Early ecclesiastical writers attributed all sorts of Faustian magical accomplishments to Simon, and according to later legends, he was court sorcerer to Nero, which may be compared to Faust's service to the Emperor in Goethe's drama. Simon Magus is often identified with the Simon who founded the gnostic sect of Simonites.

2. Trithemius (1462–1519)

Johannes Trithemius, the abbot of Spanheim, where he assembled a huge library, and later of St. James at Wurtzburg had, as already noted, a reputation as a magician, which caused him many difficulties. He was deeply influenced by the natural and Hermetic magic of Ficino and Pico, but he was critical of alchemy and other occult sciences. Twice he heard reports of Faustus when they were in the same city, but they do not seem to have met; as noted, he was critical of Faustus, perhaps to distance his magic from the necromancer's. He wrote,

> Study generates cognition; cognition gives birth to love; love to similitude; similitude to communion; communion to virtue; virtue to dignity; dignity to power; and power produces a miracle. This is the sole path to the perfect magic, divine as well as natural… (Baron 1978, 27–8)

Trithemius wrote a notorious book (*Steganographia*), ostensibly about the evocation of spirits, but the part that survives is a system of secret writing; the rest he is supposed to have destroyed (although it might not have been written). Among other occult books he also wrote one about alchemy and he was said to have used the alchemical philosophers' stone (which he a materialization of the World Soul) to produce to wealth for operating monastery at Spanheim. For the Emperor Maximillian I of Germany, Trithemius was said to have conjured up a vision of the Emperor's dead wife, the beautiful Empress Mary of Burgundy. When the Emperor tried to embrace her, he fell to the ground as if struck by lightening and Mary disappeared (cf. the evocation of Helen in *Faust* 6377-6565, "Hall of Chivalry").

3. Agrippa (1486–1535)

Henry Cornelius Agrippa of Nettesheim was a student of Trithemius. He was highly educated and served as a soldier, physician, magician, alchemist, and astrologer for various members of the nobility, including Emperor Maximillian. Nevertheless, he was accused of heresy at a young age, and often thereafter he had to flee enemies hostile to his ideas.

Trithemius encouraged him to commit his learning to writing, but he delayed publishing his magnum opus, *On Occult Philosophy*, for twenty years, publishing it in 1531 only after he had attempted to protect himself by recanting it in an apologetic profession of faith, *On the Uncertainty and Vanity of the Sciences and Arts*. He also wrote *On the Nobility of the Female Sex* and *On the Excellence of Women*, and Agrippa and his student Weyer (or Weir) defended innocent women accused of witchcraft, which earned Agrippa even more enemies.

Johannes Manlius, a student of Melanchthon, wrote in 1563 about Faust's dog familiar, which he compared to Agrippa's, also in the form of a dog. According to one tale, when Agrippa was dying he repented of magic and accosted this large black dog as the cause of his destruction, whereupon it fled the room and drowned itself in a river. This may be compared to the idea of the repentance of Faust, which was not a part of the old stories, but was used by Goethe. He was also said to have paid his bills with money that

later turned into worthless horn or shell, to have called back Cicero from the dead, and to be able see distant scenes in a magic glass, all of which may be compared with events in Goethe's *Faust* (although they were the stock in trade of many magical tales).

C. Goethe's Sources

1. The *Faustbuch*

The Faust stories also had a role in the Reformation, for Protestant leaders used it to combat religious skepticism. This was especially the case in the first published account of the magician's life, Johann Spiess's *Historia von D. Johann Fausten* (1587), commonly known as the *Faustbuch*.
In this version Faust makes a pact with the devil Mephostophiles [sic], offering his soul for 24 years of knowledge, wealth, and power. It was a primary source for most later versions of the legend including Marlowe's *Tragicall Historie of Doctor Faustus* (1605) and, via later versions, for Goethe's drama. (Selections from *The History of the Damnable Life and Deserved Death of Doctor John Faust*, the 1592 English translation of the *Faustbuch*, can be found in the Norton edition of Goethe's *Faust*.)

2. Puppet Plays

Troupes of players, traveling throughout Europe, frequently performed versions of Marlowe's play, which was also adapted into a puppet play. During his childhood in Frankfort Goethe saw these puppet plays, which were very popular in the eighteenth century, and they significantly influenced his impressions of the Faust legend. (Extracts from such a puppet play are in the Norton edition of Goethe's *Faust*.)

3. Lessing's Salvation of Faust

A third transformation of the Faust theme, preceding Goethe's, is worth mentioning: the final salvation of Faust. This appear for the first time in the *Faust* of Gotthold Ephraim Lessing (1729–81), of which drama only a fragment survives (translated in the Norton edition of Goethe's *Faust*). This reflects a more sympathetic understanding of Faust's insatiable quest for knowledge, which accompanied the advancement of science in the seventeenth century.

V. Relevance to Environmental Semester

A. Relationship to Nature

Goethe's ideas, as expressed both in his *Faust* and in his scientific writings, suggest a different relationship to nature from that typical of contemporary science, technology, politics, economics, and even ecology. By coming to understand his ideas better, we may be able to enhance our relationship to nature, or to shift it somewhat, and perhaps redirect the trajectory of our society to avoid the many environmental problems that concern us.

B. Three Faustian Technologies

To focus our attention in this seminar, and keep our discussions relevant, we will consider three "Faustian" technologies that are currently under development. They all have the characteristic that they promise many improvements for human life and society, but they also raise disturbing questions. These are certainly not the only Faustian technologies, and in a sense all technology, as well as many other aspects of

contemporary society, are Faustian. Nevertheless, these technologies are particularly stark in their possible benefits and threats. In any case, I invite you to think about other cases in which our society has, or may soon, make "Faustian bargains." We will have opportunities to consider them throughout the semester. Here are the Faustian technologies I propose for our consideration:

1. Germline Genetic Engineering

We are all familiar with the idea of genetic therapy: altering a person's genes, for example in their blood or bone marrow, to cure a genetic disease. This is a very exciting area of research and promises to alleviate the suffering of many people. However, *somatic gene therapy* (SGT) of this sort can only cure one person at a time. If the person's genetic disease was inherited from their parents, then they will carry it in the chromosomes of their germ cells (sperm or egg) and quite likely pass it on to their offspring. *Germline genetic engineering* (GLGE) attempts to solve this problem by altering the genes in a person's germ cells. Then, any change will also be passed on to the patient's children, grandchildren, and so on, forever. Thus, the promise of GLGE is that certain undesirable genetic conditions (such as sickle cell anemia, hemophilia, or cystic fibrosis) might be eliminated from the human race once and for all.

Part of the difficulty of this technology is that it can be used for modifying any genes, and what is a "genetic problem" is somewhat in the eye of the beholder. We may all agree that hemophilia is a genetic disease and should be cured. But what about below-average intelligence? If your children have below-average intelligence, they will be at a disadvantage in many ways and probably a shorter life on average (due to having a lower paying job, poorer health care, etc.). And why shouldn't well-to-do parents pay for GLGE that will give their children *above* average intelligence? Or why shouldn't they have genes altered to increase muscle bulk or blood oxygen carrying capacity, so that their children have greater athletic ability, and are more likely to get a scholarship or succeed in professional sports? If germline *therapy* is good, why not germline *enhancement*?

Many people are disturbed by these possibilities, for many reasons. For one, it could amplify *socioeconomic* differences into *genetic* differences. Since, in principle, any gene can be changed and then passed on to all descendents, this technology could permit us to change what it is to be a human being.

Some discussions of germline genetic engineering (just a sampling):

- "Germline Gene Therapy" <www.ess.ucla.edu/huge/genetic.html>, UCLA. Discusses techniques and recent successes.
- "Human Germline Engineering: Implications for Science and Society. Best Hope or Worst Fear?" <research.arc2.ucla.edu/pmts/germline/>, UCLA. Multimedia exploration.
- "Best Genetic Engineering Links," <www.care2.com/channels/ecoinfo/genetic_engineering>, EcoInfo.
- Hayes, Richard, " The Quiet Campaign for Genetically Engineered Humans" <www.mercola.com/2001/feb/24/ge_humans.htm>.

2. Artificial Intelligence & Artificial Life

Artificial intelligence (AI) is the investigation of how computers exhibiting human-like can be designed. When AI first arose as a discipline, researchers were very optimistic and thought that computers with human intelligence would be designed within a couple decades.

AI is my own research area and I am awed by the complexity of brains (animal as well as human) and about how little we know about how they work. Therefore, I do not expect to see artificial human-scale intelligence any time soon. Nevertheless, many researchers argue that we are on verge of breakthroughs, and soon will be facing the prospect of computers with more than human intelligence. (See, for example, Hans Moravec's articles at <www.frc.ri.cmu.edu/~hpm/>.) Are we designing our replacements? Some

advocates of this technology argue that we should feel sad if humans are superceded, for by designing our successors we are fulfilling our role in the evolution of intelligent life on earth. In "Robots, Re-evolving Mind" <www.frc.ri.cmu.edu/~hpm/project.archive/robot.papers/2000/Cerebrum.html>, Moravec writes:

> "Rather quickly, they could displace us from existence. I'm not as alarmed as many by the latter possibility, since I consider these future machines our progeny, “mind children” built in our image and likeness, ourselves in more potent form. Like biological children of previous generations, they will embody humanity's best chance for a long-term future. It behooves us to give them every advantage and to bow out when we can no longer contribute.
>
> "But, as also with biological children, we can probably arrange for a comfortable retirement before we fade away. Some biological children can be convinced to care for elderly parents. Similarly, “tame” superintelligences could be created and induced to protect and support us, for a while. Such relationships require advance planning and diligent maintenance: it's time to pay attention."

A related discipline, in which I also work, is *artificial life* (AL), in which we attempt to design artificial systems that act sufficiently lively (whether they are "really" alive or not is mostly a theoretical matter at this stage). In this case we may not be so interested in machines with human intelligence as in robots with the size and intelligence of insects or small mammals (e.g., rats). Such systems would have many applications, including planetary exploration, waste cleanup, and warfare. If you think about an application such as planetary exploration, it becomes clear that in the long run would like these robots to be able to heal (like living beings), to learn and adapt, and perhaps even to evolve to adapt to changing or unpredicted conditions. (Already, we routinely simulate evolution in computers, and researchers have developed simple systems in which the hardware itself evolves.) We can see the benefits of such systems, but there are also dangers. Such an evolving, self-perpetuating population of robots, if released in an environment, could have the same unpredictable impact as releasing a non-native natural species into an environment.

Again, it might seem we are quite far away from this, but researchers are already genetically engineering bacteria so that may be introduced into environments for some purpose (e.g., cleaning up pollutants). UT researcher Gary Sayler (Center for Environmental Biotechnology <www.ceb.utk.edu/>) has done widely-acclaimed work in this area. Such genetically modified microorganisms are not artificial life per se, but they are artificially-enhanced life, and raise similar issues.

3. Nanotechnology

Nanotechnology is a rapidly expanding field in which systems are designed at scales measured in nanometers (millions of a millimeter). Much of the work going on in the field now is devoted to the development of new materials that have been designed at the atomic level. However, researchers are also planning more active nanostructures, for example microminiature robots, which could be injected into the bloodstream to detect and remove blood clots or plaque deposits. Further, there are long-term projects directed toward the design of *assemblers*, which can be programmed to assemble any desired structure at the molecular level. Once implemented, such assemblers could be used to assemble other assemblers, in fact, to create *self-replicating assemblers*, which would continue to produce copies of themselves so long as raw materials were available. Since self-replicating assemblers could be programmed to scavenge commonly available materials from their environment, some well-respected researchers have expressed concern that they might eventually pose an environmental hazard. Like a scene from a science fiction movie, one can image a spilled batch of self-replicators eroding the surrounding land to create an ever-growing mass of self-replicators, engulfing the earth in what has been called "gray goo." Far-fetched, perhaps, but researchers have already produced nanoparticles, too small to be trapped by filters, whose health effects have not been evaluated. Recently I saw a presentation from a scientist who had isolated the protein that a virus uses to pierce a cell wall, and she showed now it could be controlled to create a microminiature robot arm.

For a discussion of some of these nanotechnology issues, see:

- Shactmann, "Rage Against the (Green) Machine" <www.wired.com/news/technology/0,1282,59287,00.html>, *Wired News*, June 19, 2003.
- Etc Group, "The Big Down" <www.etcgroup.org/documents/TheBigDown.pdf> (pdf document), Jan. 2003.
- Joy, Bill, "Why the Future Doesn't Need Us" <www.wired.com/wired/archive/8.04/joy_pr.html>, *Wired* 8.04, Apr. 2000. A seminal critique by a technology "guru," who has elsewhere called nanotechnology a Faustian bargain.

4. Others

There are, of course, many other Faustian technologies, of greater or lesser importance, including email, pervasive sensor systems, atomic energy, and steroids.

A good presentation of many of the issues, especially in regard to the three technologies highlighted here, is McKibben, 2003.

VI. Course Mechanics

A. Reading

This is the way the course will go week by week. At the end of each class I will assign you some reading for the following week. Typically some of it will be required and some will be optional, if you have time. I have tried to keep the required reading to about an hour a week, sometimes a little more, sometimes a little less; in any case it's just an estimate. If you do the optional reading, it should still be at most two hours total per week. You are expected to do the required reading, and only the required reading will be needed for class discussion and assignments, although I may occasionally bring in issues from the optional readings. I do hope you will read everything if you are able, since it is all worthwhile. (An up-to-date reading schedule is available also on the course website, <www.cs.utk.edu/~mclennan/Classes/UH348/Schedule.html>.)

B. Discussion

When I assign a week's readings, I will often suggest some questions or issues to think about for those readings. However, if you have any other thoughts or insights, especially as they relate to the environment, you should make a note of them for class discussion. At the beginning of each class I may ask you some questions to make sure everyone is doing the reading. Then I will lead a discussion of the passages we have read, highlighting the ideas that I think are important and often beginning with a short presentation. This is just the starting point and basis for the discussion; I hope you will also raise issues that you find thought-provoking, confusing, or otherwise interesting. Although the discussion will normally focus on the week's reading, it may range back over prior readings or even look ahead.

C. Assignments

Towards the end of semester I will assign a short term paper or a set of essay questions. Details will be settled later.

VII. Bibliography

Note! This Bibliography is limited to works relevant to this Introduction to the seminar.

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4. Hillman, James. *The Myth of Analysis: Three Essays in Archetypal Psychology*. New York: Harper-Collins, 1978. See especially Part 3, "On Psychological Femininity."
5. McKibben, Bill. *Enough: Staying Human in an Engineered Age*. New York: Henry Holt & Co., 2003.
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9. Shumaker, Wayne. *Natural Magic and Modern Science: Four Treatises. 1590–1657*. Binghampton: Medieval & Renaissance Texts & Studies, 1989.
10. Walker, D. P. *Spiritual and Demonic Magic from Ficino to Campanella*. University Park: Pennsylvania State Univ. Press, 2000.
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