# The Pursuit of Knowledge

# The Many-Splendored Society: Volume 4

Second edition

This book describes how science became an independent realm of society. We also describe its contemporary nature and its relations to other realms, including those pursuing journalistic, religious, political, and economic ends.

This book stands alone, and one can read it by itself. It serves also as the fourth installment to a larger work in seven volumes about social theory and about a many-splendored society that is within human reach.

TO KARIN BUSCH ZETTERBERG

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Volume 3. Fueled by Symbols, 2010, 3rd ed 2013, chapters 11-17

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Volume 5 The Pursuit of Beauty, Sacredness and Virtue

Volume 6. The Pursuit of Wealth and Order

Volume 7. The Pursuit of Life and the Good Life

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# THE PURSUIT OF KNOWLEDGE

# THE MANY-SPLENDORED SOCIETY: VOLUME 4

Hans L Zetterberg

*Illustrations by Martin Ander*

Volume 4.

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2nd edition

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Illustrations by Martin Ander



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# Preface

In this work, we use the adjective "many-splendored" to depict a society with personal freedom and a shining differentiation of six self-governing realms: economy, politics, science, art, religion, and morality. A good society joins these societal realms so that no one rules over the others, while everyone obtains valuable sideshows from the others.

This book, Volume 4 of the series *The Many-Splendored Society,* has two parts: Part 1 takes science as an example of *Societal Realms and How They Emerge.* Part 2 is subtitled *The Societal Realm of Science* and deals with the social reality of contemporary science, its role as a human endeavor.

The fact that science gets more space — and a binding of its own — than other societal realms in *The Many-Splendored Society* is purely pedagogical; it is not any claim that science is the most important societal realm. The realm of science, however, is the most recent full-fledged one, much younger than the economy, polity, art, and religion. Science is well documented; in fact, its Makers thrive on publications. In the case of science, we can learn from its recorded history how a societal realm begins and grows. We dissect it in more detail than the other realms in order to help us to a fuller understanding of the nature of 'societal realms,' the large building blocks of societies.

All science, be it physical, biological, or social science, is dominated by strict descriptive discourses that help us understand our world. The societal realm of science contains not only descriptive verbalism from the language brain, but has also openings to the mathematical brain. Physical reality is beautifully summarized in *mathematical terms*, as Newton, Faraday, Einstein and other great physicists have shown. Physical reality can actually be understood as labeled mathematics. Social reality, as we will notice many times in *The Many-Splendored Society*, can best be formulated in *grammatical terms*. At its base, we will find a grammar, i.e. a system for a language, but not necessarily as in the old school grammars.

This does not relegate mathematics to irrelevancy in the study of society, as some students of language and literature may hope. We will need numbers and statistics to cope with the multitudes of language products that constitute social reality and civilization. However, in this work we do not write our models of society in equations; our propositions and their interrelations will appear in ordinary language. Our ambition is to make writing of social science as accessible as writing about humanities in the language of the sources. We depart rarely from this practice in this book: for example, so-called Baysian probabilities are presented not only in words, but in mathematical formulae as well.

We devote Part 1 of this book to distill certain general principles about the rise of societal realms from the history of the organization of scientific efforts. Before any societal realm becomes independent, it is likely to assume selected features from already existing realms. The emerging societal realm of science showed such copying from the realm of religion. The first who practiced science in the West, the so-called natural philosophers, typically viewed the search for knowledge as a calling. Not unlike the priests in "the religions of the book" – Judaism, Christianity, and Islam – studying God's Scriptures, the first who practiced science studied God's Nature. In later times, the realm of science became organized as an imitation of the guild system of the pre-capitalism economy. Over a few generations, professors became specialists-monopolists of their fields, somewhat like bygone masters of guilds of crafts and trade. In our times, science has borrowed some good things from the economy and polity – and some things that threaten academic autonomy.

A case history of the attempt to merge the societal realms of science and religion in creating a medieval cultural synthesis, an ideal Catholic society in the outlook of Thomas Aquino and his followers, is included in Part 1. As the realm of science grew, this merger became unhinged. An important piece of evidence supporting a very central proposition in *The Many-Splendored Society* is: Full-scale mergers of societal realms (including their cardinal values, stratifications, organizations, networks, media, et cetera) tend to create unstable structures that deteriorate over time.[1]

Science is a very rational pursuit. Scientists, however, work under the same language-dependent conditions as other people. For example, the struggle to formulate and gain acceptance of "the present standpoint of science" has much to learn from the struggles to achieve consensus in other realms of society. Distortions in and corruptions of science are shown to follow the same paths as in other societal realms.

Turning to modern science, we note how the German universities in the nineteenth century created a new home for science by making competence in research, rather than in learned teaching, the criterion of appointment of professors, thus moving most serious research into a reformed structure for higher learning. These universities formalized the meaning of academic freedom, and became a model for scientific pursuits all over the world. They also incorporated the Napoleonic idea that universities should be open to all qualified students, regardless of their kinship and their class background. We trace the modification of these ideas into the graduate schools of the American research universities of the twentieth century.

The enormous success of applied research in medicine and engineering still has a big base at universities. However, the recent growth of the societal realm of science has increasingly, taken place outside the universities in the context of varied applications.

We take time to study the stream of technical innovations and find that it consists mostly of new combinations of old innovations. A full acceptance of innovations in society is found in rather shorts periods, marked by values of materialism and pragmatism.

## Abstracts of the many-splendored society, Chapters 18-28 the pursuit of science

In Chapter 18 — we number chapters from the beginning of the first volume of the *Many-Splendored Society* — we present highlights of the early history of science, not just as a body of knowledge but also as living arrangements in the form of an emerging societal realm. We see the emergence of a new realm, among other things, as the appearance of a new 'spirit' in a society. A spirit of worship had a strong grip on Europe in the Middle Ages. This was at the center of a cultural synthesis and a social order inherited from antiquity. The Roman Empire in the West was gone but the Roman Catholic Church carried on and flourished. A heritage of science from antiquity, particularly from Aristotle, had been maintained through the centuries inside the Church. Its 'spirit of discovery' became a force of its own, and a new societal realm emerged with natural philosophers, rather than monks, and with academies, rather than cloisters. There is nothing magic about such 'spirits.' We show that these are joint mobilizations described in the propositions we already know. In our own days, we might even sense a parallel in the 'spirit of justice' in the growing realm of morality paving the way for universal human rights.

The natural philosophers, schoolmen, and scientists involved shared a cardinal passion, a 'spirit of discovery'. Societal realms cannot flourish without such passion. We tell the European part of this story, well aware that other parts of the world have other versions of the way to fit knowledge into a social fabric.

Chapter 19 is an attempt to identify further steps in the structuration of the scientific realm. We follow how religion alienated science to a point at which science alienated religion. We note the practice of self-correction in science based on the replication of findings. We attend to the misfortune of Doomsday Science.

Chapters 20-24 deal with the internal state of the realm of science, presenting defining aspects of the language of science, now as a full-grown societal realm with all the formal attributes of such a phenomenon. We note in chapter 20 the practice of self-correction in science based on the replication of findings. We also discuss the extent to which scientists who keep their work secret become marginalized in the academic community. We look at the debate of the "two cultures" in the world of scholarship: humanities and natural science. We end this chapter with a debate on what drives science to its exceptional successes; is it new research instruments or new theories?

The rationality of modern science is expressed in two different ways of thinking: in analysis and in systems. We deal with these in Chapter 21. We illustrate the difficulty for politicians in evaluating the quality of a system before they put it into practical operation as policy.

Honorific rewards manifested in citations permeate science and establish the unique stratification of competence found in science. In Chapter 22 we describe how scientists, themselves, in their reporting on research in their journals are careful to maintain this system. Received citations, in effect, circumscribe or enhance their careers and promotions. We take up issues of research reporting and common distortions of findings.

Chapter 23 begins our long discourse about universities, the main organization devoted to teaching and research in modern societies. Universities emphasizing academic freedom, a unique bundle of liberties, emerged at universities inspired by Wilhelm von Humboldt's design for the University of Berlin in 1810. Prior to Humboldt's intervention, universities were devoted to the teaching of what was known, not researching what was unknown. A century later, most of the world's important researchers had moved to university campuses as professors: one professor for each subject, each with his own department. This rigid structure led some scholars with a broad agenda to become trailblazing "freebooters," some very successful, for example Max Weber.

However, after World War II, the growth of the number of students and the enormity of facilities needed for solving new research problems, made the Humboldtian model of universities less appropriate. American research universities became the new model for the world; we explore the mass university and the multiversity. The expansion of independent research institutes and think tanks have changed the realm of science so that in the United States and some other countries, there is now more research done on facilities outside campuses than on campus.

Chapter 24 is devoted to the financing of research. Mixed financing of universities in the United States set them the apart from the dominant state funding elsewhere in the world. More run-of-the mill research is presently undertaken in the context of applied science. The "Big Science" of particle colliders and telescopes orbiting in space do not fit in university budgets. Science is universal. Big Science is dependent on internationally institutionalized funding and on new organizational forms that are not yet settled.

With Chapter 25 – 28, our focus shifts from procurement of resources to science, to the contribution science provides to other realms of society.

The differences and similarities between science and journalism occupy us in Chapter 25. Journalism publishes news, including some scientific news, but mostly news from other societal realms such as the economy, polity, art, religion, and sports. News production has criteria of authentication that have some similarities to, but mostly clear differences from, verification in science. The journalistic task includes the cracking of secrets in high places of public trust, but otherwise journalists, like the practitioners of medicine and social science, are also expected to respect the integrity of private small worlds.

In Chapter 26, we address the scientific base for the content of education and its role in certifying the knowledge of the functionaries of a modern society. The occupations we call professions have different knowledge bases, all with a claim to be scientifically valid.

Scientists are expected to give up property rights to their discoveries in return for the honor of having made a discovery. The only accepted exception is when they publish a discovery as a patent right. Patents are a legal bridge between the realms of science and the economy. We review the usage of patents in Chapter 27. Here we discover problems that may require intervention from the central zone of society.

Engineering and medicine have reshaped modern living and prolonged modern life. They have even affected our everyday language. While science marches on, the progress of engineering and medicine is not self-evident. The progress of applied science depends on special arrangements, and on supporting value climates. The extraordinary impact, driven by this complex, on modern society occupies us in Chapter 28 and goes beyond the planners' dreams. Unplanned consequences of planned actions are legion.

We end our discussion of the realm of science with a critical review of the recent efforts by the body politic and the economy to take advantage of science for their own ambitions. The exploitation of science by the body politic is illustrated by a review of the Intergovernmental Panel of Climate Change (IPCC). The exploitation of science by the economy is illustrated by the so-called triple helix.

## Our Typographical Border Signs of Social Reality

The presentation of *The Many-Splendored Society* includes some warning signs when the text drifts off its central topic of language-based social reality. These signs were introduced in the beginning of its first volume.[2] The following is a summary:

[BIO] This book does not focus on biological spontaneities and processes, but when truly needed to understand social reality, we bring them in. When we touch upon the biological base in a more decisive manner, we flag this by including a special notation, [BIO], in the margin of the text or after a heading.

[TECH] Homo sapiens are better at using tools than other beings, and the relation between technology and human social reality is fundamental, but it is not the main topic of this work. The impact of technology on social reality is given no separate treatment in this treatise; instead you find these matters scattered in the text, mostly in Chapter 27 below. However, whenever technology as such is discussed, you will see a [TECH] in the margin or after a heading.

[NAT] Continents and oceans, valleys and mountains, rivers and lakes, sunshine and rain, earthquakes and tsunamis, and numerous other features of nature have a major impact on the shape of human societies. Ecology has recently gained extraordinary attention. This topic, however, is not the center of attention here, but when we bring it in, a special sign, [NAT], for nature, marks it.

[ANIM] A border between man and animals — or between the speaking animal and other animals — is hinted at times in our text. [ANIM] is our fourth and last sign indicating a digression from our central topic of language-based social reality.

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[1] Ch 10 (Vol 2) Societal Realms and Their Relations: Beyond Organic Collaboration, p 331ff

[2] Introduction: Layman's Society and Social Reality (Vol 1) Our Typographical Borders Signs of Social Reality, p 7-8

# PART 1.
# SOCIETAL REALMS AND HOW THEY EMERGE

## Introducing Societal Realms as Basics

The main division of social reality is not class, as Karl Marx thought, but societal realms. They are six in number: science, art, economy, religion, polity, and morality. They are the homes of knowledge, beauty, wealth, sacredness, order, and virtue, all being cardinal values of humanity.

Class is important enough as a division within the economy that separates rich and poor, prosperity and poverty, wealth and indigence, and all that this implies. However, it is an insufficient base for the understanding of the entire society. For one thing, not only class, but also other distinctions with roots outside the economy are important independent stratifications. Consider, for example, scientific competence, levels of artistic taste, high or low offices of political power, or characteristic degrees of religious sanctities; not to forget, distinctions in moral rectitude. These stratifications are as real as that of economic class. Did Marx consider them? As far as I can tell, he did not do so explicitly in his writings. Robert K Merton (1972, 25) notes that Marx's collaborator, Friedrich Engels, claims in a letter to Josef Block that Marx was fully aware of such distinctions — who isn't? — and that he included them in his thinking of class. If so, according to the societal realm to which they belong, we should keep such stratifications conceptually separate from one another.

We will live in a 'many-splendored society' if and when all stratifications — competence, taste, class, sacredness, power, and rectitude — are given about equal attention, sway, and honor. In such a setting, we would hear the voice of money, not as a soloist, but in a chorus of other voices. We state the counterpart to the class struggle in the latter type of society in our Proposition 10:4 on Monopolization of Cardinal Values.* This Proposition pinpoints a universal struggle to monopolize all cardinal values, not just wealth.

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* Proposition 10:4 recalled. *Monopolization of Cardinal Values:* In any society, people who possess or control a large amount of a cardinal value (knowledge, wealth, power, beauty, sacredness, virtue) tend to act to preserve this situation (2: 179).

The different societal realms — science, art, economy, religion, polity, and morality — have become both units of analysis in social science and co-authors of humanity's history. Already in 1919, Max Weber noted in a lecture on politics as a vocation: "We are placed into various life-spheres, each of which are governed by different laws" (Weber 1946, 123).

Scholars usually specify two initial attributes when they talk about societal spheres or realms: they are separate and they are autonomous. Their autonomy is not absolute but relative. However, autonomy is a crucial attribute, the *sine qua non* of a societal realm. In a chapter on "The Losing Spell of Augustus"[1] that opened our work *The Many-Splendored Society*, we emphasized that the societal realms of Western Europe have emerged with a striking independence, a wonderful and remarkable heritage.

Also for other parts of the globe than Europe, there is a place for the societal realms both in the texts of social science and in the history books. Since we find the roots of societal realms in the language brain, it is our good assumption that these realms are present in all civilizations, not just in a specific culture. Human beings everywhere are born with a language brain. It is a universal fact; we are mistaken to believe that everything about human life is relative.

[ANIM] Let's say it again: The societal realms of science, art, economy, religion, polity, and morality are products of humanity's language brain. Animals without language brains do not have societal realms.

Science, dominated by a language of executive descriptions, creates knowledge. The economy, overshadowed by a language of prices, i.e. executive evaluations of goods and services, brings us riches. Polity, dominated by a language of executive prescriptions, provides law and order. Art, full of symbolism of emotive descriptions, gives us beauty and its contemporary non-figurative extensions, all worthy of our contemplation. Religion, loaded with symbols of emotive evaluations, provides human lives with meaning and sacredness. Morality, with its language loaded with emotively engaging prescriptions, arranges for humanity's virtues. We find the underpinnings in social theory of these societal realms in two

Propositions.† Our multi-volume work, *The Many-Splendored Society*, includes three tomes providing portraits of the six grand societal realms:

Volume 4: *The Pursuit of Knowledge* (the present book) is about the historical emergence of science in Part 1 and a presentation of the contemporary societal realm of science in Part 2.

Volume 5: *Beauty, Sacredness and Virtue* is about art, religion and morality.

Volume 6: *Wealth and Order* deals with the economy and the body politic;

Each of these volumes stands on their own. Each is also a part of a larger story, a general social theory. Each one illustrates a slice of exciting developments and discoveries in social science. Each one tells about committed people who shape their realms and write history. Their commitment means that they have invested their egos in the success of the realms.[2] With this follows great motivation.

We may say, with Max Weber, that "the spirit" of their realm has caught these people. We see a spirit of discovery in science, a spirit of beauty or *Erscheinung* (staging appearance) in the arts, a spirit of capitalism in the economy, a spirit of worship in religion, a spirit of statesmanship in the body politic, and a spirit of justice in the realm of morality. We shall argue that a societal realm is not likely to emerge, to survive, and to grow without a passionate spirit.

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† Proposition 5:2 recalled. *Tri- and Bisections of Language Usages and The Understanding Principle*: (a) Any symbolic environment tends to become differentiated by the language brain into a trisection of descriptive, evaluative, and prescriptive usages, each of which contains a bisection of executive and emotive components, i.e. totally six types of usages. (b) The language brain of persons in this symbolic environment has the capacity to differentiate these six usages regardless of their syntax (1: 185).

Proposition 9:1 recalled. *Grand Structuration*: In the history of living symbolic environments, there is a tendency to develop separate and considerably independent realms of morality, religion, art, polity, economy, and science (2: 167).

## Reviewing

Here is a brief rehearsal of key elements in our theory presented in previous volumes of *The Many-Splendored Society.*

Knowledge, riches, order, beauty, sacredness, and virtue produced in the societal realms are called 'cardinal values.' The built-in division of human language delineated in Proposition 5:2, clause (a)[‡], produce a differentiation into societal realms as indicated in Proposition 9:1,[§] each with a cardinal value of its own.

The first order in the study of realms is to view them one by one: science, art, economy, religion, polity, and morality. They should be seen as parallel to one another, not in any hierarchy in which one is seen as "higher" than any other, or as more important than another.

In the internal organization of any one societal realm, we must also count what we have called its 'side-shows' from other realms.[3] Rightly applied, side-shows enhance the cardinal value of the realm in which they intrude. It is normal that 'the main show' of any societal realm incorporates small elements of other realms to facilitate its operations. We have called this phenomenon 'realm embedding.' Most activities in our society cannot work really well without some of the funds from the economy, some regulations from the polity, certain commandments of morality, and some of the knowledge from science. Likewise, enhancements offered by art, as well as meaningfulness offered by religion, are also helpful for a smooth pursuit of the major mission of a realm. These exchanges in the social drama have their special actors, the Procurers and the Providers. All told, the organizations, networks, media, stratification, and spontaneous orders in any of the realms of morality, reli-

‡ Proposition 5:2. *Tri- and Bi-sections of Language Usages, the Min-imum Vocabulary, and The Understanding Principle:* (a) Any sym-bolic environment tends to become differentiated by the language brain into a trisection of descriptive, evaluative, and prescriptive usages, each of which contains a bi-section of executive and emotive components, i.e. totally six types of usages. (b) These usages do not reduce to one another. (c) The language brain of persons in this symbolic environment has the capacity to differentiate these six us-ages regardless of their syntax (1: 185).

§ Proposition 9:1. *Grand Structuration*: (a) In the history of living symbolic environments, there is a tendency to develop separate societal realms of morality, religion, art, polity, economy, and science (2: 230).

gion, art, polity, economy, and science tend to embed smaller elements from the other realms.[4]

Emotive symbolism dominates in the societal realms of art, religion, and morality. They are often bundled together in elementary textbooks or in newspaper sections under the label "culture." Sometimes science, with its more rational executive symbolism, is also included under this label. In principle, such bundling of "culture" is more confusing than illuminating. However, this particular usage of the notion of "culture" has been useful as a common banner of the underdogs among the societal realms in modern Western societies, dwarfed as they are by body politic and business.

To drop an old-fashioned curtsy for culture, or to tip your hat for culture, is not a meaningless gesture, but signals an "awareness of what is missing" in today's society.[5]

## What is New?

Historians, philosophers, and social scientists have already presented the societal realms of science, art, economy, religion, polity, and morality. In particular, contemporary political scientists and economists have given us very advanced expositions of their realms. So why, should we present still another exposition of them?

We know that we cannot improve on existing presentations without finding new facts. Historians of art or science, economists or political scientists, and theologians or moral philosophers will always know more about their particular specialties than a single author from outside. Furthermore, for pedagogical reasons, this author's work will make an effort to refer to parts of science, art, and literature that may already be familiar to many readers. We will also refer to economic and political events and processes that readers may have heard of, or, in some instances lived through in their lifetime. We will cite religious and ethical notions that may already have crossed their minds. So what is the purpose?

The answer is that we yearn to illustrate how the most essential parts of societies work, that is to say, to tell a theory of social reality. In the first three volumes of *The Many-Splendored Society* we have presented some basic definitions and propositions of this theory. Now we must prove that this theory can account for the "inside story" of events and processes in the main realms of social reality: science, art, economy, religion, polity, and morality, and also account for their "outside story" describing how the realms have made humankind's history by their joint development and interacting.

## A Checklist for the Study of Societal Realms

A study of societal realms begins with the cartography of each of the realms. We describe each realm using *one and the same checklist*. This is a rather unusual approach in social science. The list has the same categories for all realms. This does not mean that all different realms are reduced to a single one. "Freedom" is one item in the list. However, this does not allow us to reduce the many-splendored freedoms – academic freedom, artistic license, religious freedom, civic rights, and freedom of conscience – to the freedom to make money. This is an illusion of our days, as appalling as it is common.

Here is the selection of categories in each realm to which we shall pay attention when we tell the "inside story" of a societal realm, regardless which one we are addressing.

| | |
|---|---|
| Critical symbols | * |
| Lifestyles | Organizations |
| Cardinal values | Networks |
| Stratification | Mass media |
| Reward System | Net-organizations |
| * | Net-assemblies |
| Makers | * |
| Keepers | Spontaneous order |
| Brokers | Rationality |
| Takers | Freedom |
| Providers | * |
| Procurers | Passions/ Mobilization |

These categories are rows in our "The Periodic Table of Social Reality."[6] These categories summon the bases that I believe practitioners of social science should touch when they account for the internal organization of any societal realm. Of course, no one should accept this statement at face value. We must demonstrate its usefulness. We will begin an empirical search for familiar evidence in this and the following two books.

We analyzed the possible ways in which societal realms relate to one another, and gave a summary, in the "The Table of Valences of Societal Realms."[7] It tells about 15 possibilities for realms to pair up with and interact with other realms. We can note them, but we cannot deal in full detail with all these 15 combinations.

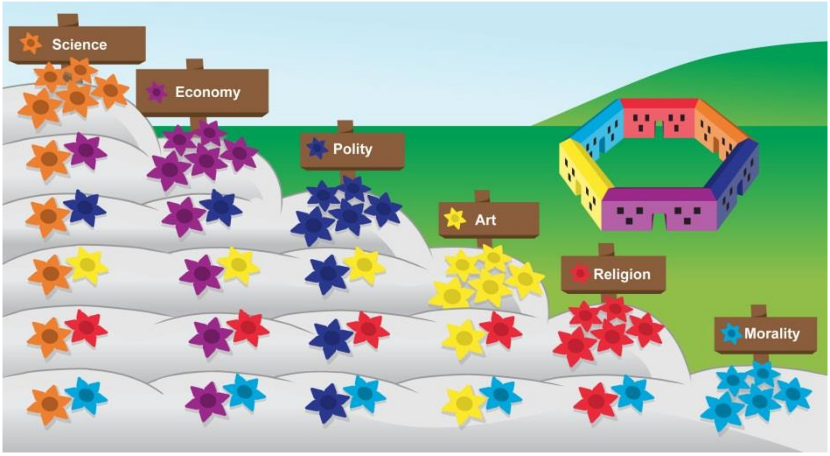
Science-Economy
Science-Polity
Science-Religion
Science-Art
Science-Morality
Economy-Polity
Economy-Art
Economy-Religion
Economy-Morality
Polity-Art
Polity-Religion
Polity-Morality
Art-Religion
Art-Morality
Religion-Morality

If society were a rock garden, we could represent these possible interactions by the flowers in a rock garden, as in Figure 18.0. Each societal realm has its color and grows and blooms mostly in one place. All flowers also spread to the grounds of the others.

We have presented cases of such normal 'organic collaboration' between societal realms.[8] We shall also include in each volume at least one showcase of a full-fledged attempt to merge societal realms. A history of the attempt to merge the societal realms of science and religion is included in Chapter 18 below. The medieval synthesis, an ideal Catholic society in the view of Thomas Aquino and his followers, joined religion and classical Aristotelian science. This merger became unhinged as the realm of modern science grew.

Another brief account of mergers of realms is included in *Wealth and Order*[9], namely the attempts to merge economy and polity in creating a socialist society in the view of Karl Marx and his followers. This merger, once so full of hopes for its first generations of socialists and communists, proved inefficient and unstable. This is a great lesson from the twentieth century, the last signal being the fall of the Soviet Empire in 1991.

*Figure 18.0. First Order Interactions Between Societal Realms Represented by a Flower Garden.*




A case history of the contemporary attempt to merge the societal realms of polity and morality in creating a modern welfare state is included in Volume 6 of *The Many-Splendored Society: Beauty, Sacredness, and Virtue*. Here we also sense that this merger is unstable, at least in its Nordic version to put the moral responsibility for welfare on the government, excluding the full force of both the market and the civil society as serious welfare agents. We had a first view of our recurrent conclusions on Merged Societal Realms in Proposition 10:14.** Among other things, it holds that any total merger of societal realms is inherently wobbly.

Science is the most recent of the six sociolinguistic societal realms that presently is making up social reality. We shall take advantage of the fact that we have better historical records of the

** Proposition 10:14 recalled. Merged societal realms: (a) initially, the proponents of mergers between societal realms tend to become approvingly evaluated in a society, particularly by its takers. However, (b) any mergers of full societal realms (including their cardinal values, stratifications, organizations, networks, media, et cetera) tend to create instable structures that deteriorate over time. (c) the depth and the speed of this deterioration are inversely related to the position of the merger on the scale of valence of societal realms (2: 330).

emergence of science than we have of the rise of the independent realms of art, economy, religion, and polity; all of which have older roots than organized science. What we learn will be particularly useful when we deal, in Volume 6, with the societal realm of morality. In Western civilization, morality is in the process of becoming independent and full-fledged as a republic of virtue at the core of civil society.

## Notes to Introduction

[1] Ch 1 (Vol 1) The Losing Spell of Augustus, p 11ff

[2] Ch 15 (Vol 3) Scales of Evaluation: The Range of Fairness, p 121ff

[3] Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: Sideshows Embedding Alien Cardinal Values, p 254ff

[4]We wrote more on this important observation, that no societal realm is an island unto itself in Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: Societal Realms and their Functions: Makers, Keepers, Brokers, and Takers, p 251ff

[5] Ch 11 (Vol 3) Vocabularies of Justification: Awareness of What is Missing, p 34ff

[6] Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: A Periodic Table of Societal Realms, Table 9.10, p 301-302

[7] Ch 10 (Vol 2) Societal Realms and Their Relations: The Valence of Societal Realms, Table 10.1, p 320

[8] Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: Sideshows Embedding Alien Cardinal Values (including the subsection Pareto Optimality of Sideshows), p 254ff

[9] Volume 6 of the series The Many-Splendored Society

# 18. The Emergence of Science in Europe

### Non-Revolutionary and All-Too-Human

Compared to the societal realms of religion, the body politic, or the economy, the realm of science has a shorter history. Its story reveals a great deal about how a societal realm can emerge and grow. This realm is so new to us that its appearance has been called the "scientific revolution," but its history includes no such thing as a revolution, i.e. a fierce, very rapid, and totally embracing change in a society. The history of science, so far, is mainly non-violent, with many, mostly happy, surprises that progressively made each generation more knowledgeable than the previous. Steven Shapin, a most celebrated scholar of science has told this story very well. To attract readers, he and his publisher, nevertheless, called his book *The Scientific Revolution* (1996). We trust his text anyway.

A scholarly study of science and its place in society cannot differ much from the scholarly study of the economy, or of the body politic, or, of any other realm. All our observations and generalization of social life apply also to those engaged in the societal realm of science, be they researchers, textbook authors, teachers, or students. Steven Shapin collected his papers under the title "*Never Pure*. *Historical Studies of Science as if It was Produced by People with Bodies, Situated in Time, Space, Culture, and Society, and Struggling for Credibility and Authority*" (Shapin 2010). This long title probably bothered his publisher; however, this time it is very accurate.

## The Heritage of Aristotle

Aristotle (384 – 322 BCC) is the greatest all-around scholar of antiquity. He is more than a philosopher; he is an explorer of nature and society using scientific methods. He systematized and preserved his knowledge in books. He conveyed his knowledge in his lessons with young and adult students and in his consultations with the Macedonian prince who was to become Alexander the Great.

Aristotle, himself a genius, shows that the popular vision of a scientist as a lone genius is wrong. Even in his day, knowledge could be organized as a part of society. He had studied in the first academy in Athens, a creation by Plato. The academy held seminars and disputations for students from near and far, young and old. Aristotle founded *The Lyceum*, a second academy. These two academies were the foundation for Athens as a university town, a function it maintained for centuries, also after its commercial and military power were gone and its extraordinary creativity in artwork had faded.

Plato, the mentor of Aristotle, believed that the reality we see on earth is a shadowy copy of a World of Pristine Forms in which original versions exist of everything that can be found on earth. Aristotle, unlike Plato, realized that our own world was the only available one on which we can base knowledge. Its elements, he found, are five: *fire* (hot and dry), *earth* (cold and dry), *air* (hot and wet), *water* (cold and wet), and *ether* (the substance of the cosmos).

Aristotle divided living organisms into "animals with blood" and "animals without blood." He described the shapes and organs of 110 animals. He had personally examined about a third of them. For example, he had found that a cow has four stomachs. He placed organisms in a "natural scale" with eleven steps according to their increasing complexity. Higher ones had greater vigor and mobility than lower ones.

The Earth according to Aristotle was the center of the universe.[1] He placed heavenly bodies in concentric spheres around the Earth. Nearest were the moon, Mercury and Venus. Next to them, Aristotle located a sphere for the sun. Outside the sun were spheres for Mars, Jupiter, and Saturn. Beyond these known planetary spheres were a number of spheres for fixed stars. The total of Aristotle's universe had 55 crystal spheres around the Earth. The outermost was a Primary Mover that made the entire system rotate. In some translations of his writing on metaphysics, the translator talks about the Mover as a god.

Aristotle also wrote extensively and incisively about politics, aesthetics, and ethics, topics that belong in our own multi-volume work, *The Many-Splendored Society*. Even today, we have reasons to return to his books on these topics. No modern physicist or biologist seems to have such reasons to return to any writer from antiquity. However, we social scientists do.

I do not think that this means that social science is backwards compared to natural science. Social science is the easier one of the two. The grammar of social reality is easier than the mathematics of physical reality, and the grammar is known almost automatically by any young language brain. Already in ancient Athens, one could acquire abundant and accurate knowledge of human affairs; the wisdom of its dramatists and philosophers has produced centuries of aha-experiences. It was harder to obtain solid knowledge about phenomena of physical and biological reality. Such knowledge required initiatives that are more conscious, and technologically advanced instruments.

The books and lecture notes that Aristotle wrote (about 150) were copied and distributed in small numbers in the Hellenic world, the nearest thing to a mass-medium of those days. Four out of five of them are lost.

The modern scholarly enterprise also rests on organized structures, such as universities, and on the same four activities that Aristotle also pursued. First and foremost is the scientific method, the rules of evidence and logic, i.e. the accepted ways for the development and formalization of knowledge. Second, are publishing and librarianship, i.e. methods for the orderly selection, distribution, and storage of this knowledge in lecture notes, scholarly journals, books, and in databases. Third, there is pedagogy, methods to mediate knowledge in a series of lessons, explorations, audiovisual aids, exercises, and tests. This includes the task of popularizing science for the public. Fourth, there is the practice, applying established knowledge to concrete problems, for example in engineering and medicine.

Using the labels in our schema for analyzing societal realms[2], we can say that Aristotle, in one person, represented all of the functions of science as a societal realm. He was a Maker of knowledge in his research on nature, man, and society, a Keeper of knowledge in oral or written presentations. Aristotle was also a contracted Provider of knowledge to the Court of the Macedonian Kingdom, including the future emperor Alexander the Great. He served as a Broker of knowledge to students in his *Lyceum* in Athens, where he lectured in the morning to students. Often in the afternoons, he could be found to present science that is more popular to Takers, a public of males of varied ages. He taught them while he walked around the Lyceum. This practice gave a nickname to his enterprise as the Peripatetic School. Aristotle was not an Athenian citizen and not allowed to own real estate in the city; thus his ample outdoor teaching.

We rightly celebrate Aristotle as a model for the societal realm of science, fulfilling all its functions. One secret of his success rests in the fact that all these functions had one aspect in common, a careful, inclusive *kategoriai*. We may today smile at his categories of nature as hot, cold, dry, wet, and his categories of animals with and without blood. Nevertheless, the method of categorization of the many on basis of a few properties is a most useful canon. Such a categorical schema allows a scientist to ask the most profound questions, a librarian to provide the most efficient organization of established knowledge and new research findings, a teacher to cover an entire field without the bias of omission, and a practitioner to be relevant and stop wandering all over the place in search of solutions.

Contributions to categorical schemes are nowadays made in many occupations. Professors, critics, librarians, encyclopedia editors, officials in patent offices and other database operators contribute. Headmasters creating schedules of lessons for their schools are also categorizers of knowledge. Editors organizing the sections in newspapers or blocks of TV-programs are engaged in the art of categorization. Categorization is familiar to readers of *The Many-Splendored Society*, for example in our many "tables of words."

## Schoolmen, Natural Philosophers, and Scientists

On the European Continent, the Makers and Keepers of knowledge have travelled under many names after the founding era in antiquity of what we now call science. We shall present three of them, schoolmen, natural philosophers, and scientists.

### A Prophet of Merger and His Schoolmen

St. Augustine, the philosopher and Father of the Church, wrote in Latin, but like many Romans, he was fluent in Greek. He interpreted Plato and Neo-Platonism in a way that was agreeable with Christianity to which he had converted. After the fall of The Western Roman Empire in the fifth century, European scholars continued to read Plato in Latin. Stoic philosophers from antiquity were also available to them in Latin. Except in Ireland, Greek, the language of the New Testament, lost ground to Latin in the scholarly world of the European Middle Ages.

At that time, Aristotle's writings were virtually unknown in Europe. When Arabic had become a written language in the wake of the publication of the Qur'an, Aristotle's surviving books had been translated into Arabic. One or two translations of Aristotle from Greek into Latin were made in Venice, but most came from Toledo in Spain; the latter were secondary translations of Aristotle from Arabic. Prior to these Arabic translations, Aristotle's texts had not had any aftermath for European thinking. Scholars in medieval Europe knew his ideas piecemeal. It took several hundred years until the full surviving oeuvre of Aristotle was available to them. Many scholars relied on a commentary on Aristotle by the Muslim sage Averroes, active in Cordoba in the twelfth century.

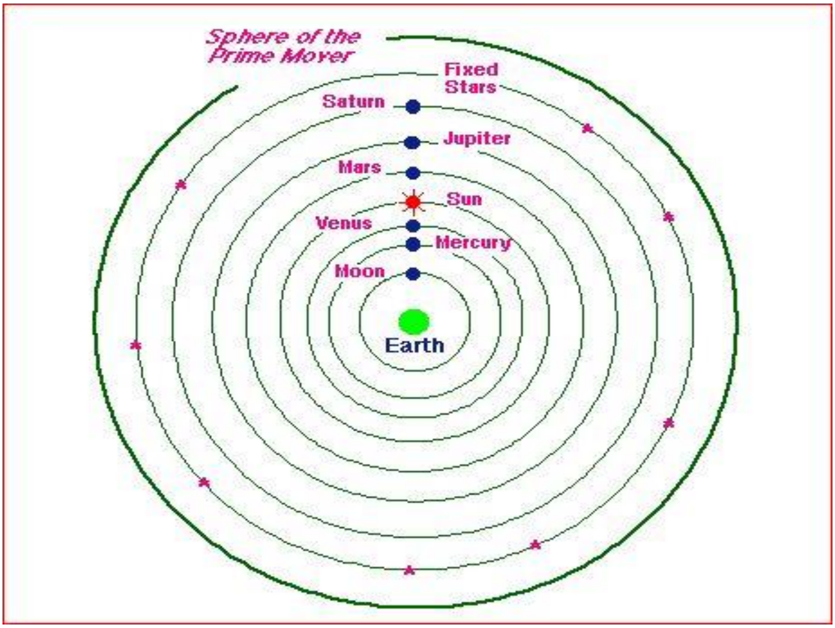
The greatest medieval theologian, Thomas Aquino (1225 — 1274) opened the big portal bringing Aristotle to Europe. He is a great 'prophet of the merging of societal realms'. He commented on and incorporated in his theological writings many of Aristotle's thoughts on morality, and metaphysics, benefiting from a new translation directly from Greek to Latin undertaken by Aquino's collaborator, William of Moerbeke. Aquino referred to Aristotle as "The Philosopher," and Aristotle became in due course an authorized philosopher of the Roman Catholic Church.

Gradually, Aristotle took a place next to Plato — and in many matters replaced Plato — as the main link to Antiquity in Europe (Rubinstein 2003). A blend of Aristotelian philosophy and Christianity became the high points of Medieval Scholasticism. Its practitioners were called *schoolmen.*

Of course, there were also some schoolwomen who in one and the same person pursued a calling to scholarship as well as piety. Since the church barred women from priesthood, they became by definition secondary also in scholarly positions. Giovanna da Piacenza is one of these schoolwomen. She was an aristocratic abbess of a Benedictine cloister in Parma. The nuns there pursued humanistic specialties ranging from hieroglyphs to Greek culture. A young artist, Correggio, soon to become famous, painted the ceiling and walls in the abbess' private room at her direction, completed in 1518 – 1519. It shows great pagan learning, including some eroticism. A small inscription reads *Ignem gladio ne fodias* ("You will not poke out the fire with the sword"). These words are a protest against male authority in the Church in a period when bishops, including the Popes, maintained institutions using violence. They had policing law officers, they kept prisoners, and often enough, had armed guards, and in many instances whole armies of their own.

It is unlikely that the theological version of scholasticism would have emerged if the Christian scholars from its very beginning had had a complete view of Aristotle's work. For example, Aristotle's vision of a cosmos is centered on Earth (Figure 18.1) and is empty of angels and other celestial beings, except for The Prime Mover. The latter force was an Aristotelian concept that the many Christians later thought was the same as their God.

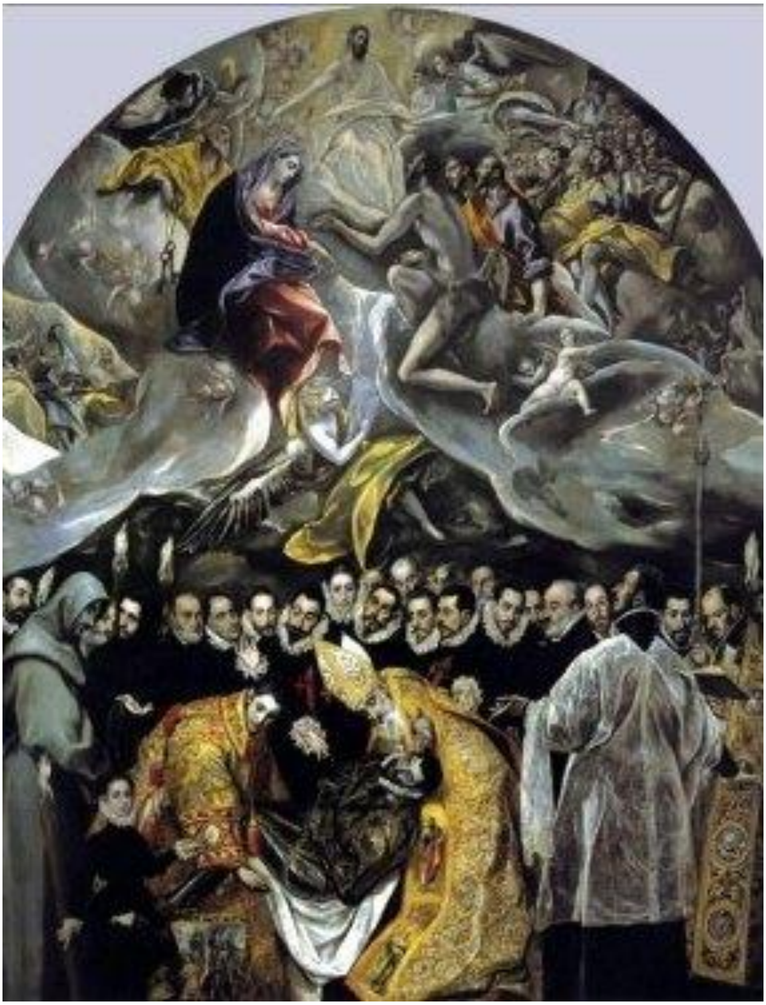
*Figure 18.1. Aristotle's Universe.*




Source: Web lecture from Physics Department at The University of Tennessee.
http://csep10.phys.utk.edu/astr161/lect/retrograde/aristotle.html

In contrast, the Medieval Christian vision of the cosmos — dramatically depicted, for example, in El Greco's painting of the burial of the Count of Origan and the simultaneous saving of his soul (Figure 18.2) — shows a heavenly paradise populated by saints, angels, and the Trinity, i.e. Father, Son, and Holy Spirit. Had El Greco had ancestors in Greece at the time of Aristotle, their gods would not have lived in the heavens but on Earth, in Mount Olympus in the highlands of the peninsula.

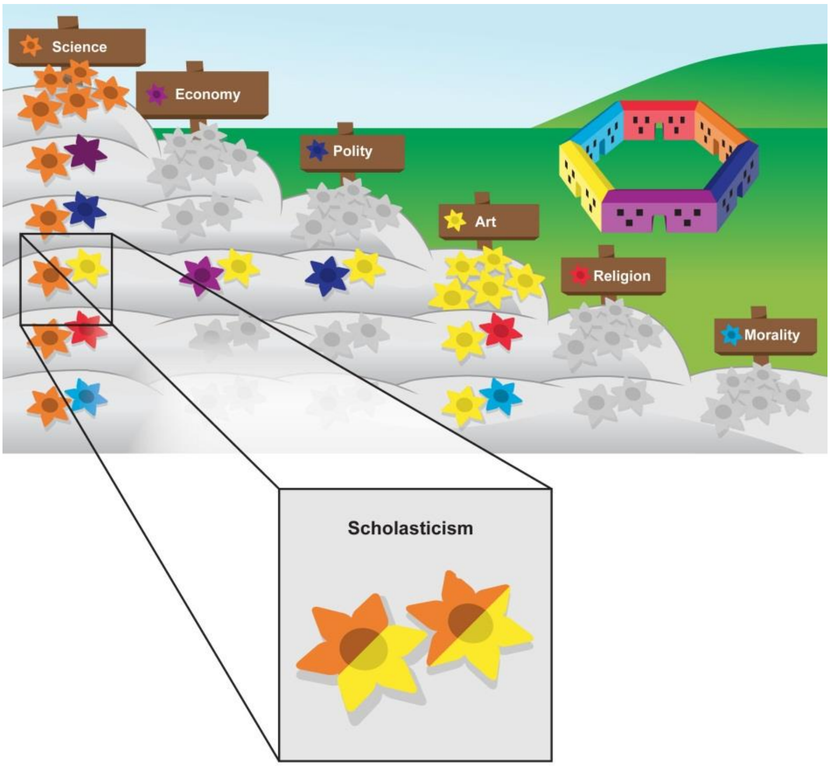
*Figure 18.1. El Greco's Version of the Christian Universe in his painting The Burial of Count Origan.*



The schoolmen were ignorant of the fact – or ignored it – that Aristotle's science was developed on the basis of observations and could be changed and advanced through new and even better observations. The schoolmen focused on academic disputes — and became brilliant at this — without much regard for the new realities of the world.

To Aquino and his early generations of followers, Aristotle was authoritative, with unchangeable texts. By the end of the Middle Ages, Western Europe had obtained a virtually unquestionable consensus in matters of learning in the form of an Aquino-Aristotle synthesis. This is the core of the "cultural synthesis of the Middle Ages."

*Figure 18.2. The Merging of the Societal Realms of Religion and Science into Scholasticism.*




Organizations, assemblies, networks and media of religion and science merged. The cathedral schools that preceded the emergence of European universities had not separated scriptural and more practical knowledge. The theological faculties at the universities housed also philosophy. Wandering students from all over Europe spread this new scholarship to their home countries from the University of Paris and from the ten other universities existing at that time.

Learning found a special home among monks in cloisters. Before literacy became widespread, the monks who were illiterate or could not read Latin became lay brothers. The other monks became friars spreading the message outside the cloisters, and still other monks could devote themselves to holy rituals and study inside the monasteries. The library in a monastery served both religion and science. Wandering monks spread learned insights from cloister to cloister.

The disputations on religious topics followed the same rules as disputations on philosophical and other topics of knowledge. In addition to the common *method* of disputation, the training of priests and the training of teachers had many identical aspects as regards *content*. In many ways, the merging of the search for the sacred and for salvation with the search for knowledge and wisdom seemed natural. For a couple of centuries, it was also a great success.

Modern readers have obtained a good hint of this milieu and its intense disputations in Umberto Eco's novel *The Name of the Rose*. The solution to a murder in a monastery hinges on clues in Aristotle's book on Comedy, not found in the superb library of the cloister. No copy had survived anywhere.

## The Deterioration of the Aquino-Aristotle Synthesis

The linking of knowledge and salvation was a hopeful and promising message, inspiring to this very day to the followers of Thomism. It seems to be a characteristic of all prophets of mergers of societal realms that their message is hopeful and helpful. We have seen its optimistic face, also, when Augustus merged the societal realms of the Roman Republic into the Roman Empire.[3]

A sure means for the schoolmen to criticize any original and new discovery was that the finding could not be found in Aristotle. In this practice, we find a key to the breakup of the merger of religion and science. The process follows the mechanism that we delineated as Proposition 10:14 on Merged Societal Realms.

The Aquino-Aristotle synthesis had created orthodoxy incorporating latent conflicts. Any thinker who deviated from the Aristotelian views also became a religious deviant, a heretic. The Church gave unbelievably harsh treatment to three brilliant, pious, and peaceful men of new knowledge, who became fathers of “natural philosophy.” Nicolaus Copernicus (1473—1543) received a bull of excommunication for his discovery that the earth rotated on its axis once daily, and that it traveled around the sun once yearly. Giordano Bruno (1548—1600) was burned at the stake for proving that the Sun is only one of the numerous celestial bodies in a virtually infinitive universe. Galileo (1564—1642) was exposed to show trials to force him to denounce the observations he made with his invented instrument, the telescope; among other things, his discovery that the sun has sunspots in continuous movement. Unlike Bruno, he disclaimed his own discoveries; nevertheless, he was banished by the Church.

The harshness that most of the schoolmen showed against the emerging natural philosophers is understandable to us only when we realize that the latter were seen as apostates and renegades from the Christian faith of the Aquino-Aristotle synthesis. This pushed the budding natural philosophers and their students to degradation in this world and to the threat of hell in the future world.

The more the natural philosophers deviated from established orthodoxy, the more they had to be degraded. Let us use what we have learned from the previous volume of the series *The Many-Splendored Society*. We have dealt with degradation in our Proposition 16:5 on Socially Induced Compliance.* Clause (c) in this

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* Proposition 16:5 recalled. *Socially Induced Compliance:* (a) The more favor-able evaluations a person receives in an encounter, the more he is likely to conform to the prescriptions in the encounter. (b) The more persons comply with the norms (customary prescriptions) in an encounter, the more favorable evaluations they receive from others in the encounter, (c) The less they comply, the more unfavorable evaluations they tend to receive. (d) When a person in an encounter deviates from its norms, the others in the encounter tend to articulate these prescriptions. (e) A person in an encounter who does not comply with norms of the encounter and consequently thereof hurts other members of the encounters, i.e. victims, are met by an expectation (a new norm) that requires him to compensate the victims in proportion to the damage he has caused. (f) Compensation shall be given not only to the victims, but also to persons in the victims' other encounters who have been affected by the violation (restorative justice). (g) If they are publically visible, the above reactions in (d), (e), and (f) spread to include all other encounters in a shared symbolic environment, including encounters of non-victims and non-affected who have not at all been involved in the original violation. Thus the latter, a general public, also articulate the broken norm as in (d), and they articulate the compensation norm as in (e), and they articulate the restorative justice norm as in (f) (3: 147-148).

Proposition states, *"the less they comply, the more unfavorable evaluations they tend to receive."* To the schoolmen, natural philosophy was also hearsay and infidelity that denied all students of natural philosophy admittance to heaven and paradise. The schoolmen thus raised claims of penance — *"to compensate the victims,"* i.e. the students and followers of natural philosophy (clause d). This repentance was due *"also to the victims' significant encounters that have been affected"* i.e. their fellow men in the Church (clause f).

The schoolmen that imposed the punishments on the heretics felt good when they did so. We here recall our First Principles of Social Punishment, that "*people tend to maintain their self-evaluation by giving negative evaluations of those who deviate from the norms in the encounter.*"† Only by imposing sanctions could the schoolmen keep their own sense of status and self-respect. This circumstance contributed to their zeal in punishing the budding natural philosophers.

Thus, our theory has little or no difficulty in explaining the roots and intensity of persecution of the scientists by the Catholic establishment. This, of course, does not excuse its repression that stood in the way of creating a step toward independent societal realms, the building blocks of a many-splendored society.

We may also attempt to use our theory to understand the response of the schoolman to the persecution from the Church. Our Proposition 5:5 on Evaluative Motives, reproduced below, gives a hint.‡ The "repertoire of action" of the schoolmen to oppose deg-

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† Proposition 16:6. *First Principle of Social Punishment:* In social encounters people tend to maintain their self-evaluation by giving negative evaluations of those who deviate from the norms in the encounter (3: 149).

‡ Proposition 5:5. *Evaluative Motives.* In a normal shared symbolic environment the following applies: (a) Persons and collectivities of persons are inclined to act to preserve the customary evaluations they receive in this environment, be these high or low. (b) They are more inclined to maintain those customary evaluations that are longer continuous flows than shorter ones. (c) They are inclined to act so that they avoid direct or indirect degradation, i.e. receiving more unfavorable evaluations than these customary ones. (d) If degraded, persons and collectivities of persons are inclined to act to restore their customary evaluation by anything available in their repertoire of actions, and. (e) Their effort toward restoration to the customary level of a loss in evaluation may have an immedi-

radation, mentioned in clause (d), included the scientific method. Their counterattacks did not have to be directed against the cardinals, which would have been a losing battle. The counterattack, instead, could be directed against the cardinals' "Philosopher of the Church" and could be used to bring Aristotle from his sacred pedestal.

## Natural Philosophers

In the Renaissance, the idea was unknown and alien that social reality consists of words, our present assumption.[4] Francis Bacon (1561—1626), the great methodologist of natural philosophy, argued explicitly that the pursuit of knowledge should deal with things, not words. Gradually, the schoolmen of words gave way to the natural philosophers of things. In effect, this was a narrowing of the European vision, the beginning of a great disenchantment. It made it easier to reject the Churchmen's version of Aristotle.

Many of the advances in knowledge by natural philosophers were efforts to correct Aristotle. This was true, as we have seen, for the early discoveries by Copernicus, Bruno and Galileo. This was also the case with the greatest in the ranks of natural philosophers, Isaac Newton (1643 – 1727). Aristotle had thought that a continuous force is needed to maintain velocity. Newton's Second Law states that a force brings only acceleration in velocity. To use a modern phrase, Newton believed that Aristotle's Prime Mover had "booted up" the universe, and that, then, it was left spinning in no need for continuous pushing, as Aristotle had assumed.

Correcting Aristotle also became a task for Charles Darwin (1809 – 1882) who uncovered that the complexities dividing animals were not fixed by any scale of nature; they had evolved by natural selection according to reproductive advantages in changing environments.

Darwin's thesis has an enormously large informative value. It is valid for the humblest insect and for the largest mammals. We know now that evolutionary change is not fully linear; it is affected by random mutations and environmental uncertainties. One such factor was the impact of a meteor 65 million years ago that pre-

ate or delayed success, but the longer the delay, the less effort the restoration receives (1: 203).

sumably extinguished the powerful dinosaurs, a breed of lizards. Their extinction made the planet safer for mammals to survive. For the evolution of the only mammal with a fully developed language brain, homo sapiens, there is no better alternative explanation than that of Darwin.

Darwin's theory of natural selection still represents "the present standpoint of science" in the face of resistance and assaults from opponents equipped with convictions, money, and in control of many classrooms and large religious audiences. The theory explains what has happened and how organisms have adapted to changing circumstances. Here, it separates scientists from charlatans. However, Darwin's theory is usually unable to forecast what will happen. It cannot predict what future species will look like, whenever and where we cannot forecast what the future environment of various organisms will be like.

Darwin's generation was the first to call themselves "scientists." The word "science" had long been in use as a designation of a field of knowledge, but not until the mid-nineteenth century, did the Makers of knowledge become known as "scientists" rather than natural philosophers.

The scientists continued to correct Aristotle. Albert Einstein's (1879—1955) theory of relativity denies the Aristotelian assumption of straight motions, something that Newton also had held as true. Astrophysicists, using Einstein's framework, could partially observe and fully calculate how the universe had continuously expanded from an extremely dense state some 13.7 billion years ago, the beginning of the present phase of the "Big Bang." Consequently, the present phase of the universe was created without any Prime Mover as Aristotle had assumed.

## The Rise of Social Science in Europe

It remains for us to consider how the social sciences, the broad topic of our writing in *The Many-Splendored Society*, were added to the growing tree of science.

Social science was formally added to modern science by a Frenchman with formidable intellectual capacity, Auguste Comte (1798—1857). His work on "positive science" (1830—1842) has five volumes, delivered as lectures in his private rooms. The first two volumes deal with the then established fields of mathematics, astronomy, physics, chemistry and biology. His last two deal with "social physics," or "sociology," a comprehensive term he invented.

Comte's summaries, except perhaps of his mathematics, were remarkably comprehensive, given the knowledge of his time. Terry Nicholas Clark in his book on the French universities and the emergence of the social sciences writes:

> The new science of society would develop by applying to mankind the same method of exact observation and analysis used in the "lower," "more simple" sciences.... But mathematics was a sorrowful subject for the prophet who had unraveled the laws of history, created sociology, and proclaimed himself High Priest of Humanity (Clark 1973, 103).

In terms of ideas, Claude Henri de Saint-Simon (1760 – 1825) was the first and greatest source of inspiration for sociology. In many ways, Comte was his systematizing apprentice, younger friend (until they broke up on Comte's initiative), and also, in a couple of publications, his co-author.

Saint-Simon had introduced the concept of "industrialization" and had written of social development and differentiation, thus giving Comte (and later Herbert Spencer in England) a flying start. He analyzed how elites must adapt to social development, and opened the path later trodden by Gaetano Mosca and Vilfredo Pareto. He wrote of the role of class in history — of the workers who create welfare and the lazy exploiters of the workers' toils — and enhanced people's receptiveness to Karl Marx's far sharper doctrine of class struggle based on rationality rather than on a felt indignation with the present. In theory and practice, Saint-Simon took up common values (mainly religious) and their consequences for society, thus presenting the subject of one of Durkheim's major contributions to sociology. Saint-Simon distinguished between stable structures and those that have not yet crystallized, thereby heralding the analytical notions of sociological functionalism and structuralism, and the quest of the latter to find what is really taking place under the surface of social developments. He foresaw that European nations would develop into parliamentary republics; he even believed in a European parliament.

Saint-Simon was an officer of the higher nobility, but lacked a fortune. He tried to survive the French Revolution by changing his name and calling himself M. Bonhomme. Some Jacobins who were more familiar with his origins than his ideas, threw him into prison. However, their control of the revolution was waning and Saint-Simon managed to escape the revolution's orgy of exterminating the aristocracy, whereupon he resumed his real name.

Saint-Simon is also a primary figure of socialism. ”Almost all the ideas in latter-day socialism that are not purely economic are to be found, in the fetal stage, in him,” said Friedrich Engels. The breed of socialism he represents is usually termed “ethical socialism,” also known as “utopian socialism,” when it sought to establish co-operative model societies.

Based on Saint-Simon’s ideas about societies, Comte’s writing “created the stubborn association between positivism, sociology, and political radicalism that since in practice has been in place for long times, but which does not say anything essential about the character of sociology” (Poirier Martinsson 2011, 235). Today, many writers — I for one in this book — use the term “social science” rather than “sociology” to signal something different from physical and biological science.

Social science, contrary to Comte’s supposition, came to resemble biological science more than physical science. Darwin's work on the evolution of species has a closer resemblance to social science than Newton's or Einstein's work on the behavior of matter (Lieberson and Lynn 2002). Darwin, like the social scientist, was faced with the task of drawing conclusions based on series of observations rather than controlled experiments. Darwin, like the social scientists, had to condense volumes of diverse data into a relatively simple system with few independent variables. Darwin, like modern social scientists, had to use and publish a theory that often was incomplete in respect to both evidence and conceptual development, a fact of life of which this author is acutely aware.

Moreover, again contrary to Comte’s assumptions, we can best describe social reality as a product of human language and its grammar, while physical and biological reality are reachable by mathematics and mathematical laws of nature.

Finally, and perhaps most important, also contrary to Comte, social reality, unlike physical and biological reality, is not deterministic. Our own key to social reality is this: if humanity has the capacity to cook up previously unheard-of sentences, it also has the capacity to cook and serve never before seen social structures.

Language is our key to freedom.[5] Through language, we can change existing social designs. Through language we can even find social designs that at least temporarily modify or contradict forecasts from our Propositions of social science.

## A New Societal Realm of Science Emerges Showing an Early Affinity to the Realm of Religion

For a long time, the Makers of knowledge favored a solitary life. The Catholic schoolmen living in cells in those cloisters that had libraries are not too different from the natural philosophers who spent introverted hours in their private observatories and laboratories, or in their gardens with medical plants.

The English "Gentlemen Scholars" of the seventeenth century also avoided the bustling city life. Shapin (2010, 119) says: "At the point of securing their knowledge, they are said to be outside the society to which they mundanely belong."

Robert Boyle (1627—1691) is credited as having decisively separated chemistry from alchemy. He discovered a law of nature that carries his name: the arithmetic product of pressure and volume of a pure gas is a constant, i.e. increased pressure leads to decreased volume and vice versa. Boyle did run a number of his experiments in chemistry on Sundays, celebrating God's work!

Boyle and his colleagues among the natural philosophers did not become a collective of atheists, as several of the moral philosophers did.[6] The men of science typically viewed the search for knowledge as a calling. Not unlike the calling of a priest in "the religions of the book" — Judaism, Christianity, and Islam — studying God's Scriptures, the natural philosophers studied God's Nature.

### Weber on Calling to Science

A calling is not just any occupation. It is more of a vocational life-task carrying a strong commitment. It is called *Beruf* by Max Weber. Swedberg's *Max Weber Dictionary* specifies: "The concept of *Beruf* has its origins in religious tasks set by God, and was extended by Luther, through his translation of the Bible, to secular work…. While Luther saw vocation as ascribing value to one's traditional work, ascetic Protestants extended it to whatever task best served God" (Swedberg 2005, 293-294).

Weber applied the idea of *Beruf* to the first generations of actors shaping a capitalist economy. He also applied the idea to non-economic realms, such as politics, science, and art. Let us cite from a lecture at Munich University on "Wissenschaft als Beruf" given in 1917 at the request of the students, many of whom planned a career in science. Below is Weber's original German text and a translation into English by Professor Hans Gerth of the University of Wisconsin and C Wright Mills, at the time his graduate student:

All work that overlaps neighboring fields, such as we occasionally undertake and which the sociologists must necessarily undertake again and again, is burdened with the resigned realization that at best one provides the specialist with useful questions upon which he would not so easily hit from his own specialized point of view. One's own work must inevitably remain highly imperfect. Only by strict specialization can the scientific worker become fully conscious, for once and perhaps never again in his lifetime, that he has achieved something that will endure. A really definitive and good accomplishment is today always a specialized accomplishment. And whoever lacks the capacity to put on blinders, so to speak, and to come up to the idea that the fate of his soul depends upon whether or not he makes the correct conjecture at this passage of this manuscript may as well stay away from science. He will never have what one may call the 'personal experience' of science. Without this strange intoxication, ridiculed by every outsider; without this passion this 'thousands of years must pass before you enter into life

Alle Arbeiten, welche auf Nachbargebiete übergreifen, wie wir sie gelegentlich machen, wie gerade z.B. die Soziologen sie notwendig immer wieder machen müssen, sind mit dem resignierten Bewußtsein belastet: daß man allenfalls dem Fachman nützliche *Fragestellungen* liefert, auf die dieser von seinen Fachgesichtspunkten aus nicht so leicht verfällt, daß aber die eigene Arbeit unvermeidlich höchst unvollkommen bleiben muß. Nur durch strenge Spezialisierung kann der wissenschaftliche Arbeiter tatsächlich das **Vollgefühl**, einmal und vielleicht nie wieder im Leben, sich zu eigen machen: hier habe ich etwas geleistet, was *dauern* wird. Eine wirklich endgültige und tüchtige Leistung ist heute stets: eine spezialistische Leistung. Und wer also nicht die Fähigkeit besitzt, sich einmal sozusagen Scheuklappen anzuziehen und sich hineinzusteigern in die Vorstellung, daß das Schicksal seiner Seele davon abhängt: ob er diese, gerade diese Konjektur an dieser Stelle dieser Handschrift richtig macht, der bleibe der Wissenschaft nur ja fern. Niemals wird er in sich das durchmachen, was man das »Erlebnis« der Wissenschaft nennen kann. Ohne diesen seltsamen, von jedem Draußenstehenden belächelten Rausch, diese Leidenschaft, dieses: »Jahrtausende mußten vergehen, and thousands more wait in silence' -- according to whether or not you succeed in making this conjecture; without this, you have no calling for science and you should do something else. For nothing is worthy of man as man unless he can pursue it with passionate devotion. (Weber 1946, 135).

ehe du ins Leben tratest, und andere Jahrtausende warten schweigend«: — darauf, ob dir diese Konjektur gelingt, hat einer den Beruf zur Wissenschaft *nicht* und tue etwas anderes. Denn nichts ist für den Menschen als Menschen etwas wert, was er nicht mit *Leidenschaft* tun kann. (Weber 1922, 588-589).

**Note.** One or two sentences in this quote are typically Weber, i.e. Gothic castles with many towers. My mother tongue is Swedish; the first foreign language I learned in school was German, later came French, and English, and I had only one year at an English-speaking university when I first tried a text by Max Weber – in English translation by Hans Gerth and C Wright Mills. I admit that, even in C Wright Mills' smoothening English editing, I had to struggle with the above passage when I first encountered it in 1950 as a graduate student at the University of Minnesota. To me it was illuminating to find out what a life in social science would be like.

I have marked the word "Vollgefühl" above in bold. It is mistranslated from German as a flat and rational "fully conscious," thus hiding a pivotal part of the scientific career, namely *the joy of discovery* that Weber describes as Vollgefühl. Its correct meaning — thanks Berit Stolt — is a feeling in strongest degree bursting of cheerfulness and bliss, filling the whole body. Such are the emotive aspects of the rewards of a scientific discovery!

My sociology teacher in Sweden, Torgny Segerstedt, had not included Max Weber in any of our reading lists and examinations. At the time of my first reading of the quoted passage, I was not particularly eager to cope with more Weber than was assigned in the course work in graduate school at the University of Minnesota. At that time, I concentrated my studies on ideas from the Chicago School of Sociology;[7] ideas that were easily integrated with what I had learned from Professor Segerstedt. Only in due course did Weber's texts become moving and molding to me. **End of Note.**

There are many bottoms in Weber's statement about a career in science, particularly social science. The quote has a message about the necessary, but academically unrewarding efforts, of a sociologist (acting in the role of general social scientist) to cross into the specialties of others, i.e. what we still do almost ninety years later in *The Many-Splendored Society*.

The next message in Weber's sermon is that the work of a scientist must, nevertheless, be highly specialized to achieve enduring results. Scientists are normally judged (and promoted) on the basis of discoveries in a narrow field. To reach fame in the very short life-time that is given us, a scientist must persist in a specialty until a discovery is established.

Weber preaches, furthermore, that scientific endeavors depend on passion. The genuine pursuit of science includes a passion for discovery. However, errors in using the scientific methods can never be excused by the fact that the researcher was passionate. I first interpreted this to mean that passion of discovery promotes science by guaranties that research is done, but that this passion for discovery is no guarantee that the research is done accurately. Later, we have learned that passion involves much more, and that accuracy in research[8] may be distorted in situations without any particular passion for discovery.[9]

Moreover, Weber gives a serious warning that your entire worth, "the fate of your soul," depends on making scientific discoveries correctly. Thus, your conformity to, or deviation from, the norms of the scientific methods shapes the evaluation you receive from your encounters in the community of science. This follows Proposition 16:5, clause 3, cited above.[10] Clearly, for a scientist there is no substitute for correct experiments and comparisons, for accuracy of measurements, for carefulness in use of sources and statistics, for truthfulness in tales and modeling. Here, the very meaning of your short life on this earth is at stake, when "thousands of years must pass before you enter into life and thousands more wait in silence."

Finally, Weber reveals the core of his message to the students training for science: your own development to a mature, autonomous self, to a personality of your own, depends on making your chosen science into, not just a daily routine, but into your calling *(Beruf).*

Weber stressed here the personal qualities of a scientist. Today we would emphasize also the importance for success in science of working in an institution correctly organized for research[11] with access to adequate technologies of measurements,[12] and to be in a research team with sophisticated leadership.[13] We would also locate different chances of scientific success in the very age of the current paradigm of the chosen science.[14] It is easier to make contributions to knowledge in the early stage of a new paradigm when many new applications await discovery than in a mature paradigm in which others already have booked most discoveries. All this we will elaborate in next chapter.

## Affinity to the Old Realms

Toward the end of the years 1643 – 1727, that were Isaac Newton's lifetime, he was considered as the greatest living representative of natural philosophers. Given the pious attitudes of the natural philosophers of his days, it is not surprising that he spent an inordinate effort in secretly trying to incorporate the Trinity of the Christian God into his theory of gravitation. At that time, the spirit of scientific discovery had an affinity to a traditional passion for religious salvation, specifically a Protestant version of salvation.

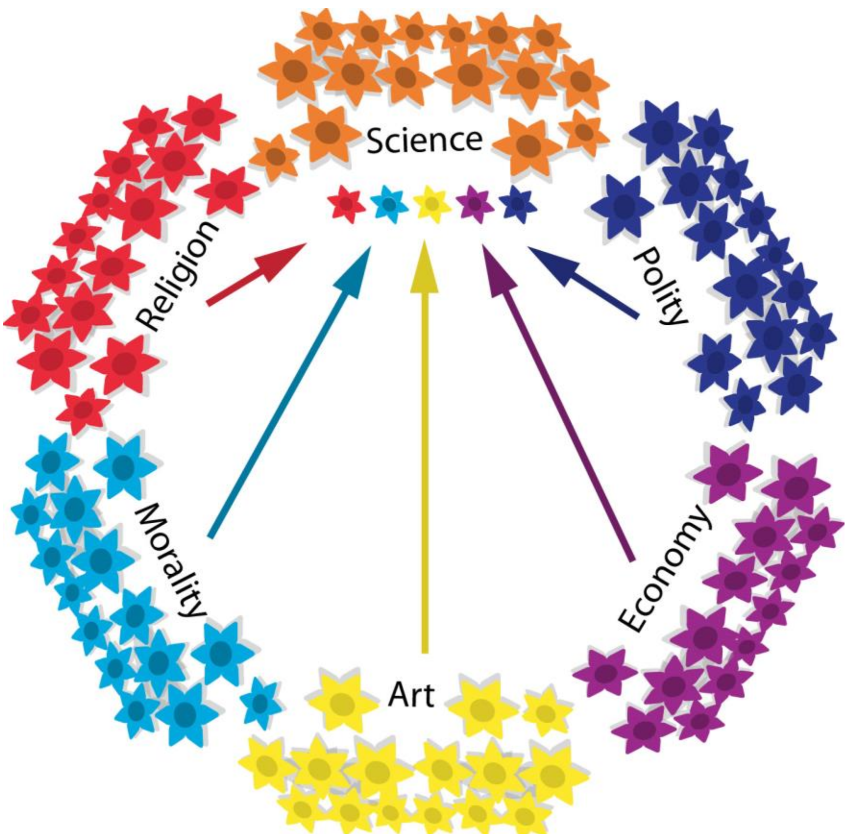
The religious undertones of the emerging realm of science, and the several affinities between religion and science were systematically analyzed by Robert K Merton, first in a sociology journal (1936) and then in a journal on the history of science (1938). His findings apply to the emerging phase of science, not to our times when science is established as a full-fledged societal realm.

New societal realms are likely, at least initially, to be patterned after already existing ones. This may particularly be the case when the new realm is a breakaway from an existing one; such was our case of European science surfacing in the Renaissance from inside the realm of religion. Our "Table of Valances of Societal Realms" shows closeness and distance between realms.[15]

We record this process as a Proposition:

> Proposition 18:1. Affinities Between Old and New Societal Realms: (a) In a society that is only partially differentiated in societal realms, a new realm is initially likely to take over selected structures from the existing realms. (b) The realm normally chosen as a model for a new one is a dominating realm at the time and place involved, and/or a realm whose valance is low in relation to the emerging realm. (c) As society changes and other realms become dominant, the new realm tends to adopt structures from the latter prior to emerging as an independent realm with structures of its own.

*Figure 18.2 Procurement to the Realm of Science.*




## The Spirit of Discovery

The new realm of science has a mood of rationality evidenced in its careful methodology, i.e. a critical use of sources, a representative use of cases, rules of measurements, experimental designs, and a careful reasoning used in interpreting the results. All scientific academies share in a concern for methodology. Subsequently, professional philosophers of science entered the scene to offer new views. For example, Karl Popper wrote in German (Logik der Forschung 1934) and reformulated in English 25 years later (The Logic of Scientific Discovery 1959). In these books, Popper writes about the context of justification in science, not its context of discovery that more concerns us here.

In critical debates on scientific issues, Popper's accounts are often appreciated by natural scientists; "aha, this is the way we work." At other times, natural scientists may dismiss philosophers of science as being so pure and abstract that practicing scientists can hardly recognize their situation in a philosophical text or context. Furthermore, scientists tend to resent the idea that philosophers take the role of ultimate policemen of scientific practice.

The social scientists are less helped by a determinist philosophy of science, such as Popper's, which holds that a single experiment can falsify a generally held thesis. Social scientists need philosophical help to understand that they are users of the logic of a grammar when studying social reality, rather than the logic of mathematics as used in natural science. The linguistic nature of social reality was abundantly illustrated in previous volumes of the series *The Many-Splendored Society,* and as well as in the Preface of the present volume.[16] Our discussion of this problem will continue in the section on uncertainty in social science.[17] We must also consider that a special freedom applies to the users of human language, i.e. the very people who are the subjects of social studies.[18] The latter point implies that a general proposition cannot always be invalidated by a single contrary case; the data may be a product of a social design by individuals exercising their freedom to use language.

What philosophers of science usually miss, but what sociologists of science (such as Weber) observe, is the fact that a passionate spirit of discovery is a significant part of the scientific enterprise.

Newton had been personally elated that his commitment to the study of gravity had been such a resounding success. It was a case of the high level of celebration and evaluation, as we know from clause (b) in Proposition 15:1 about Emotive Sense of Fairness, recalled here.[§]

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§ Proposition 15:1 recalled. *The Emotive Sense of Fairness:* (a) If the evaluations a person receives for a set of actions in encounters become disproportionately smaller than his commitment to these actions, then he tends to show negative emotive reactions, while. (b) If they become disproportionately larger than the extent of his commitment to these actions, he tends to show positive emotive reactions (3: 119).

Newton's achievement with gravitation was a boost to his motivation for new discoveries. His colleagues also felt motivated by sharing in the joy. The growth of a cardinal value, such as knowledge, creates its own preference to search for more knowledge, as we stated in Proposition 11:2 about Motivations from Cardinal Values.[**]

Above all, Newton's additions to the cardinal value of knowledge added to the achievement motivation of his colleagues. This is precisely the message of Proposition 10:6 on Achieving When Cardinal Values Change.[††] To keep up with Newton, the other natural philosophers would have to accomplish more, simply in order to stay in the same place of esteem and honor in their field of scholarship.

The three processes mentioned above combined into creating a passionate 'spirit of discovery' in the new societal realm of science. A cardinal passion such as a spirit of discovery is obviously a great boost for a new societal realm to grow and flourish.

At a later date, in European history, kings ruled over body politics that did not only seek expansion and order to their territories but also set as their goal to amass gold to their courts. They thus embraced the economy in their reigns in what is called mercantilism. This order was broken up by a 'sprit of capitalism' that allowed others than the royal courts and aristocratic estates to acquire and maximize riches. By the rise of such 'spirits,' various societal realms and their cardinal values gained momentum, and we obtained "The Losing Spell of Augustus," as described in the opening of our work.[19]

There is no certainty that a spirit of discovery or a spirit of capitalism, or whatever spirit you have, will end up in success and

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[**] Proposition 11:2 recalled. *Motivations from Cardinal Values*: In lasting and differentiated symbolic environments, there is a tendency to develop a preference for more, rather than less, of cardinal values, i.e. of more knowledge, more wealth, more order, more beauty, more sacredness, and more virtue (3: 21).

[††] Proposition 10:6 recalled. *Achieving When Cardinal Values Change:* The more growth and/or non-anomic inflation there is in cardinal values in a society, the stronger the achievement motives in the population of that society (2: 181).

satisfaction. Newton's failure to incorporate the Christian Trinity into his theory of gravity left him full of negative feelings, frustration, and near-depression, not surprising for those who know the human conditions — or have read clause (a) in Proposition 15:1 on Emotive Sense of Fairness.[20]

Newton did not share his failure about the Trinity with colleagues; he kept it a secret in the Royal Society and from the world. He protected his reputation from bad news, and, he protected the new spirit of discovery among his colleagues, as well. Actually, a "gag rule" of the Royal Society prohibited purely religious discussions at its formal meetings.[21]

## On Cardinal Passions

The spirit of discovery is fervent and eager. Such emotional commitments to rational pursuit of a cardinal value deserve a name of their own. We call them 'cardinal passions.'

At least three processes combine to make cardinal passions into a perfect storm.

The first process is the very basic Proposition 11:2 on Motivations from Cardinal Values, of which knowledge is one and order, wealth, beauty, sacredness, and virtue are the others.[‡‡] They are desirable; you want more rather than less of these cardinal values. A commitment to science is always a commitment to more science. You then leave the continuation of your contribution to be used — and to be revised — by other scientists.

The second is Proposition 9:6 on Achieving When Cardinal Values Change.[§§] It relates any growth in a cardinal value, such as knowledge, to renewed motivation. A scientist must keep up with his colleagues of science to stay in the same place, never leave a new issue of the journal of his specialty unread.

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‡‡ Proposition 11:2. *Motivations from Cardinal Values*: In lasting and differentiated symbolic environments, there is a tendency to develop a preference for more, rather than less, of cardinal values, i.e. of more knowledge, more wealth, more order, more beauty, more sacredness, and more virtue (3: 23).

§§ Proposition 9:6. *Achieving When Cardinal Values Change*: The more growth and/or non-anomic inflation there is in cardinal values in a society, the stronger the achievement motives in the population of that society (2: 247).

The third is Proposition 15:1 on the Emotive Sense of Fairness, recently recalled in this text,[22] that describes commitments to the realm of science and the elations that come with larger than expected pay-offs of the ordinary research process. We have defined a person's commitment to a set of actions as the extent to which his self-image is dependent on his or her engaging in these actions.

In the case of science, the three propositions produce a special vocabulary of justifications, what we have called 'learned justifications.'[23] This vocabulary is any variations on the theme "We did it to increase our knowledge." Vocabularies of justification are those we use to persuade and motivate ourselves, in contrast to compelling vocabularies that others in society use to persuade and motivate us.

With developed learned justifications that drive motivation, the creation of the cardinal passion of the spirit of discovery is completed. This passion appears also in the life-style we called Learning Buffs.[24]

We can add similar cardinal passions to other societal realms and their life-styles. In the economy we may, under the same circumstances, see at least some Money-centered people[25] with 'the spirit of capitalism.' In the realm of body politic, we may have some Civic-minded persons[26] with a passionate 'spirit of statesmanship' as a vocation. In the arts, we have some Aesthetes[27] with a passionate 'spirit of artistry' in music, dance, painting, writing, et cetera. In the realm of religion, some with the life-style of Believers,[28] are practicing with a truly passionate 'spirit of worship,' and in the realm of morality we will find that some of its Compassionates have a passionate 'spirit of justice.'[29]

You can work in a societal realm without ever being passionate about its cardinal value. "There are two ways of making politics one's vocation: Either one lives 'for' politics or one lives 'off' politics," said Max Weber (1946, 46). The former are committed to put many unpaid hours into political work. Only some of them do this in the hope of obtaining a political office and thus crossing over to live off politics.

We often hail those with a passion to live for politics as ideal citizens in a democracy; in fact, they always seem to be a minority of the electorate.

## On Cardinal Virtuosity

Church history tells that some people have more capacity for religious language than have others. Weber (1968, Vol 2, 538ff) noticed this superior capacity in ascetic Protestantism. In his sociology of religion, he borrowed the term "religious virtuosity" from theologians for these exceptional cases. However, also others, for example, medieval mysticism of Meister Eckhart qualify as virtuosity.

We may easily extend the term from religion to other societal realms, and talk about virtuosity among scientists, businesspersons, politicians, artists, and moralists. We then obtain six kinds of verbal intelligence to measure and study.[30] Research into this area got a flying start in the work of Sir Francis Galton. His cousin, Charles Darwin, had inspired him to a study of heredity in generations of humans, and he published his findings in the wide read book *Hereditary Genius* (1869). His study of the members of the Royal Society is pioneering in two ways. Its topic is "scientific virtuosity," never before systematically studied, and its method is "statistics based on a questionnaire" about the lives of the members, never used before by a scientist.

Galton's study of the Royal Society recognized education and intellectual environment as factors, but he did not abandon his idea that heredity was a decisive influence.

Virtuosity has remained an underdeveloped part of social science.  Galton himself illustrates to scientific virtuosity. One may also characterize him as driven by scientific passion. The citation accompanied his knighthood mentioned accomplishments in a half a dozen scientific pursuits: biology, criminology (finger printing), geography, meteorology, psychology, and statistics.

## Weber's Early Mistake about Economic Rationality

What we call cardinal passions have a role in the emergence and maintenance of societal realms. We could observe this in Weber's writings, when he late in life used the term *Beruf* in the analysis of various realms such as polity, science, and art. Beruf is an occupation to which you have a long-term emotive commitment, i.e. a calling.

This observation that a capitalist pursuit could be a calling, implied, as Jack Barbalet (2008) discovered, a revision of a somber mistake of emphasis in Weber's early view (Die protestantische

Etik und der "Geist" des Kapitalismus 1904-1905). Here Weber saw the spirit of capitalism as an expression of untainted rationality requiring a stricture — preferably a Puritan Calvinist stricture — of emotions in economic pursuits.

As far as I can tell, Weber never acknowledged his earlier mistake in emphasis when he later noticed that in reality, passion enters also in a capitalist businessperson's continuous, systematic calculations of what is profitable and what is unprofitable. This passion, should not be mistaken for personal greed.[31] It is a passion for doing something right and essential in a specific societal realm, the economy.

We have entered the cardinal passions of discovery, politics, capitalism, artistry, worship, and justice as Row T in our Periodic System.[32] By so-called "circular actions", these passions add to the existing biological mobilization in societies with differentiated societal realms.[33]

## On Scientific Acedia

The passion of discovery may be only a passing guest in the abode of a scientist's career. Acedia, the opposite of passion, is an occupational hazard among women and men of learning taking the form of a gradual decline of the motivation for research, and an increasing alienation from science itself (Zetterberg 1967).

During the Middle Ages, acedia had a purely religious meaning. At that time, the word stood for sloth, the fourth cardinal sin, the state of not caring about one's salvation. With the more clear delineation in the Renaissance between scholars, clergymen, and artists, it becomes appropriate to speak of secular versions, a scientific acedia, and an artistic acedia. Loss of motivation to continue in politics, or the dearth of motivation of a salesman's passion for profit, are also well known, but not given the fancy label of Acedia.

A Nobel laureate in medicine, Ragnar Granit, treats the scientific acedia as a disease:

> Acedia appears slowly and affects at first the general state of well-being. It might begin with a suspicion that everything is not in right order with appetites and health. At the same time, the diseased more and more often begins to recall the passages in his scientific works which have been weak or deficient. In time, all his work appears to have been deficient. Even if his entire contribution to science is not completely dubious, it is at any

> rate just an array of insignificant bagatelles. The diseased thinks that he has chosen the wrong course in life, and he begins to toy with the idea of a pleasant and easy office job, or, if his ambition is still left, a quiet career as a higher civil servant, or he imagines that it is not yet too late to secure an industrial position, be rich and quit counting his pennies. The stomach functions poorly and the heart jumps out of beat, facts that make him decide to decline invitations to dinner and give up the small vices of everyday life. Finally the crisis comes, the great depression, and the mighty voice of Ecclesiastes thunders to the unhappy scientist: 'Vanity of vanities, all is vanity! What can a man ever make of all his efforts under the sun' (Granit 1958, 87 translated here).

We obtain an initial understanding of acedia from Durkheim´s notion of anomie.[34] Anomie is that which prevails outside the range of the rewards to which we have become accustomed. We recall that there is an upper anomic field in which our rewards are so unusually great that we do not know how to handle them (”crisis of riches”) and a lower anomic field in which our rewards are so unusually small that we do not know how to assess them (”crisis of poverty”). Both are dangerous territories; the ordinary girl who after a quick courtship marries a multimillionaire loses her bearings as readily as the ordinary executive who unexpectedly finds himself bankrupt and stripped of his or her assets.

If acedia has an element of anomie, we would expect to find it among scientists whose rewards have suddenly become either excessively small or excessively great. It is easy to understand why the scientist whose efforts end in frustration may withdraw from science. Actually, the very structure of science has the potential of breeding a vague sense of failure in the majority of scientists. The intellectual exchanges around laboratories and research institutes and particularly around university departments in graduate schools generally focus on the ideas of a very small number of great men and women who have made decisive discoveries by their measurements, or who have formulated the current theoretical paradigm.[35] These individuals are models. The adulation generates inspiration and industry among beginners and students. However, the same adulation may bring a sense of eminent failure among the middle-aged or older scholars, the vast majority of whom realize that they will never receive the recognition given their chosen models. Most scientists working in organizations ad-just fast and well to this, and they remain satisfied with ordinary rewards of (upper) middle class professionals (Glaser 1964).

However, when an awareness of failure is sudden, the *acedia of failure* is near. The danger points are several. For example, to have spent years on a research project and find it rejected as a thesis, refused by a journal or publisher, or if published, damned by the reviewers. Other trigger events of the acedia may be to have research funds suddenly cut off, to abruptly find that the academic post one has prepared for is given to someone else, to open a journal and find the solution to one's ongoing project published by another researcher — all such events put a scientist in a dangerous zone.

The *acedia of success* is harder to grasp. A rapid gain in status has one problem in common with a sudden loss in status: The individual is uprooted and transplanted into a strange milieu. To win the Nobel Prize makes you a public figure and celebrity, a huge advantage and a huge distraction. Proposition 15:1 on The Emotive Sense of Fairness[36] helps us understand both the result of despondency in the case of failure in science and the results of the sense of elation in the case of success.

Sudden dramatic fluctuations in the level of rewards for scientific activities are, however, too rare to account for a significant number of incidents of acedia. To understand the large majority of cases that arise, we must focus attention, not on the absolute level of rewards in scientific work, but on the comparison of this level with rewards obtained in non-scientific pursuits, past or present, experienced firsthand or observed among associates. Here we recall Proposition 10:9 on The Side-show Intrusion[***] is helpful. We discover now two additional types of acedia.

One is a result of the concentration of all rewards in the scientific role at the expense of the scientist's involvement in his family, friends, and the community of all the realms of society differing from science, be they civic, artistic, financial, religious or charitable. Here the affected scientist has a want of such "side-shows." The scientist in this position has pinned his entire self-evaluation

[***] Proposition 10:9. *The Side-show intrusion* recalled: (a) Each societal realm tends to embed some elements from the other societal realms. (b) Each person who has a full commitment to one societal realm tends to embrace some elements from other realms (2: 187).

on the solution of some narrow scientific problems. When such solutions are not readily forthcoming, acedia sets in. Let us call this type the *acedia of specialization*. A good example of acedia of specialization is given by Linnaeus, the father of botany. He speaks about it as his ”melancholia”, suggesting that it was caused by his excessive preoccupation with one narrow specialty. ”When one scientific specialty tastes better than another”, he says, ”one seems to get into company only with men who have the same liking for this specialty and one cannot get one’s thoughts from it.” Birds of one specialty flock together and all they do is talk shop. The one-sided preoccupation with the same set of problems at all hours of the day in all social contacts can be dangerous: if you do not solve the problem, then you are indeed a failure.

The other type of acedia is caused by a dispersion of gratification, so that the scientist feels more rewarded in his non-scientific activities than in his scientific job. This affected scientist has too many and too much of “side-shows.” His science does not compete well with his family, his business ventures, his political aspirations, and his social life. This type might be called the *acedia of differentiation*. It is important to keep the two separate because they seem to occur in quite different circumstances. The acedia of differentiation is well illustrated by Antoine Lavoisier whose life we soon will describe. His acedia appears rather painless: it just seems that his science was drowned in a shower of other exciting activities, aristocratic, economic, and political.

The above remarks are sociological, and are not intended to make any psychologist or psychiatrist unemployed. Of course, any personality disorder involving depressions leads also to symptoms like acedia. Here we can only contribute with certain societal conditions.

## Scientists and Their Academies

The passionate spirit of discovery was first organized, not primarily into universities, but in new associations called academies. The universities were institutions geared to teaching rather than research at that time. In the academies, the members avoided the usual quarrels among intellectuals about politics, culture, art, and religion. They had what we call a “gag rule” forcing immediate and permanent tabling of purely religious issues that may have entered a discussion. The new academies should devote their discussions and activities to science and science only.

In a period in which authors and painters could produce in groups, the natural philosophers still produced mainly as individuals in their research efforts, not as research teams. Individual philosophers of nature, however, did join and did seek protection for their activities in alliances with learned peers. In 1657, Galileo's students formed *Accademia del Cimento* in Florence to promote the development of laboratory experiments and common standards of measurements.

A more long-lived association, *The Royal Society of London*, was founded three years later. Its most famous member was Isaac Newton. His fame rests on his work on gravitation and optics, and on the foundation he laid for differential and integral calculus in mathematics. In 1703, Newton was elected President of the Royal Society.

The designation "Royal" did not mean that the Society was part of the court or even of the body politic. It was a vehicle to achieve independence for science from other societal realms.[37] The Society discussed and published scientific progress. It established claims to anteriority of discoveries for its members, a corner stone in the reward system of science. For example, the Society helped Newton in his controversy with Leibniz when both scientists had independently of one another developed the infinitesimal calculus.

The designation "Royal" gave respect to the Society and its members, and, more important, kept the Church, police, petty moralists, and bureaucrats at arm's lengths from a pursuit that many admired, but still more people saw as odd, irregular, or alien to tradition — and perhaps also alien to God's will.

The Royal Society in London and its members received only trivial financial support from the Crown, some years none at all. The cost of research in those days was modest by our standards. Of course, cash was needed for new instruments and to get the expensive mercury for alchemy. Other ingredients and glass containers for chemical experiments were usually low cost items; perhaps one could compare them to kitchen and carpentry equipment. Newton invented and built the first refractory telescope himself.

The main cost or condition for scientific study was *time* for contemplation, reading, writing, and correspondence. Many natural philosophers were part of *The Republic of Letters*. This was not a formal organization, nor an assembly, but an informal quasi-clandestine intellectual network, founded in Italy around 1400.

The members of The Republic of Letters transcended national borders by writing and copying letters to one another. They first wrote in the all-European language of their day, Ciceronian Latin. Later in the seventeenth and eighteenth centuries, they turned to French, which had become the unifying language of Western intellectuals, royal courts, and diplomats (Fumaroli 2011). By then, their network stretched from European countries to America.

The Republic of Letters is mostly known for having promoted the ideas of the Enlightenment. Their network spread opinions effectively and in less visible ways than was done by organizations and the mass media.[38] Organizations, assemblies and media were more easily monitored by the authorities. In its French period, the Republic of Letters also became an important corner in the central zone of society.[39]

The early members and potential members of the Royal Society were "Gentlemen Scholars." They could usually support their research from family assets or jobs in the public sector. Newton had a teaching post at Cambridge University. He gave it up when he became a top civil servant as Master of the Mint, responsible for the production and delivery of Pound Sterling.

The designation "Gentlemen Scholar" did not mean that membership in the Royal Society was dominated by the gentry. Newton, himself, came from modest circumstances and a family broken by the early deaths of both his father and stepfather. In the deliberations of the Royal Society, it became apparent that the full development of science depended on a strict rule of meritocracy. Joseph Priestly, son of a weaver, obtained a fellowship from the Society in 1766. He was the discoverer of oxygen and several other gases. Later, in 1824, Michael Faraday, son of a blacksmith, was elected to the Royal Society. He is considered to be the greatest experimental physicist of all times.

In 1666, an *Académie des science* in Paris was founded by Louis XIV, the Sun King. Unlike its English counterpart, the Académie received plentiful subsidies from the Crown, and could hold its meetings in the King's magnificent library. Among its most illustrious members, we can single out Antoine Lavoisier, the father of modern chemistry. At his time, both laymen and the learned believed that a fire-like substance called "phlogiston" was released in any burning. The most famous of his chemical experiments, published in 1783, revealed that combustion occurs without release of any flammable materials. In 1798, he also became a pioneer of modern physics with his law of the conservation of matter in isolated systems.

Lavoisier was born of wealthy parents, became a partner in Ferme Generale, the private and profitable company that handled tax collection for the French Crown. He married the daughter of another partner in the Ferme. He had a flying start in science and at the age of twenty-five he was already a member of the French Academy of Sciences. He also served as a member of the Provincial Parliament of Orléans, sponsoring a large number of reform bills. From his father he inherited, amongst other things, a farm to which he added new land and became so involved in agriculture that he gladly served in the official Administration of Agriculture. He did a great deal of consulting for the government on education, taxes, and budgets, and the new republic of 1789 elected him president of the Discount Bank, to eventually become the Bank of France. The preceding royal regime had turned to him for advice about gunpowder production, and he had organized and helped administer the state-owned Regie de Poudres. His scientific activity both profited and suffered from his political and financial involvements. He undertook agricultural experiments on his farm, and he could run experiments in his gunpowder arsenal.

The French Revolution reformed the body politic with democratic constitutions. However, it was a disaster for the realm of knowledge. The Revolution closed many universities and other sites of learning used by privileged families. The glory of Sorbonne came to a pause. We have noted how it treated Saint-Simon.[40] The brilliant aristocrat, Antoine Lavoisier, with such outstanding services to science and country fared even worse. He was guillotined at the height of the French Revolution. He faced trumped up charges of selling watered-down tobacco. The rules of honor in science were incompatible with the rules of the Revolution.

In science, as we noted about The Royal Society in London, it does not make any difference whatsoever if a discovery is made by someone who is born high or low, or has made achievements that are high or low in any other realm of society, or even if the discovery is made by a friend or an enemy. Scientific contributions stand on their own merits. They are valid in a totally impersonal manner, regardless of the discoverer's position. In this embrace of impartiality[41] science, the youngest of the societal realms, is the most advanced of them all, and stands out as a model, as we will soon see.[42]

Since their findings were likely to question authority, social philosophers had more to fear from the religious and political establishment in the seventeenth century than did natural scientists. John Locke, although a member of the protective Royal Society, had to disguise as Christian sermons some of his observations and conclusions about the human mind, freedom, and power. He also anonymously issued early editions of a few of his works.

# Notes to Chapter 18. The Emergence of Science in Europe

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[1] Ch 18 (Vol 4) The Emergence of Science in Europe: A Prophet of Merger and his Schoolmen, Figure 18.1, p 19

[2] Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: A Periodic Table of Societal Realms, Table 9.10, p 301-302

[3] Ch 1 (Vol 1) The Losing Spell of Augustus: Gaining Hegemony, p 11ff

[4] Introduction: Layman's Society and Social Reality (Vol 1) Approaching Social Reality, p 3ff

[5] Ch 5 (Vol 1) Linguistic Forms and Usages: Freedom in Social Reality, p 188ff

[6] Ch 18 (Vol 4) Non-Revolutionary and All-Too-Human, p 14ff

[7] Ch 7 (Vol 2) Leadership and Collectivities: The Chicago School of Sociology p 105, and Ch 14 (Vol 3) Compelling Vocabularies of Self-Images: Conversations with the Self, p 105ff

[8] Ch 18 (Vol 4) Weber's Early Mistake about Economic Rationality, p 40

[9] Ch 22 (Vol 4) Distortions in the Realm of Science and its Meta-analysis, p 114ff

[10] Ch 18 (Vol 4) The Emergence of Science in Europe: Proposition 16:5 anticipated, p 24

[11] Ch 23 (Vol 4) Universities Then and Now: Organizations for Research, p 149ff

[12] Ch 28 (Vol 4) Science in Deep Collaboration with Other Societal Realms: The Hidden but Rare Benefit: Research-Technology, p 245ff

[13] Ch 23 (Vol 4) Universities Then and Now: Leadership of Research, p 151

[14] Ch 20 (Vol 4) The Contemporary Pursuit of Science: Internal Factors of Scientific Progress: New Instruments and/or New Paradigmatic Theories [BIO, NAT, TECH], p 87

[15] Ch 10 (Vol 2) Societal Realms and Their Relations: The Valence of Societal Realms, Table 10.1, p 320

[16] Preface (Vol 4) p vi

[17] Ch 21 (Vol 4) Rationalities in Science: Uncertainty Principle in Social Science? p 99ff

[18] Ch 5 (Vol 1) Linguistic Forms and Usages: Freedom in Social Reality, p 188ff

[19] Ch 1 (Vol 1) The Losing Spell of Augustus, p 11ff

[20] Ch 15 (Vol 3) Scales of Evaluation: The Range of Fairness, Proposition 15:1, p 122. Recalled p 38

[21] Ch 18 (Vol 4) The Emergence of Science in Europe: gag rule, p 46

[22] Ch 15 (Vol 3) Scales of Evaluation: The Range of Fairness, Proposition 15:1, p 122. Recalled p 38

[23] Ch 11 (Vol 3) Vocabularies of Justification: Learned Justifications, p 24ff

[24] Ch 3 (Vol 1) Language and Its Distortions: Learning Buffs, p 73

[25] Ch 3 (Vol 1) Language and Its Distortions: Money-Centered, p 74

[26] Ch 3 (Vol 1) Language and Its Distortions: Civic-Minded, p 75

[27] Ch 3 (Vol 1) Language and Its Distortions: Aesthetes, p 74

[28] Ch 3 (Vol 1) Language and Its Distortions: Believers, p 75

[29] Ch 3 (Vol 1) Language and Its Distortions: Compassionate, p 75

[30] Ch 3 (Vol 1) Language and Its Distortions:The Inherited Part of Intelligence, p 61ff

[31] Part 1 (Vol 6) The Cardinal Value of Wealth: Swindlers

[32] Ch 20 (Vol 4) The Contemporary Pursuit of Science: Table 20.1, p 76

[33] Ch 16 (Vol 3) Compelling Vocabularies Supporting Order: Circular Emotive Actions, p 136ff

[34] Ch 15 (Vol 3) Scales of Evaluation: Anomie, p 120ff

[35] Ch 20 (Vol 4) The Contemporary Pursuit of Science: Scientific Knowledge, p 78

[36] Ch 15 (Vol 3) Scales of Evaluation: The Range of Fairness, Proposition 15:1, p 122. Recalled p 38

[37] Ch 1 (Vol 1) The Losing Spell of Augustus: The Realm of Science, p 23

[38] Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: Societal Realms and Their Collectivities, p 249ff

[39] Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: The Central Zone of Elites, p 278ff

[40] Ch 18 (Vol 4) The Emergence of Science in Europe: The Rise of Social Science in Europe, Saint-Simon, p 27

[41] Ch 6 (Vol 2) Positions and Roles: Impartiality p 58

[42] (Vol 2) Introduction: Universal Norms, p 64ff

# 19. Finding a Modus Vivendi and an Ethos of Science

As we have seen, to elaborate, test and correct Aristotle were central tasks of the emerging realm of science. Soon, however, the task did not focus any more on Aristotle; only the remaining schoolmen bothered about his heritage in natural science. Instead, scientists tested, re-worked, and added to the growing body of each other's creative ideas. This became the modus vivendi of science, a truly professional expression of the spirit of discovery and the career of a scientist.

In reviewing each other's work, scientists began first and foremost to look at the empirical evidence, not how the findings squared with current opinions, nor the practical implications of the findings: Do the phenomena mentioned in this report actually exist? In science, "facts kick" (in Gunnar Myrdal's phrase) and scientists can never ignore facts. In constructing science, facts are not private. When publicized, statements of facts are initially put "on probation." They should be provable and verified by other scientists or by other reliable observers. Scholarly acumen as well as skepticism became the ethos of science. To check facts presented by other scientists is a *first* rule in the realm of science. We talk here about a behavior practiced in varying degree by working scientists and their community, not about "*the* scientific method" in an ideal or schoolbook sense.

In everyday life, we are helped by intuition. A scientist's introspection and intuition, "the sixth sense," in addition to the traditional five ones of sight, hearing, touch, smell, and taste, about his object of study may also be inspiring. What is achieved by introspection and intuition may also be mistaken and must be confirmed in the usual scientific way by other scientists to become part of what is called "the current standpoint of science."

While intuition may be helpful at times, it is normally disqualified as a method to qualify as knowledge accepted by the scientific community. However, when the object of study is the inner life of persons, an exception may be allowed. For example, we accept that Sigmund Freud in his so-called "self-analysis" (conducted about 1884 – 1900) unraveled facts about the human mind, such as the Oedipus' complex. Needless to say, such discoveries must be confirmed by other psychologists or psychiatrists to qualify as science. This was in fact Freud's position. Other psychoanalysts competed with one another in rushing in with case histories supporting Freud's discoveries.

A *second* rule of thumb that scientists began to apply in reviewing each other's work is known as Occam's razor. Occam was a fourteenth-century English friar, William of Ockham. His name is given to a rule of scholasticism that has survived in science. If something, for example an argument, can be done adequately by one, it is superfluous to do it by several. Principles of parsimony, i.e. to make do with the fewest possible number of assumptions and thus promote simplicity, informative terminology, and the most general propositions, have become part of the ethos of science. In recent research, for example, this has proven its usefulness in reducing "statistical noise," i.e. prediction errors in models overloaded with variables.[1]

Occam's razor removed the ether in space; gravitational forces were sufficient. The razor removed the phlogiston from the burning process. In the text of the series *The Many-Splendored Society* we also have had some occasions when Occam's razor is at work. We sheared away an organ of conscience and a facility of internalized norms. Both were replaced with different relations between justifying and compelling vocabularies.[2] These claims are still on probation.

## The Current Standpoint of Science

In the post-scholasticism era, one can no longer talk about a fixed intellectual position of science on any issue. One can talk of 'the current standpoint of science.' This is *a moving consensus among the most competent scientists* about a problem under scientific study. As a moving consensus, a current standpoint of science on any specific issue is not necessarily the same as a past position, and the scientific community is open to the idea of a different position of science in the future, unknown at this time.

A full account of a current position of science on a given topic could be complemented by a statement of the currently known *ignorance* by science of the topic at hand. This is not just a show of personal humility in front of the vast unknown and mysterious, "In workaday science," says Robert K Merton (1987, 8), "it is not enough to confess one's ignorance; the point is to specify it." Thus a stage is set for further inquiry, and a new stepping stone is laid for the advancement of knowledge. We will soon return to our concern about unknowns that are known and those that are unknown.[3]

Scholasticism with its stable orthodoxy became unfit as a canon for science. Skepticism became part and parcel of the ethos of science.

## In Passing, Science Alienates Religion [NAT]

Within the early community of natural science in Europe, questions of specific religious issues occasionally appeared. There was nothing like a wholesale rejection of the Gospel. For example, Linnaeus, the botanist, could apparently tell his students (in closed seminars, not in published writing) that bodily resurrection from the dead — many years hence at the end of time — was impractical, but, of course, the soul could nevertheless be immortal. A typical belief among learned folks was that the miracles of Jesus were results of the fact that he understood more of science than did the natural philosophers and scientists of those days.

As we have seen,[4] the representatives of official religion were very harsh on the up-and-coming men of science. The scientists were not as aggressive in return. The early proponents of atheism or near-atheism were not scientists but moral philosophers. In the eighteenth century, Hume, Voltaire, Diderot, challenged the honesty of theologians and the veracity of the Christian doctrines. Voltaire, without first asking the scientists, wanted science to replace religion.[5] Rousseau and d'Holbach used a different anti-clerical rhetoric. They celebrated impulses and pleasures, which they found to be incompatible with Christian morality, which they viewed as destructive of free persons. The latter line of condemnation of Abrahamic religions reached its apex a century later with another philosopher, Friedrich Nietzsche (1844 – 1900).

Not by purpose or by ill will, but *in passing*, the modus vivendi of science became a drastic correction of many theses of the Holy Scriptures and conventional church teaching. In passing, by simply practicing its modus vivendi, science grew alienated from religion. One by one, several religious beliefs were no longer taken as science. A scientist may still have the religious life-style of a Believer, but the Holy Scriptures and their interpretation by preachers did not qualify as manuals and lectures on science. Since these belong to separate societal realms, they may both flower in their own right.

The date of creation was not some thousand years ago as the Jewish, Christian, and Muslim Scriptures assumed. The Big Bang took place billions of years ago. The new astrophysics could fully account for, at least our present, universe without assuming that any God has created heaven and earth, or that any creative design or designer had any part of the process.

A bang of mixing matter and antimatter would normally lead to the annihilation of both. In our Big Bang 13.8 billion years ago, however, there was somewhat more matter than antimatter where we happen to be located in the universe, and our world was created. With such sightings, the Scriptures in their pages on cosmology became incompatible with “the present standpoint of science.” The same is true about Scriptural ideas about the creation of man. Biology after Darwin and the story of the creation of Adam and Eve became incompatible.

The pursuit of science, mostly in passing, continues to spread doubts about religious beliefs. We lack scientific evidence — i.e. evidence that respected modern journals of natural science admit and could publish — showing that messages in prayers and other religious worship change physical reality. However, engaging in prayers does affect at least some worshippers, and thereby it may affect his or her social reality.

The non-Christian religions are not exempted from a similar alienation from modern science. Scientists have found no evidence that deceased ancestors can return to earth and interfere with the living, or that souls wander from species to species. Science remains skeptical about biological differences over time and generations brought about by karma. The holy scriptures of any religion are great for what they are, but they are not textbooks of modern natural science, neither in astronomy or astrophysics, nor in biology or medicine.

The participants at the annual meeting of the American Society for the Advancement of Science in San Francisco 2001 heard Pervez Hoodbhoy, professor of nuclear and high-energy physics at Quaid-e-Azam University in Islamabad, cite a guide on teaching of chemistry in the Islamic way. This Islamic approach decries the usual way in which the formation of water from hydrogen and oxygen is taught. ”No, says the book, the teacher must say that when hydrogen and oxygen combine then, *by the Will of Allah*, they turn into water.” Such formula has no place in natural science; it adds nothing to scientific knowledge. It is merely a ritualistic reminder of Islam's contemporary hegemony in Pakistan, which in scientific discourse is easily removed by Occam's razor.

We may add that neither are religious beliefs appropriate in assessing scientific matters, unless they happen to have support from empirical evidence. In the latter situation, the religious assumption may be unnecessary and Occam's razor shaves them off the face of scientific knowledge. Religious considerations are noise in the margins of the modern discourse of the natural sciences, sometimes cute or enlivening noise, but more often distracting and irrelevant noise.

Many of the early social scientists in the United States had a background as preachers or missionaries. Slowly they realized that they could use the criteria of social science in the study of religion. This is what we too will do in dealing with religion.[6] We shall treat religion as a natural and universal part of social reality, particularly what we know as "virtual reality."[7]

Søren Kierkegaard (1813 – 1855) stands in the disputes between science and religion as a wise philosopher and sincere believer. In his view, faith has nothing to gain by seeking support in science; faith is a saving jump into deep waters, entirely valid on its own. In Kierkegaard's view, this makes salvation and redemption more, rather than less, valuable.

## The Present Standpoint of Science as a Public Opinion

The old stories about the Creation were acceptable and awesome to old generations. Many American scientists are amazed that not all of their contemporary fellow citizens believe in evolution. A CBS poll in 2009, for example, showed that most Americans do not accept the theory of evolution. Instead, 51 percent of adults in the United States say that God created humans in their present form, and another three in ten say that while humans evolved, God guided the process. Just 15 percent of Americans say that God was not involved while humans evolved.

Now, isn't the elaboration of Darwin's evolution the present standpoint of science? Yes, it is so, quite solidly. Many people believe, nevertheless, that God created Eve and Adam, and others believe in an "intelligent design" that does not treat the creation of man as a natural selection. Freedom of opinion in the United States means that the government should not use its force to interfere on behalf of any one of these stands, provided the preaching is peaceful.

Whether the accounts presented by science about evolution and the Big Bang will prove to be acceptable and awesome to new generations is an issue decided by the process of opinion formation, i.e. the fuelling forces of symbols that mobilizes humans to hold and change beliefs. There is nothing automatic about the acceptance of scientific views in public opinion. As a social scientist that has specialized in opinion research, I claim that conditions of public acceptance of established views from the societal realm of science follow the same processes as those ruling political, economic, and artistic opinions.

We have mentioned some such conditions in the previous volumes of the series *The Many-Splendored Society* and reproduce Proposition 16:2[*] and Proposition 8:3[†] as examples. The former purports that majority opinions spread more readily than do minority ones, and both kinds gain acceptance in relation to the social appreciation given to the holders. The second proposition says that the opinions a person holds depend on the opinions encountered and learned in past positions from childhood onwards (status-sequences), and, in addition, depend on opinions in the current set of his or her engagements (status set), and the routine patterns of interactions that the latter provide (role-set).

All societal realms — science, art, business, religion, politics, and morality — compete with one another for the limited hours of a school curriculum, and the outcome of this struggle affects the status of science in public opinion. Those with many hours of science in their class schedule are probably more bent to accept the present standpoint of science. To explain the acceptance in public opinion of standpoints of science, we should look in particular at the introduction to science that young people receive as students.[8] Students are most likely to accept opinions which are congruent

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[*] Proposition 16:2 recalled. *Socially Rewarded Convergence:* (a) Persons have an inclination to express communications that harmonize with customary and/or habitual communications found in their encounters. (b) This tendency increases when others in these encounters have favorable public views (shared evaluations) of them (3: 133).

[†] Proposition 8:3 recalled. *Opinion Demographics*: Persons with similar status-sets, status sequences, and role-sets tend to have similar opinions (2: 83).

with the present standpoint of science in countries in which an exclusive right to certify teachers is granted to universities with a pronounced spirit of discovery. Of course, a head start in accepting the present standpoint of science — and to express it in public — belongs most readily to those whose parents are, themselves, scientists or learning buffs. Such are the effects of status-sequences and role-sets.

## European Spirit of Discovery Includes Social Sciences

Of the multitude of human societies, very few have developed a full-fledged societal realm of science. Still fewer, hardly any, have made this societal realm of science as significant as the body politic, the economy, religion, or as exciting as art, or as compelling as morality, and thus approached what we see as a many-splendored society.

Natural science, with engineering and medicine, as developed in Europe and North America, has not only brought an advanced living standard and longevity to the home territories but in time, to the rest of the world. It has obtained a momentum of its own in Asia and Latin America, and is spreading elsewhere.

The European spirit of discovery, also driven by the search for new riches and the establishment of colonial power, expanded to other parts of the globe. As a byproduct, the scientific disciplines of geography, ethnology, anthropology, and the economics of international trade developed primarily in Europe. For example, based on data about totems used by the native Australian population,[9] Émile Durkheim (1912) in France set forth one of the earliest and best insights ever formulated about the way religion works in a society. By contrast, Durkheim´s great precursor in the Arab world, Ibin Khaldun, knew how to compare one Arab country or period with another Arab country or period. Khaldun was much less inclined to study non-Arab societies and to compare Arab and non-Arab societies.

Jean-François Mattéi (2011, 199-203), drawing on ideas from Leszek Kolakowski, Claude Lévi-Strauss, and Cornelius Castroriadis, has elaborated on a certain difference between social science in Europe and in the rest of the world. In the modern era, Europeans showed a much larger interest in learning about foreign people than these people showed in learning about Europeans. This holds true, for example, for the Aztecs, Hindus, Arabs, and the Turks, says Castroriadis, who at the same time, emphasizes that the cultures of these peoples are not at all inferior to European culture. Lévi-Strauss, whom we remember as adamantly against the idea of any Western superiority,[10] readily admits that the West has had better methods in researching non-Western people than the latter has had in studying the Western world.

Kolakowski notes that the European quest for discovery has included a serious concern for understanding ourselves. Knowing the Other is not just something to be strived for but is seen to be dependent on knowing Oneself. All such knowledge depends on our ability to grasp differences. This effort, we may add, has included a value change — discussed by Charles Taylor (1989) — that after the Renaissance and the Reformation opened an inner room of personal values in the European selves.[11] By knowing themselves more thoroughly, the Europeans and their social scientists became better at knowing others. Unfortunately, this insight did not become particularly noticeable until post-colonial times.

## European Doomsday Science and Its International Bent

A fine contribution to the greatness of Europe is its science. Taking a lead in the development of science brings credit to Europe in world history. Europeans can rightly fend off its detractors on this score.

Unfortunately, Europe has taken the lead also in misusing science. We have no reason to use European science to jump overboard and uncritically celebrate *la grandeur de l'Europe*.

Since the middle of the nineteenth century, the belief in degeneration, rather than belief in regeneration, has become a repeated theme of the European spirit. Approaching an apex, European civilization began to distrust her destiny.

Jacob Burckhardt (1818 – 1897), the historian in Basel who so brilliantly had depicted the dawn of modernity in the lively and creative world of the Italian Renaissance, turned out to prefer the society of the Middle Ages. He meant that democracy, capitalism, socialism, yes, also his contemporary art and science, served only an approaching barbarism.

His young friend, Friedrich Nietzsche (1844 – 1900), held that the process of civilization was turning out to be a victory for the majority, which was composed of weak people, over a minority of more perfect and stronger people.

Thomas Robert Malthus (1766 – 1834) is Europe's most longlasting doomsayer. His ideas about the dangers of population growth have been a bandwagon of lurking disasters that has caught the imagination of every European generation in two centuries. The dooms vary from his original ones of threatening famine and poverty to include modern concern over peak oil and wars over limited natural resources, and global warming, making our globe inhabitable.

[BIO] In the wake of Charles Darwin (1809 – 1882), some biologists, but not Darwin himself, focused on the idea that our heritage conceals a dormant portion of ineptness, stupidity, deformity, and inhuman cruelty that could, one day, mean the fall of civilization. Had not certain European royal lineages become genetically bankrupt?

In the nineteenth century and forward, many maintained that degeneration was due to demographic facts. An insufficient number of children were born to the brightest elites of society. Alternatively, one assumed that the underclass with high fertility had more genetically defective children than the middle classes.

Criminologists, such as Cesare Lombroso (1835 – 1909), explained rising crime rates pursuant to increasing atavism, that is, a return in new generations of distant ancestral genetic dispositions. In a similar vein, Gustav Le Bon (1841 – 1931), a physician and social psychologist, was convinced that a primitive crowd-mentality would surface when democracy came to France.

Sigmund Freud (1856 – 1939) and the psychoanalysts found that the regression to more primitive stages of parent-child relations could account for the many neuroses in modern times. Some lesser intellectuals have gone far beyond Freud in stressing regression, and presenting extensive ongoing degeneration, sometimes to ethnic parts of the white race, sometimes to whole races or entire ethnicities.

Some European multiculturalists in the twenty-first century have taken the disinterest of immigrants to learn the customs, values and the languages of their new countries as a proof of immigrant vitality, compared to the doomed decadence of European culture.

Many feminists have become convinced that a patriarchal order — and by this, they mean nearly all the European conscious cultures in the wake of Homer, Virgil, and Dante — is doomed for demise, and will give rise to a matriarchal culture.

Parallel to the regressive views of the past 150 years, runs Karl Marx' (1818 – 1883) prediction that capitalism inevitably leads to mass poverty and to a revolution making possible the dictatorship of the proletariat.

These apocalyptical views came mainly from European philosophers, historians, and from social scientists entertaining the prediction of disasters, often based on biology and climatology. A common conclusion is that the current course of our civilization must stop. Every little or large species of plant or animal that has survived in the evolution up to the present must be "rescued" and allowed to survive forever. Humankind must stop every new or increased emission into the atmosphere. The present standpoint of science, however, is that the evolution of the universe and nature has always been changing and that change has never stopped.

North American intellectuals kept a more optimistic tone about the future. In the middle of the twentieth century, however, colleagues from science outside of Europe joined Europeans in their pessimism. Europeans helped them to embrace beliefs in the self-destruction of humanity.

[NAT, TECH] The invention and first use of the atomic bomb during World War II acted as a catalyst. Niels Bohr, a Danish atomic scientist, joined American colleagues in presenting the future as *One World or None* (Bohr, et al. 1946). They saw not only mass destruction, but also a new ice age, caused by atomic explosions. At a meeting in 1957 in Pugwash in Nova Scotia in Canada, two British scholars, philosopher Bertrand Russell and Polish-born physicist Joseph Rotblat founded the Pugwash Conferences on Science and World Affairs. They forcefully argued for a ban on the testing and disseminating of atomic weapons, and warned against the development of other weapons of mass destruction. These efforts achieved the Nobel Peace Prize in 1995.

Pugwash was international in scope; its initiative attracted several followers. A decade after its founding, it appeared that such organized initiatives in the societal realm of science came mainly from America. The Union of Concerned Scientists was founded in 1969 in Boston by scientists from MIT, who were joined by congenial colleagues from nearby Harvard and by ranking international colleagues. These futuristic scientists, with mostly pessimistic concerns, expanded attention far beyond nuclear technology into all types of high-tech, focusing on the impact on the planet of over-exploitation and over-consumption.

Concerned spokespersons for climatology, meteorology, and ecology argued that our oil-based technology would lead our world, not into a new ice age, as atomic technology, but to global warming, causing deserts to spread, oceans to overwhelm the land, bringing mankind to starvation. In 1998, The United Nations formally authorized a new group of climate scientists. This endorsement gave it a higher status than the NGOs of Pugwash and Concerned Scientists. This Intergovernmental Panel on Climate Change (IPCC) also includes politicians, a fact that adds to its power but not to its scholarly accuracy.[12] It has proven very effective in spreading a catastrophic threat of a global warming, near in time and near your neighborhood.

The climate conundrum that the UN Panel opened up brought the same type of mobilization of apocalyptic scenarios as had been expressed by earlier, voluntary groups of concerned scientists. Its general theme of manmade global warming with already present or soon-to-be-seen disastrous consequences has had echoes into many corners of society, even creating a new branch of literature, the cli-fi. IPCC message is the loadstar of the Environ-Savior wing of the environmental movement.[13] In level of acceptance and expense, it seems to beat all past episodes of doomsday science.

In the latter part of the twentieth century, European prophesies about the demise of civilization thus went global, toward worldwide demise and disaster. The articles and books documenting the global anguish, usually in their main titles, subtitles, or section titles reflect variations of Spengler's paradigmatic text from the first half of the century, *Untergang des Abendlandes* (1926 and 1928). Many of the issues raised by doomsday science pass through the stages in the general process of interaction between modern social movements, media, and decision-makers that we have previously analyzed.[14]

Large numbers of people, mostly, but not only, in Europe, are attracted to these ideas of decline and fall. Even the optimism and celebration at the turn of the century was marred by thoughts of forthcoming disasters. Many believed, at that time, that our computers were programmed to stall by an inability to cope with the new dates. This would have untold consequences for public administration and for the functioning of markets for goods and services. In the West, to the benefit of the IT industry and its financial bubble at that time, many computers were upgraded into better models or reprogrammed. In Asia, the issue was not seen with the same degree of alarm, and fewer measures were undertaken.

In fact, everyday life continued as usual even when new dates arrived. For practically all people on earth, human society has also survived through all predicted degenerations of humans and practically all predicted manmade disasters.

Jared Diamond, an American expert in human biology and ecology, has analyzed some of the real manmade disasters that have hit our earth and society. His list of case histories of disasters is long. It includes the demise of the Mayan cities in the Latin American jungle, the population and culture of Easter Island, Pitcairn Island, and Henderson Island that lost support from neighboring friendly societies. He also reviews the Native American society of Anasazi with no problems from hostile neighbors, but suffering from drought and population growth, Norse Greenland with overuse of thin soil by agricultural methods imported from Norway, and experiencing a natural (not man-made) climate change. The latter case is close to a controlled experiment. Norse and Inuit shared the same island, but with very different cultures — one survived. Diamond's repeated finding is that collapse isn't inevitable even in a harsh environment, but depends on a society's choices.

The above ideas of doomsday science did not predict any of the disasters analyzed by Diamond. Even the popular fear that environmental deterioration inevitably leads to collapse is put into perspective by Diamond, who flatly states: "I don't know of any case in which a society's collapse can be attributed solely to environmental damage: there are always other contributing factors" (Diamond 2005, 11).

The worst risks facing humans used to be natural catastrophes. In the wake of a book by Ulrich Beck (1986), we have learned to talk about "risk society" as *any modernizing of society by new technology* as a process involving considerable risk. In this new cultural climate of risk, a series of preliminary consonances that we will know as "the present standpoint of science," will eventually sort out glooms and dooms from real risks. Beck and his followers tend to treat the very progress of science as an increase in humanity's risks and anxieties. The fact is that science also continues to relieve humanity of numerous risks, as well as superstitions about risks, which through the ages have caused unnecessary anxieties, sufferings, and premature deaths.

It is well to recall the two Master Trends of Civility and Rationality.‡ The secular trend of civility, an increase in language-based activities, runs contrary to humanity's regression to the reptilian brain[15] that much of doomsday science assumes. The long-term decline in the use of violence that Steven Pinker (2011) has documented also speaks against humanity's historical regression. The second trend spelling out an increased implementation of rationality by humankind manifests itself in the growth of the societal realm of science, bringing an increased consonance into our otherwise more varied descriptions of reality.

## Transference of Cardinal Passions

Emotive symbols loaded with pessimism come together in the accounts of what we called "doomsday science." Scientific skepticism is not supposed to give much room for the dark emotive pessimism that abounds in contemporary opinion climates colored by doomsday science. However, along with the obvious charlatans, several well-known scientists appear among the promoters of chosen eschatological items in our above catalogue about alleged degenerations or catastrophes of our civilization. Most of these individuals are not formally invited as consultants (Providers) to the body politic, the economy, or civil society. They are there voluntarily and on their own.

Many more scientists than these fellow-travelers of prophets of doom are unfairly cited as supporting the cause of the promoters of degeneration and disasters. Mass media, usually thriving on disastrous news,[16] are not particularly kind to scientists who present corrections and a counterbalance to the media's profitable disaster stories.

‡ Proposition 3:4 recalled. *The Master Trend of Civility and The Master Trend of Rationality:* (a) The history of humanity is a slow but increasing expanse of language-based activities, both in absolute and relative terms, in comparison with humanity's pre-language activities., (b) A slow but increasing proportion of language activities based on rationality, both in comparison with the pre-language activities and in comparison with all language activities (1: 100).

It is important to realize that the concerned scientists have not abandoned the scientific spirit of discovery, but they have allowed a political spirit of statesmanship, and/or a moral spirit of justice relevant to the present situation to take an upper hand.

We recall how, in the sixteenth century, Boyle ran chemical experiments on Sundays to honor his God and Creator.[17] In his case, the passion of discovery became subordinated to his passion of worship.

What we see here is a societal transference of cardinal passions between different realms. It is not too different from Freudian transference between individuals such as therapist and patient, parent and child, leader and follower in that it involves great passions. However, it is different in the sense that it involves an established social process of status-sequences and status-sets, and that it is supported by mass communications.

> Proposition 19:1. *Transference of Cardinal Passions*: In a symbolic environment in which societal realms are differentiated, a realm is awarded a cardinal passion transferred from another realm to the extent its participants have experienced status sequences, which include commitments to the former realm and/or have status-sets, which include a commitment to the former realm.

The realm of science contributes much to the public and to its opinions. We can only hope that science will find courageous ways of ensuring that contemporary public opinion will be more responsive to the present standpoint of science.

## Summary of Realm Emergence

We are far from finished in presenting the societal realm of science. Universities, institutes, and think tanks for research have to be added to old academies and learned societies as major configurations of science. A plethora of research journals and conferences have replaced the networks of correspondents of early days. The same applies to careers, reward systems, freedoms and rationalities and other attributes that separate science from other societal realms.

However, it is time for us to pause to consider the information we have gathered on the general problem of the emergence of a societal realm. One should be hesitant to generalize from this chapter on the early history of the rise of science in Europe to the rise of other societal realms in other places and times. At best, a single case can suggest ideas for further research.

Proposition 19:2 records some conditions for the development of any societal realm. These conditions include advanced symbolic environments, the explicit creation of cardinal values, use of differentiated reward systems, and the application of cardinal passions.

> Proposition 19:2 *Emergence of a Societal Realm*: A budding societal realm emerges in societies when these conditions apply: (a) Symbolic environments are differentiated enough to have cardinal values that are mentioned or implied in the pervading linguistic structuration of positions, organizations, assemblies, media, and networks. (b) One specific cardinal value forms a unique and competing stratification and reward system. (c) This cardinal value and these social structures incorporates a relevant cardinal passion.

The mechanism of "linguistic structuration" mentioned in this Proposition is described and illustrated in the opening pages of *An Edifice of Symbols*.[18]

Note that in the Far East, as well as in ancient Greece and Rome, morality and religion appear as two separate societal realms, each with bounded autonomy, what Weber called *Eigengesetzlichkeit.* During the past three hundred years, Western secular morality has also been an emerging independent societal realm, breaking away from religion and from the jurisprudence in the polity. In this endeavor, however, the societal realm of morality has apparently been less successful than the realm of science. However, there is no reason to believe that our spirit of justice always will fade in comparison with our spirit of statesmanship, spirit of capitalism, and our spirit of discovery.

## Notes to Chapter 19. Modus Vivendi and Ethos of Science

[1] Ch 21 (Vol 4) Rationalities in Science: On Chaos, p 98ff

[22] Ch 17 (Vol 3) Justifying and Compelling Vocabularies Writ Large: Conscience and Non-Violence: Discarded Reifications, p 173

[3] Ch 21 (Vol 4) Rationalities in Science: On Systems, p 103

[4] Ch 18 (Vol 4) The Emergence of Science in Europe: The Deterioration of the Aquino-Aristotle Synthesis, p 22ff

[5] Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: Realm Hegemony, p 288

[6] Beauty, Sacredness and Virtue, Part 2, Volume 5 of the series The Many-Splendored Society

[7] Ch 3 (Vol 1) Language and Its Distortions: Toward Virtual Realities, p 98

[8] Ch 26 (Vol 4) Providing a Knowledge Base for Education: Providing Enlightenment by Schooling, p 193

[9] Ch 16 (Vol 3) Compelling Vocabularies Supporting Order: An Etic Conception of Compelling Vocabularies: Totems and Deities, p 167ff

[10] Ch 5 (Vol 1) Linguistic Forms and Usages: The Emic and the Etic, p 172-176

[11] Ch 4 (Vol 1) Vibrations in Symbolic Environments: An Illustration: From Virgil to Luther, p 168

[12] Ch 28 (Vol 4) On Applied Natural Science: A Collaborative Merger of Science and the Body Politic, p 254ff

[13] Ch 7 (Vol 2) Leadership and Collectivities: The Shifting and Expanded Foci of the Environmentalists, p 159ff

[14] Ch 7 (Vol 2) Leadership and Collectivities: Social Movements, p 157ff

[15] Ch 3 (Vol 1) Language and Its Distortions: An Image of the Human Brain, p 54ff

[16] Ch 7 (Vol 2) Leadership and Collectivities: Media Bias for Disasters, p 150ff

[17] Ch 18 (Vol 4) The Emergence of Science in Europe: A New Societal Realm of Science Emerges Showing an Early Affinity to the Realm of Religion , p 28ff

[18] (Vol 2) Introduction: A Fishing Story, p 8-9

# Part 2.

## The Pursuit of Knowledge

# 20. The Contemporary Pursuit of Science

## A First Demarcation of Scientific Discourse

The societal realm of science is tied primarily to executive descriptions, for example, statements of facts, generalizations, and accounts of methodologies. We know that any language has other symbols and other kinds of sentences than descriptions. Moreover, far from all descriptions are scientific. Figure 20.0 shows how we can locate scientific discourse among other discourses.[1] The voice of science is heard from a special part of society that we call the realm of knowledge, in a special language of executive descriptions.

*Table 20.0. Symbols and Sentences in Six Discourses.*

| Dominance of | DESCRIPTIONS | EVALUATIONS | PRESCRIPTIONS |
|---|---|---|---|
| Executive Symbols | Scientific / Other | Economic & other | Political & other |
| Emotive Symbols | Artistic & other | Religious & other | Ethical & other |

Science seeks an objective accuracy, that is, correctness that can be confirmed by others. The many confirmed descriptions in the symbolic environment of science are condensed into precise classifications and into the most informative system of propositions. In natural sciences these propositions are laws of nature. In the social sciences they are probable regularities that can be adjusted by humans exercising their freedom.[2]

There are always old and new versions of scientific truths, and the tensions between accuracies are the stuff of *academic life*. Academic tradition includes rules for the use of the scientific method and the publication of the fruits of scholarship. Academic freedom is the oxygen vital to life in this sphere.

The pursuit of knowledge — at least in Western civilization — has come to rest on three principles, says the philosopher Isaiah

Berlin (1999, 21-22). First, all real questions have an answer. You, yourself, may not know the answer, but wise men may know it — either in the past, present, or future. Second, there are methods to discover and to learn the answers to the unsolved issues. Third, says Berlin, all real answers are compatible and do not contradict one another, implying that, in this sense, all real knowledge is rational.

By sharpening Berlin's principles, modern science emerged in the period of the Enlightenment as a separate societal realm in Europe. Scientific answers to Berlin's questions were sought, not in revelations, not in dogmas, not in tradition, not in inner contemplation. Science arrived in force when the answers were sought in empirical studies and in logical reasoning based on such studies.

The rationality in Berlin's third answer represents an end-state for science. However, we are not there, and may perhaps never get there, as all existing sciences, including physics, embrace some degree of ambivalence. In the social sciences, this ambivalence is grounded in languages we use, and mainly due to the inherent freedom of our language in creating new social designs.[3]

The search for scientific knowledge is not just an arena for a bunch of virtuoso learning buffs and masterminds like Aristotle, Galileo, Newton, Darwin, or Einstein, but it is an every-day lifestyle for a large number of men and women.

Modern "Learning Buffs," as we have noted,[4] have expanded the quest for knowledge into a lifestyle. They have dedicated their lives to absorbing ever more knowledge and their self-image is shaped by how much they have learned. We find them in libraries, in study groups, at the bookstore shelves for non-fiction, in archives, and in laboratories. For these individuals, learning is not a phase in life, but a lifelong mission, albeit often as part-time pursuits. Exceptionally eager to uncover facts and connections between them, they apply technical vocabularies, foreign languages, and sometimes mathematics as their refined instruments. Non-professional Learning Buffs subscribe to popular journals, such as *Scientific American* and *National Geographic* or their counterparts in other countries. On the Internet, they frequently consult sources such as Wikipedia. In their reading, they prefer non-fiction to fiction, and in their viewing, they prefer documentaries to entertainment. Many are greatly attracted to careers in education and research. Among learning buffs who become professional scientists, we find those who are fully enveloped in a deep, passionate spirit of discovery.[5]

## A Short View of Science as a Social Institution: CUDOS

One of the first scholars in the twentieth century, who systematically promoted the notion of science as a social institution, different but on par with other social institutions, was Robert K Merton, the American progenitor of the sociology of science. From an immigrant family without much education, he entered Harvard in 1931 as a graduate student, and became an astute sociological observer at a campus with great science and scholarship at work. Here he came into contact with the pioneering historian of science, George Sarton, and with a learned giant in sociology, Pitirim A Sorokin, whose assistant he became for the preparation of a chapter on science in the latter's *Social and Cultural Dynamics* (Sorokin 1937-41). His doctoral thesis had these two advisors and dealt with this emerging realm: *Science, Technology and Society in 17th-Century England* (Merton 1938).

Four years later, Merton had his main generalizations ready concerning the constitution of the scientific realm (Merton 1942). Its key conditions, he said, are Communism, Universalism, Disinterestedness, and Organized Skepticism:

*Communism:* the property rights to scientific discoveries are published and offered for free to the scientific community.

*Universalism:* contributions by scientists are not dependent on the race, religion, or nationality or on any other personal attribute of the scientist.

*Disinterestedness:* scientific work is carried out in the same way without regard to its possible promotion or defamation of the scientist's religious faith, political, moral, economic, or other persuasions.

*Organized Skepticism:* claims to novelties in science must be subject to scrutiny by other scientists before being accepted and credited to the scientist.

Merton called these conditions CUDOS because their initial letters formed this word, which is also Greek for honor given to an achievement. This kind of cuteness appears now and then in Merton's writings, and in the case of CUDOS, this became a vehicle by which his argument was, and is, remembered. Later historians of the realm of science marveled at the fact that it took only a couple of decades until Merton's ideas had been generally accepted; it became "Mode 1 of science," or, "the realm norms of science."

By then, Merton had changed the term "communism" as an attribute of science to the more acceptable "communalism." It refers to the fact that research findings are not private property. Immediately, nay as fast as possible and ahead of all others, a scientist seeks to secure his additions to knowledge into a public domain. The finding is now forever tied to his name. This is a unique part of the reward system in the societal realm of science.[6] A variation is found in some journalism.[7] However, specific benefits, if any, of scientific discoveries amenable to commercialization may be published as a patent right, which for a limited time remain private property.[8]

Off and on during his career as a social theorist, Robert K Merton returned with new insights to the field of sociology of science, for example, in *On the Shoulders of Giants* (1965), and with a general summary of the field in *The Sociology of Science* (1973). The book *Travels and Adventures of Serendipity* (Merton and Barber 2004) was long in the making and was published posthumously. It deals with the common experience of finding scientific gold when you look for something else, for example, when you work at the anticipated result of your approved application for research funds.

I had the advantage of being a junior colleague of Merton's at Columbia University 1953 – 1964, and I could watch him as an expert in the sociology of science, as a scholar in general theoretical sociology, and as an administrator of a university department of a social science, circumstances that have been very helpful in writing these pages.

Minerva, the Goddess of Science, appears in Merton as requiring exacting work -- just like what Weber's Minerva had asked, upon "the fate of their souls" those entering science.[9] Unlike Weber, however, Merton's Minerva is full of generosity in delivering serendipity to her followers in the form of unexpected scientific findings with full honor to those who have paid attention in their pursuit of other findings. Furthermore, Merton Minerva plays game with her followers, and occasionally let researchers or research groups discover the same finding quite independent of one another. In this case, she allows honor to both.

Slips in attention to CUDOS do occur. Even in Merton's own department, we once discussed whether or not we could let a weak Ph D thesis by a disadvantaged Southerner pass with the silent justification that we certified the author for "Southern competition."

Fifty years later, I encountered an insidious violation of the universalism of CUDOS in an article in my Stockholm newspaper by a political scientist working on climate problems. It dealt with "the fundamental challenge" behind alarm reports about the climate.

> Behind every curve of temperature, behind every line of text, and every table are not only thousands of hours of work, but also a human being: a parent, a friend, a family member, and a citizen. Researchers who enter the academy are not automatically excused from their civic duties to actively continue the democratic debate (Galaz 2014).

Please note that CUDOS does not include additional scientific value in hard work on scientific problems, nor of embracing them with a bleeding heart. The findings by lazy scientists without civic concerns happen to be equally valuable to science.

Even climate scientists need to consider that your sacrifice and effort, and your colleagues' sacrifices and efforts, do not cut any ice. The only factor that matters is that your empirical evidence and your scientific model are right. The fact that the IPCC is *politically* correct does not satisfy Minerva who is concerned with what is scientifically correct. If your work is in political science — as is the case of Dr Victor Galaz, active at the Stockholm Resilience Centre and quoted above — science should mean something else than in Christian Science.

## Properties of the Realm of Science

In the societal realm of science, we find a specific lifestyle with its different levels of mobilization, stratifications, reward system, type of rationality, type of freedoms, spontaneous order, organizations, assemblies, networks, and media. Here we meet Makers (researchers), Keepers (scholars), Brokers (teachers), Takers (students), as well as Providers, and Procurers, in short, all the scenes and actors we know from a social reality created and maintained by linguistic structuration[10] and the categories we selected for the inside story of a societal realm.[11]

*Table 20.1. Science and Other Societal Realms*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | *Societal realm* | 1 SCIENCE | 2 ECONOMY | 3 POLITY | 4 ART | 5 RELIGION | 6 MORALITY |
| B | *Critical symbols* | Executive description | Executive evaluation | Executive prescrip-tion | Emotive description | Emotive evaluation | Emotive prescription |
| C | *Lifestyles* | Learning buffs | Money-centered | Civic-minded | Aesthetes | Believers | Compas-sionate |
| D | *Cardinal values* | Knowledge | Wealth | Order | Beauty | Sacredness | Virtue |
| E | *Strati-fication* | Compe-tence | Class | Power | Taste | Piety | Rectitude |
| F | *Reward system* | First to discover | Monetary devices | Positions, tributes | Artistic fame | Reverence | Testimonials |
| G | *Rationality* | Scientific method | Market economy | Democracy | Aesthetics | Theology | Ethics |
| H | *Freedom* | Academic freedom | Free trade | Civic liberties | Artistic license | Religious freedom | Freedom of conscience |
| I | *Spontan order* | Self-correction | Market prices | Public opinion | Art improvi-sations | Non-ritual prayers | Unplanned civilities |
| J | *Organ-izations* | Academies universities | Corpora-tions | Admini-strations | Theatres museums | Temples | Welfare agencies |
| K | *Associa-tions* | Profesion societies | Coops Unions | Political parties | Art guilds | Congrega-tions | Humanitar charities |
| L | *Assemblies* | Faculties | Guilds | Parlia-ments | Art colonies | Sects | Giving conferences |
| M | *Mass media* | Scince journals | Advertising media | Tribunes | Stages, novels, exhibits | Holy texts, cults | Heralds |
| N | *Networks* | Learned societies | Markets | Electorates | Art circles, bohemia | Fellow believers | Good neighbors |
| N 1 | *Netorgs* | Competing labs | B2B markets | Political parties | Schools (approach to art) | Rival con-gregations | Contending moral group |
| N 2 | *Net-assemb* | Univer-sities | Chambers commerce | Confede-rations | Biennales | Synods | Civil society |
| O | *Makers* | Researchers | Entrepre-neurs | Legislators | Creative artists | Prophets | Sources of high norms |
| P | *Keepers* | Librarians | Bankers | Judges | Critics | Learned clerics | Ethicists |
| Q | *Brokers* | Teachers | Salesmen | Bureau-crats | Performers, entertainers | Preachers | Moralists Carers |
| R | *Takers* | Students | Consumers | Citizens | Fans of culture | Seekers | Decent people |
| S | *Providers* | Consul-tants | Investment advisors | Legal advisors | Patrons of art | Chaplains to other realms | Ethics counselors |
| T | *Procurers* | Research applicants | Investmnt seekers | Taxmen | Art suppli-cants | Salvation seekers fr other realm | Chasers of moral support |
| U | *Mobiliza-tion* | Spirit of discovery | Spirit of capitalism | Spirit of statesman-ship | Spirit of artistry | Spirit of worship | Spirit of justice |

The letters marking the rows are those found in a summary of the various language-products in society called Table of Societal Realms.[12] The letters after "I" continue as columns to make space in the center for some illustrative examples.

If you read the words in italics in the Periodic Table 20.1 you see categories found in any societal realm, also listed in the Introduction.[13] If you read the text in the cells you find their counterparts in the societal realm of science. Thus, we may see and learn the amazing affinities and differences between the societal realms.

If you read the words in italics in the Periodic Table 20.1, you see categories found in any societal realm. If you read the bold text in the first column, you see the content of the societal realm of science. In the other cells, you find their counterparts in the other societal realms. Thus, we may see and learn the amazing affinities and crucial differences between the societal realms

## The Semiotic Square of Knowledge

We are now ready to make further and more sophisticated delineation of the cardinal value of knowledge.

A language of knowledge requires discipline to distinguish it from a language of its opposites. We introduced the device of so called semiotic squares in *Surrounded by Symbols*, our first Volume in this series, when we contrasted femininity and masculinity and received two additional categories, namely bi-sexual and a-sexual.[14]

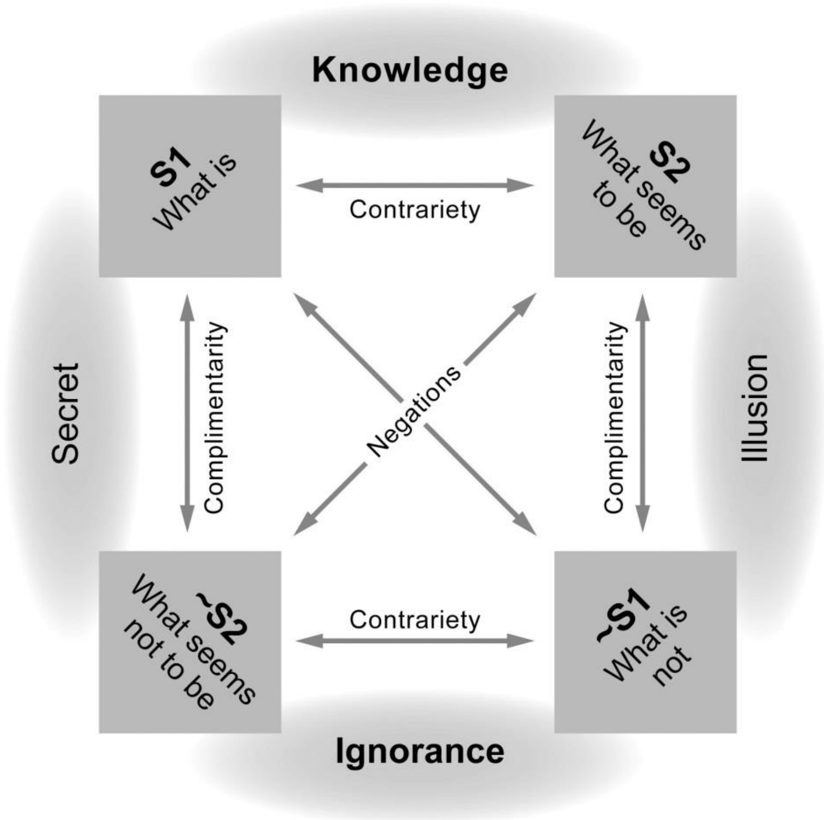
A semiotic square is a device for constructing a schema of classification, rather than a help for the reader of the resulting classification. Those who find our diagram incomprehensible can simply read on in the text to find the categories suggested by the semiotic square.

We shall now use a semiotic square to isolate knowledge from ignorance. Figure 20.1 helps us to delineate what is knowledge and what is not knowledge.

In addition to outright 'ignorance' as the opposite of knowledge, the semiotic analysis found 'illusions' and 'secrets' to be related concepts that must be separated from unadulterated knowledge.

Let us discuss both of the latter in turn.

*Figure 20.1. Semiotics of Knowledge.*




## Scientific Knowledge

Scientific knowledge is what we have called "the current standpoint of science," which in practice is a moving consensus among the most competent scientists about a problem under scientific study.

All scientific research is subject to scrutiny by other scientists. First and foremost, a scientist must publish his methodology, and, secondly, if appropriate, also in due time when the project is definitely finished, make the sources, on which his publication is based, available to other scientists. Statistical or other choices of methods of summaries and analyses should be accessible for inspection, even in the settings where actual inspections are rare. All original data, if any, collected specifically for research, should, if possible, be saved in an archive. References in published research should be made to the archival sources used.

Many scholarly archives are nowadays, not on paper, but stored electronically for access on the World Wide Web. An increasing number are open sources, retrievable by all registered comers. In short, they are more than documentation; they are facilities for further research by others than the original authors.

Scientific discoveries must be replicable *(nachvollziehbar)*. Experiments in physics and chemistry can always be replicated, but historical events cannot. A variation of the above German term, such as ”after-controllable,” or “subject to post-control” is perhaps more adequate than “replication” to convey the credo prevailing in all the humanities and much of social science and in certain areas in biological science. We will soon return to the problems of replications.[15]

## Illusions of Knowledge

In *Surrounded by Symbols,* Volume 1 of the treaties *The Many-Splendored Society,* we have found three difficult tasks for students of society to identify as illusions of knowledge. They are spuma, magic, and defensive bilge. These phenomena are antitheses to science, but one can be scientific about them.

We wanted to keep all concepts, we introduced, scientific, which is why we introduced their mortal enemies in the form of spuma, magic, and defensive bilge early on in our text,[16] rather than waiting for our full account of the societal realm of science in the present writing. Spuma, magic, and defensive bilge should not be included in the pursuit of science; those who have not read about them are encouraged to do so now. They define three types of sentences that are unacceptable in the language of science. Here is a reminder:

*Spuma* consists of confabulations, i.e. language governed by biological spontaneities, and not controlled by the language brain. In gathering summaries and conclusions of research findings, this babble is not welcome. It has no place in constructing scholarly definitions and propositions, or in accounting for the scientific methods and measurements.

*Defensive bilge* is verbiage of excuses, including the speaker’s projections and sour grapes. When used by scientists, journalists, or others in reporting events, it gives a distorted account of reality. It is unacceptable in scholarly discourses.

*Magic* is based on a few principles about cause and effect that are not admissible in scientific discourse without supporting empirical data. Our examples:

Magic(1). In time, all events that happen simultaneously subsequently belong or appear together, in some manner.

Magic(2). In space, all things that have once touched each other, thereafter, hang together in some manner.

Magic(3). What holds true for the part, always also holds for the whole, and vice versa.

Magic(4). All happenings and creations are willed by some being.

Magic(5). One can always find special verbal formulas ("abracadabras") that produce a quick change from anything undesirable to something desirable, and vice versa.

This list is not closed, but is sufficient for our purposes.

These symbolic forms of causality are deeply human. They are treated with the greatest respect by the philosopher Ernst Cassirer who explored them (1923-29/2001-02, vol 2) and from whose work on symbolic forms they are derived.[17] One cannot understand the development and expression of human culture without knowing such principles of magic. These principles were the bases of the enchantment of the world of our ancestors. In contrast, the disenchantment of the world — *die Entzauberung der Welt* in Max Weber's often quoted words — is a profound cultural change in modern civilization, noted also in other ways than the emergence of science in the pursuit of knowledge.

The historical march of science is a long fight against spuma, defensive bilge, and magic. This march has been very successful in basic science; however, it is still far from success in many applied sciences. The march away from spuma, defensive bilge, and magic has still a way to go in much of social science. Reasoning involving spuma, defensive bilge, or magic also appear in journalistic reports of current events in science.

## Secret Knowledge

The 'secret' is another concept delivered by our reading of the western part of a semiotic square of knowledge. Secrets may or may not be true, but in principle, they are inapplicable in the societal realm of science where all relevant discoveries, as mentioned, become public knowledge. Journalists, more than scientists, focus on *secrecy* and work to reveal deceptions.[18]

Request for stamps of secrecy are particularly common in the body politic, including the military, where secrecy is standard operating procedure. Secret knowledge has always been found in the military, about weapons, resources, and plans. The United States Atomic Energy Act of 1954 went beyond the normal range of classifying military secrets. The Act classified parts of the science of physics and related calculations as forbidden knowledge. Still, it is difficult for a government to sue a professor who lectures about such forbidden facts, or a blogger who reveals such facts. A trial in such a contest would necessarily make at least some aspects of the forbidden knowledge public knowledge by the rules of court hearings.

Industrial secrets abound, as is evident by the prevalence of industrial espionage. Secret agendas are found in corporate planning. Findings and methods of market, medical and industrial research involving secret components are often labeled "proprietary," indicating that they are owned by a specific entity. This is not entirely compatible with the norm in the societal realm of science that a scientist shall give up property rights to his findings in return for the honor of being cited as the one who first made the discovery. Nor does secrecy help the requirement of replications to be counted in achieving "the current standpoint of science."[19]

There are business secrets that are helpful in competition. A classic example of corporate secrecy is the recipe of Coca-Cola from 1886 that supposedly has been kept undisclosed ever since. The corporate secret is an alternative to the patent, which is a protection of a published marketable novelty or innovation as a private property that lasts a couple of decades. The phenomenon of patent is a very interesting link between the societal realm of science and the realm of economy, provided by the realm of polity.[20]

Requests for proprietary and secret market research emerges in market economies particularly when launching new products or services, or when old ones need repositioning, and also when current beliefs about an industry no longer corresponds to its actual situation. Some corporate secrets are produced by "market research" or "management research" for private or state companies.

These researches are based on scientific canons, but most findings are not published and thus cannot be cited or checked by outsiders.

Researchers that have produced findings which then become business secrets usually have a record of also having published other findings in their field, and may have written more comprehensive theories resting both on their published and unpublished research. There is little reason to discard such contributions with reference to the ideal of scientific skepticism. One finds a natural, human element of trust also in the workings of the research community, a trust of a serious colleague's data that morally or practically require secrecy. This trust includes, for example, brilliant practitioners of market and management research who have based their cumulative theories as much on proprietary data as on published data. For example, I trust the management theories of Peter Drucker (2001) and the market theories of Evert Gummesson (2008) which are based on both kinds of data.

Drucker invented the term "knowledge worker." He holds that all managers are responsible for the application and performance of knowledge in their organizations, and in a business organization they are also responsible for other people's money. In his younger days, he wrote *Concept of the Corporation* (1946) about General Motors, a work that is very well documented. However, a summary of his later wisdom called *The Essential Drucker* (2001) has several passages apparently dependent on proprietary observations that have never been published. Most of us, nevertheless, would consider these passages trustworthy, as they come from a legendary management and market researcher with much know-how both from his confidential consultancies and from his original published research. In the art of science, it is as much a fault not to see a good idea as to believe in a wrong idea.

Fortunately, it is in the nature of business and markets to overflow with public information about prices, volumes, and specifications and annual reports on performance of firms. Researchers and journalists comb this information for use in their own writing.

My experience in market research suggests that ability to learn faster than the competition from non-secret sources is a recurrent commercial advantage for a firm. Marketers who put an effort into the understanding and use of publicly available knowledge, for example in the form of industry statistics, do quite well in the competition for customers. Joint and common efforts by competitors to provide industry statistics are almost always worthwhile to each one of the contributing competitors. Most firms survive without any need for private or secret knowledge, but from being good at and quick at using public knowledge of their branch.

Applicable knowledge of fields of business is found in economic history and in comprehensive studies of contemporary business segments — an example of the latter is Patrik Aspers' (2010) sociological exploration of the fashion market. It includes broader views of society than is customary in marketing departments.

## Secrecy in Research to Protect Personal Integrity

Special rules apply when researchers obtain information that is sensitive and threatening to personal integrity of informants, subjects, or patients. Such information is usually obtained on conditions of anonymity; this should be stated in a written document. According to the rules of the realms of science, the promise of anonymity is equally binding on the scientist if given only orally.[21] When associates in science request them, access depends on secrecy conditions expressed and agreed at the time when the data were collected. Institutions for medical and social research have standard form of consent about the further use of personal information gathered and saved by the researcher.

There are usually, but not always, ways of removing all identifications of sensitive personal data, thus making data anonymous to other researchers, sometimes even anonymous to the original research team. You simply erase all names, addresses, and id-numbers. This way data may be turned over to colleagues in science. However, real anonymity can never be guaranteed to individuals in small samples with many variables. Nor can anonymity be guaranteed when variables have readings with unusual combinations, or when a variable has readings in an unusual range. In such instances, a (computerized) search can propose probable identities. When such conditions apply, a researcher who has made a promise of anonymity to his interviewees or patients shall not make his data available to others. Let us make clear that journalists, policemen, and courts have no right to such data. Respect for personal integrity is a civilized duty[22] and has its own justifications.[23] In the effort to make necessary after-control of findings, science shall arrange for entirely new study of replication instead of violating this duty.

In a many-splendored society, decisions (or complaints) about accessibility of a researcher's data should be handled within the realm of science, not by courts of state, mass media, nor by economic considerations, or as responses to public opinion.

With the exception of concern for intrusion of personal integrity, the pursuit of scientific knowledge is a most open activity, shunning secrecy, as its semiotic square shows.[24] This holds also for the history of science and technology. Libraries retain the old journals and monographs. Science museums exhibit pioneering research instruments.

## The Two Cultures: The Place of Mathematics

The difference between natural and social scientists is shaped by the properties of their respective subject matter and how they are recorded. In modern natural science, the subject matters of both micro cosmos and macro cosmos are taken as given, and the main task of scientists is to record the differences between various objects. These differences and their relations are recorded as mathematical expressions. Physicists are less comfortable in telling us about the "nature" of their subject matter. So we are left with the impression that the very nature of physical nature is mathematical. At any rate, it is apparent that physical science cannot rely entirely on the language brain. Physical science needs the use of the mathematical platform of human intelligence, and the skills of geometry found in the spatial brain in order to analyze and present its knowledge.

We have seen how the classifications summarized as Tri- and Bi-sections of Language Usages provide main building blocks of social reality.[25] Here, the subject matter of both macro- and micro-social science is not *mathematical* but *grammatical* expressions. In accounting for the grammatical expression of the human drama, social scientists cannot avoid the use of logic, certain mathematical notions, and some basic statistical measurements, i.e. some standard tools of natural science. In this sense, social science is quite similar to natural science. Modern economics and demography are obvious cases in point. Nevertheless, social scientists are by no means obliged to translate everything into mathematics. In many instances in economic history, anthropology, sociology, and political science, it would actually be more meaningful to translate the findings into a lingua franca than into mathematics. For their subject matter is grammatical, not mathematical.

The point of view we take here is a modified version of the old divide between natural science and humanities, *Naturwissenschaften* and *Geisteswissenschaften*, which the German philosopher William Dilthey explored (1883). He cemented a gulf between the two, and this led to the breakdown of communication between science and the humanities which C P Snow (1959) diagnosed as The Two Cultures. Using our formulation, this gulf is not insurmountable, nor incomprehensible.

Natural science must always use the mathematical brain in addition to the language brain. Creativity in natural science is, in considerable measure, a product of the scientist's mathematical brain. Social science and the humanities have, in the main, language brain products as raw data. In coping with these data, a social scholar can also make good use of some mathematics, particularly in dealing with demography, market prices, and survey (interview) statistics. In the social sciences, however, a rule requiring that everything fit into a mathematical model would be an unnecessary and, sometimes, an unbearable straitjacket on both creativity and reality.

When scientists pay attention to the human beings who, with the help of their tools, overcome biological and physical exigencies and manage to create a modern human society, they enter an area of interpenetration between the social and biological and physical worlds. Here social science and natural sciences meet. In this process, researchers are no longer just social scientists but are also, more or less, dependent on natural sciences; nor are they only natural scientists but also, more or less, dependent on social sciences. For example, if you by using natural science happen to discover a climate change that is due to humans' activity and technology, you may also need knowledge from, for example, political science and communication research to do something about this climate change.

## An Illustrative Interpenetration of Natural and Social Science ence

Any interpenetration of natural and social science requires more than professional courtesies to colleagues in other fields. Collaborations may involve surprising discoveries, unanticipated by either field.

[BIO TECH] Consider designs to cope with human stress. Our ancestors evolved into the present species over millions of years, when the conditions for survival were entirely different. They gradually adapted to an environment that changed very slowly. This slowness of the change made adaptation easier. With the industrial revolution, starting over two centuries ago, the rate of change began to increase drastically. Moreover, in the electronic era, that counts its age in decades rather than centuries, the rate of change keeps accelerating.

In striking contrast, the human brain and body have remained essentially the same over several thousand years. Bodily spontaneities are adaptive in Darwin's sense, or, alternatively, they were adaptive in an earlier era or other environment. For example, in eating, the urge for fat was a hedge against famine and the urge for sugar built up the ability to run away from predators. Such spontaneities, as we now know, are less adaptive for healthy living in a rich, modern city. Here the language brain rules and adaptation in food habits spreads through networks and mass media.

Today's demands on the workplace and on communal life, which may be both psychological and physical in nature, trigger the same bodily stress responses that served our ancestors by making them ”fit for fight” or ”fit for flight.” Any situation perceived as a threat or challenge requiring effort, takes signals from the brain to the adrenal medulla, which responds with an output of adrenaline and noradrenalin. These ”stress hormones” make the body fit for fight or flight. In the event that the situation induces feelings of distress and helplessness, the brain sends messages also to the adrenal cortex which secretes another stress hormone, cortisol, which plays an important part in the body's defense.

Jobs for human beings should be designed to reduce, not stress per se but distress, i.e. the feelings of helplessness and of ”giving up” that are likely to occur when people experience events and outcomes as independent of their actions. Helplessness is accompanied by an outflow of stress hormones, particularly cortisol.

A number of studies of working life support the view that personal control and influence over the work process are important ”buffering” factors, helping workers to achieve a state of effort without distress. Demands are then experienced as a stimulus rather than as a burden. Under such conditions, the balance between stress hormones is changed: adrenaline increases whereas the cortisol-producing system remains at rest. This means that the total load on the body, the ”biological cost of achievement,” is lower.

When we design modern jobs enhancing positive challenge, effort, determination, and involvement, we apply medical theories of stress and social theories of leadership in organizations, as well as knowledge of production engineering in which speed and energy efficiency are paramount. It seems meaningless to say that one of these three specialties is more important than the others are in solving the problem. We need them all.

In many instances of interpenetration, social scientists have tipped their hats in respect and allowed, say, medical science, to dominate the interpretations. For example, we have allowed our understanding of old age to be dominated by medical diagnoses of failing bodily functions, deteriorating memory, and the dimming of the senses. In other cases, social scientists have chosen to ignore any biological interpretation and have treated underachievement in schools, crime, poverty, and any social disorder as being socially caused, and something that could be ameliorated by counseling or governmental welfare programs. The results have often been more misleading than illuminating.

A monopolization of knowledge, and particularly the application of knowledge by one or the other of the interpenetrating fields, is unwise. Instead, we should let the evidence decide which discourse — physics, life sciences, or social sciences — is most informative, and search for a synthesis that explains more than each field can do by itself.

## Internal Factors of Scientific Progress: New Instruments and/or New Paradigmatic Theories [BIO, NAT, TECH]

Scientific progress thrives on closeness to instruments and other opportunities for observation. Progress in astronomy has depended on progress in telescopes, progress in medicine is clearly linked to progress in developing microscopes and x-rays. Albert Einstein compared clocks, but was primarily a theorist who expressed expected future observations by mathematical formulae. As we all know, he proposed the equivalence of *(E)*nergy and (m)ass in the famous equation $E = mc^2$, which he formulated in 1905, as part of a special theory of relativity. The constant c in the equation is the speed of light in a space with vacuum. This was a giant leap in the progress of science. What is then most important for scientific progress: better instruments or better theories?

Thomas Kuhn, in *The Structure of Scientific Revolutions* (1962), portrays major leaps in sciences as ground-breaking shifts in their basic frameworks, what he calls shifts of "paradigms," driven in all essentials by new theories, but at times also assisted by what he sees as new societal forces in the larger society.

We have hinted at such a shift when Aristotle's universe centered on Earth[26] was replaced by a universe in which the planets moved around a stationary Sun, as further analyzed by Copernicus. The next shift occurred when the latter paradigm was in turn replaced by Bruno's universe in which the Sun is only one of numerous celestial bodies populating the universe. We have also mentioned the drastic shifts in science initiated by Newton and Darwin.

Between the shifts there prevails what Kuhn calls ”normal science”; the researchers tackle a stream of smaller riddles within the accepted and established theoretical framework. In exceptional instances of shifts, what Kuhn labels ”revolutionary science,” the accepted theoretical framework is called into question by a new idea or a new finding.

[TECH ] In two recent works — *Image and Logic. A Material Culture of Microphysics* (1997) and *Einstein's Clocks, Poincaré's Maps. Empires of Time* (2003) — Peter Galison, a historian of science, describes progress in physics more in terms of the creation of tools for observation and measurements than the creation of theoretical ideas.

In the former book, among many other things, Galison shows that progress in particle physics prior to 1980 depended on optical tools providing photographic images of how particles behave and interact. A great burst in knowledge occurred when electronic detectors were introduced which could spot particle collisions at rates of millions per second and which answered preprogramed questions of whether specific events had occurred or not. The huge volume of observations made it possible to secure good statistics also about very rare events in the world of particles.

In the latter book, Galison tells a vivid story from the last decades of the nineteenth century and the beginning years of the twentieth about making clocks located far from one another to show the same time. This problem was a practical one in the expanding industrialized society and transportation and for European states running and expanding far-flung colonies. It was also a theoretical problem: did a universal time exist with perfect simultaneity at different places, or, was time relative? Albert Einstein, then a young physicist, experimented with measuring time using telegraph networks and comparisons of clocks at different train stations. This was less of a problem for hurried passengers, but important for preventing trains from colliding. Henri Poincaré, then an already famous mathematician and engineer, headed the French Bureau of Longitude, an institute whose mission was to map coordinates across continents. In an assignment from the French Navy to provide the exact position of Dakar, a French colony at the time, Poincaré made the first practical attempt to apply one of his specialties, non-linear geometry in using signals in undersea cables.

In the end, both men came to solutions favoring relativity. Albert Einstein came from a family of skilled instrument makers. His version began with the tool, clocks, at railroad stations and ended in the use of abstract equations in the special theory of relativity. Poincaré's version rests in the tool of map-drawing of the globe with the help of mathematics and geometry.

There is a controversy among historians of science between, on the one hand, Kuhnians who emphasize ideas and breakthroughs in theory, and, on the other hand, Galisonians who emphasize tools and new technologies as the driving force of scientific progress. As long as all modern societies spend much more on technology than on intellectual-philosophical pursuits, the Galisonions may sit on a self-fulfilling prophesy in natural science.

In social science, there are similar arguments: does progress depend more on developing new theory, or more on the developing of new methodology of data handling and data analysis? Mainstream economics has mostly trusted the theory route, but has increasingly been forced to accept results from psychological experiments (Glimcher, et al. 2009). In the 1950s and 1960s, American sociology experienced a shift from the priority of tools for data analysis to the priority of theory construction. At Harvard University, Talcott Parsons' taxonomical sociology became more known and exciting than Samuel Stouffer's methodological grasps. At the Columbia Department of Sociology, where I worked, the argument ended in a draw between the master methodologist, Paul F Lazarsfeld, and the master theorist, Robert K Merton. I have written about this in the Preface to the later editions of *On Theory and Verification in Sociology* (1965), making theory my chosen priority; thus, I became a committed Kuhnian.

However, later in life, I worked in survey research and had immediate access to a national interviewing team and contracts with interview organizations in many countries — the nearest thing a sociologist can have to the radio telescopes and atom smashers of the physicists.[27] I learned to appreciate the Galisonian approach of emphasizing research tools, for example, the measurements of values in a population.[28] In the writing of *The Many-Splendored Society,* I am again a theoretician, but hopefully with better ideas from having benefited from such a long and close involvement with many smart Galisonians with interviewing field forces.

## Notes to Chapter 20. The Contemporary Pursuit of Science

[1] Ch 5 (Vol 1) Linguistic Forms and Usages: Discourses, p 186ff and Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: Revising Weber's Realms of Society, Table 9.1. Dominant Types of Communication in Societal Realms Accumulating to Different Cardinal Values, p 229

[2] Ch 5 (Vol 1) Linguistic Forms and Usages: Freedom in Social Reality, p 188ff

[3] Ibid.

[4] Ch 3 (Vol 1) Language and Its Distortions: Learning Buffs, p 73

[5] From Ch 3 (Vol 1) Language and Its Distortions: Learning Buffs, p 73ff

[6] Ch 22 (Vol 4) Stratification and Rewards in Science: Ranks and Honors in Science: the Name of the Maker p 120ff

[7] Ch 25 (Vol 4) Two Specialties of Journalism: Rewards to Journalists and Scientists p 205

[8] Ch 27 (Vol 4) The Use of Patents, p 220ff

[9] Ch 18 (Vol 4) The Emergence of Science in Europe: Weber on Calling to Science, p 31ff

[10] (Vol 2) Introduction:Language-Based Structuration, p 13ff

[11] (Vol 4) Introducing Societal Realms as Basics: inside story, p 8

[12] Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: A Periodic Table of Societal Realms, Table 9.10, p 301-302

[13] (Vol 4) Introducing Societal Realms as Basics: A Checklist for the Study of Societal Realms, p 8

[14] Ch 3 (Vol 1) Language and Its Distortions: Semiotics, p 86

[15] Ch 22 (Vol 4) Stratification and Rewards in Science: Distortions in the Realm of Science and its Meta-analysis, p 117

[16] Ch 3 (Vol 1) Language and Its Distortions: Enter the Defensive Bilge, p 110ff

[17] Ch 3 (Vol 1) Language and Its Distortions: Five Principles of Magic, p 106

[18] Ch 25 (Vol 4) Journalism and Science: News and the Cracking of Secrets, p 189ff

[19] Ch 19 (Vol 4) Finding a Modus Vivendi and Ethos of Science: The Current Standpoint of Science, p 52

[20] Ch 27 (Vol 4) The Use of Patents, p 204ff

[21] Ch 6 (Vol 2) Position and Roles: Uniformity and Individuality. Laws and Contracts: Norms to Gain Order, p 21ff

[22] (Vol 2) Introduction: Dignity and Privacy, p 67ff

[23] Ch 12 (Vol 3) Ideological and Universal Justifications: Justified by Human Dignity, p 56ff

[24] Ch 20 (Vol 4) The Contemporary Pursuit of Science: The Semiotic Square of Knowledge, p 77

[25] Ch 5 (Vol 1) Linguistic Forms and Usages: A Tri-section and a Bisection of Common Usages of Symbols, p 180ff

[26] Ch 18 (Vol 4) The Emergence of Science in Europe:The Rise of Social Science in Europe, p 26ff

[27] Ch 29 (Vol 4) Science in Deep Collaboration with Other Societal Realms: The Hidden but Rare Benefit: Research-Technology, p 275ff

[28] Ch 4 (Vol 1) Vibrations in Symbolic Environments: Valuescoping, p 155ff

# 21. Rationalities in Science

## Two Modes of Rationality

In both natural and social science, we find two modes of rationality. The world, nature, life, technology, culture are, as always, a complicated diversity, into which the scholarly mind has tried to bring some order. However, the means devised to bring order out of this chaos have varied throughout the history of knowledge. We distinguish between two major varieties of scientific rationality: *analyses* and *systems*.

The different eras in the history of science can be distinguished by looking at the dominant method to wrest order out of chaos. We have had a somewhat homogeneous period from the time of Francis Bacon (1561 – 1626) to Albert Einstein (1879 – 1955). During this era, that called itself "modern times," the sharpest thinkers were of the opinion that man was capable of fully understanding the world, and that the method to attain that understanding was analytical thinking. Max Weber, who has inspired many of our categories used in the series *The Many-Splendored Society*, was a man of those times. He also created bridges and ushered in emerging systems thinking in the social sciences.

### On Analysis

Analytical thinking passes through several steps.

*Reductionism.* Analytic scientists "go to the bottom," pulverize and divide complicated phenomena into their components. We can carry this step of the analysis as far as it will go and reach components that do not seem useful to further breakdown. These are the elements found in chemistry, cells in biology, particles in physics, phonemes in linguistics, genes in the study of heredity, natural laws in certain judicial systems, "one man, one vote" in the tenets of political democracy.

*Determinism.* We seek the underlying causes behind the elements. Analytical thinking holds that everything happens for a reason, and that nothing occurs by pure chance. The causal chain may be complicated, but it can be unraveled and mapped. A determinist wants to be absolutely definite when describing reality, as his ultimate goal is to uncover rules that do not allow for exceptions.

The causes that have been chartered in the analytic study of the elements are held to be necessary and sufficient to explain everything. Following this, there is no need to turn to circumstantial factors as causes. The purest illustration of cause and effect is a laboratory situation, an innovation of modern times in which all factors can in principle be controlled. Randomization in assigning objects to experimental and control groups equalizes known and unknown factors in both groups; all recorded effects arise from independent variables, e.g. standings for, or candidates for, possible causes. Laboratory experiments allow us to study how one or more variables at a time can affect the results and how selected, combined variables affect outcomes.

*Deduction.* In analytical thinking, the understanding of complicated phenomena can be attained by assembling what we have learned about their component parts. The aim is to find a pattern in the causal chains between the various elements in order that we may construct a general explanation, a theory, about the components. A theory captures the most important characteristics of the components and summarizes all of the instances of cause and effect that we have observed into the most general and informative propositions, i.e. laws of nature. Such laws suggest and describe future observations, as well as those already made. The theory is usually constructed and reported as a hierarchy of propositions. In the analytic mode of rationality, a theory, thus, takes on an axiomatic structure like the ones we find, for example, in geometry.

During the modern era, the analytic patterns of thought described here were applied, more or less, consciously, not only to science but also to forms of government, legislation and constitutional issues, organizations and business, and even to the fine arts. Their success was formidable.

A certain distrust of analytical thought has emerged and become common in today's cultural climate. It is nourished by ideas from Gödel, Heisenberg and quantum physics, also in ideas to be found in hermeneutics and ecology, among other sources. Some Eastern intellectuals, who have seen Western analytical thought make inroads into their culture, would also like to see alternatives that are more congenial to their own traditions rather than the analytical thinking. At times, this wish is merely a defense of traditions and superstitions, but not always.

## On Systems

Analytical thinking aims to shape order out of a chaos of ideas. An alternative with the same aim is usually referred to as the systems approach, but other names are also in use, for example, holism.

A category is usually defined by at least two attributes. A category shares one attribute with a larger class; another attribute is peculiar to the defined category. This way of organizing knowledge by *genus proximum* and *differentia specifica* is an old-fashioned one formalized by Aristotle. This was once the only standard qualifying as scientific, and is still a cornerstone in any ”analysis” as described above. Systems thinking adds distinctions between wholes and elements.

The concept of ”system” became established in science in the twentieth century; its philosophy and their enemies have been presented by C West Churchman (1979). It is central in medicine and production engineering. It is used rather loosely in most social science, often simply signaling that some elements are interconnected.[1]

With a tighter view of what a system implies, Russell Ackhoff (1999) has successfully applied systems thinking to his specialty, the field of management theory and practice. This may be a small part of social science, but I know from my own experience in consultancy that his stricter approach to systems is workable. His views on the difference between the analytical and systems approaches are echoed here.

Terminology varies somewhat between different systems theorists, but on balance, they agree that what we can call a ‘strict definition of system’ is a way of organizing knowledge of *elements* and *wholes* in the following manner:

- The behavior of each element has an effect on the behavior of the whole.
- No element has an effect on the whole that is independent of other elements.
- The elements are so connected that no subgroup of them has an independent effect on the whole.

Systems with an environment — usually consisting of other systems — are called ”open,” while systems without an environment are ”closed,” i.e. self-contained. A living system has ”autopoiesis,” meaning that its whole and subgroups are maintained, while their constituent elements are periodically consumed and reproduced, disassembled and reconstructed, discarded and invented in new forms.

Equations enact systems thinking just like they do analytical thinking. However, computer modeling and simulations can often, more easily than pure equations, represent and develop a complex system.

*Holism*. When you invoke the notion of ‘holism’ you emphasize that an entire system embodies characteristics that cannot be found in the system’s parts. This thesis debunks what we have called the third principle of magical thinking that purports that what holds for the part also holds for the whole, and vice versa. The whole, says the systems theorist, acquires unique characteristics through the interaction of its parts, not by the influence that each part has on what is the whole. No discrete part can do the job of the whole.

If not overloaded, the hull of a sailboat floats on water. If its sail has not been hoisted, we cannot be transported over the water, nor does the hull without the sail suffice for such task. The characteristics of a sailboat are not the sum of the characteristics of the hull plus the characteristics of the sail plus the characteristics of the water. The characteristics emerge in the interaction of sail and hull, not by the action of the sail and hull taken separately. Moreover, the wind not only transfers its force to the sail, but also to the water when creating waves. Waves affect the way the hull floats. As a system, a sailboat cannot be understood — or at least cannot be defined in an understandable manner — by an analysis of the conventional method of deconstruction. A good understanding of a sailboat begins with the whole, not with its component parts.

A common problem with presenting holistic systems is that they are not holistic enough. They deal with the whole, as we presently know it, but this is not necessarily the entire story. Donald Rumsfeld, an American industrialist and defense politician, at a Press Conference at NATO Headquarters in Brussels, June 6, 2002 said:

> The message is that there are known ”knowns.” There are things we know that we know. There are known unknowns. That is to say there are things that we now know we don't know. But there are also unknown unknowns. There are things we do not know we don't know.

This is an ultimate limitation of the human mind — and, again and again, leads us (including Rumsfeld himself in the Iraq war) into going wrong with confidence.

*Teleology* [TECH]. Events are governed not only by cause and effect but also by means of striving to reach ends. Aristotle identified three causal connections in analytic thinking: a material one ("there is a sail"), a formal one ("the sail is turned toward the wind"), and the effective cause ("the wind transfers its force to the sail"). He, then, included a cause that was contingent on purpose ("we sail because we want to come to a point in another part of the water"). The concept of purpose was banned from analytical thinking, but has returned in holistic thinking. Even in respect to machines — and machines are one of the triumphs of analytic thinking — it is virtually impossible to exclude teleological ideas, as Rosenblueth and Wiener (1950) have noted, and we will also use them in discussing engineering.[2]

In sociology, Max Weber defined action (*Handlung*) in terms of intentions, as we shall elaborate shortly. The young Talcott Parsons (1937) followed suit and wrote of all human actions as including goals. In later days, he claimed that we take actions to realize our goals, but he became less certain that this applied to expressive actions. The present standpoint among sociologists, articulated for example by Anthony Giddens, seems to be that an abundance of actions does not incorporate preconceived intentions, nor are all actions preceded by any formulated goals. My own position in this controversy is found in our discussion of justifying vocabularies.[3]

*Unique historical and geographic circumstances.* Sailing requires a specific environment: water of a certain depth and wind of a certain force. Control of the environment, which is so obvious in laboratory situations where analyses are performed, is replaced in systems thinking by a full appreciation of the unique situation making some things possible and others not, and makes one force strong and another weak.

There are many other things to be said about contemporary systemic and holistic thought, some of which may reveal its rather fuzzy thinking, but the above account will be sufficient for our purposes.

A basic claim of the systems thinkers is that analytic thinking does not help us to understand the systems that exist, for example, the respiratory, circulatory, and digestive systems of our bodies, or the climate system of our planet. As analysis starts by taking things apart and studying each part one by one, it destroys the essentials of a system.

In practice, however, this has not necessarily turned out to be a serious drawback. It has forced scientists in the analytic tradition to search for, not only the main effect of Factor A on Factor B, but also for all of the side effects, a routine, for example, applied in pharmaceutical research. In social science this forces researchers to pay attention, not only to the main show, but to sideshows.[4]

Interventions in economic and political and other societal systems, even those that have been carefully analyzed in advance, also produce side effects. Human history is full of unplanned consequences of planned events. One thing is certain: reliance on good intentions is far from sufficient in making forecasts about human affairs. It is only one factor among many. In coping with the many factors, some kind of systems thinking is the new scientific highway also in social science.

## On Chaos

If some initial events swell and cause top-heavy subsequent circumstances, we enter a modern scientific domain of systems thinking labeled ‘chaos theory.’ It deserves its own treatment.

[NAT] Mathematics Professor Ian Stewart introduced some findings from this field in the popular book *Does God Play Dice? The Mathematics of Chaos* (1987) and the journalist James Gleick (1988) presented such ideas so that they reached both social science and a larger reading public: recall the butterfly that (theoretically) caused a tornado in the following season in a very different place of the earth!

The wing flap of the butterfly became a much-cited example of chaos theory. It revived a nursery rhyme that had long intrigued children about a horse losing a shoe:

*For want of a nail, the shoe was lost;*
*For want of a shoe, the horse was lost;*
*For want of a horse, the rider was lost;*
*For want of a rider, the battle was lost;*
*For want of a battle, the kingdom was lost!*

Reading such accounts one is struck by the amount of magical thinking they incorporate. Each line in the nursery rhyme contains assumptions about numerous factors in the environment that must be in place to produce the outcome, for example, a system of logistics in the cavalry, a system of politics that caused a war, and a system of military strategy and tactics that lost a battle.

Mathematics related to the chaos theory includes a class of equations with numerous variables, which, applied in models, produce increasing instabilities. With computers of the capacity reached in 2010, planetary movements can be foreseen some 35 to 45 million years ahead before a deforming instability emerges in the representation of the planetary paths. The astronomers' models are apparently not stable for perpetual times as was previously thought.

At the time of this writing (2013), a system of local weather can be forecasted 3 to 12 days into the future, and a general weather forecast 7 to 30 days into the future. An oddity of climate, such as the location of El Nino (the main ocean current in the Pacific), can be forecasted some 3 to 12 months ahead. Models of great complexity requiring much iteration become intrinsically more uncertain.

## Uncertainty Principle in Social Science?

Do we have any need to also resort to chaos theory in the social sciences? Some economists have applied the mathematics of the physical chaos theory to their data. However, it is not easy to distill mathematical evidence of chaotic dynamics from the relatively short, and not always adequate, economic time series available at present (Puu 1997).

A more crucial question is whether we have counterparts in the *grammar* constituting the social reality to the *mathematics* of the reality of physical chaos? I think it might be worthwhile to elevate, as chaotic in its consequences, a portion of normal linguistic misunderstandings. The well-known impreciseness of language would indicate the existence of something like chaotic elements also in social reality. An illustration is the spread of rumor, well known since William Stern's (1902) research in Europe and Gordon Allport's (1951) research in America. As a message travels through a social network, it is successively distorted, sharpened, and simplified.

A small component of chaos in what constitutes the legal laws of the land is normal also in the jurisprudence of advanced societies. Even more misperceptions are likely about religious doctrines, prevailing opinion climates, market prices, artistic judgments, et cetera. Inevitably, small instabilities seem to appear in all human communication. In the current context of this writing, this also applies to "the present standpoints of science."

## Systems in Social Science

Max Weber, as mentioned, was a scholar of the era of analytical thinking, but he accepted some aspects of what we now call systems thought. He tied the problem of teleology in social science to human intentions. He saw that the study of some areas of social reality was impossible without paying attention to the teleological considerations found in human *intentions*. As mentioned, Weber included intentions (subjective meanings) in his very definition of ”social action” (*Handlung*) i.e. behavior invested with intention. To only be aware of the anatomical coordinates of "shaking hands" when we meet and "waiving good-by" when we part, provides us with no understanding of what goes on.

If the intention of an action is to use an effective means to reach a rationally chosen goal, Weber called such action ”instrumentally rational *(zweckrational)*; for example, a young person who intends to become a judge and he or she starts by the rational choice of going to law school. If the intention is to use rational means to reach an uncompromisable goal, Weber called the resulting actions ”rationally committed to a value” *(wertrational);* for example, a young person gets a fixed idea that meat is bad for humans and she or he buys only vegetarian food and chooses vegetarian cookbooks and restaurants with vegetarian menus. We use this distinction in our studies of cultural values, and call this axis fidelity – pragmatism to account for modern instrumentalism.[5]

If an action is a conscious outflow to cope with a person's emotional state, Weber calls it ”affective”; for example, a young couple is in love and acts accordingly. If the action is not consciously new in any of its ways of dealing with means and ends, Weber calls it ”traditional”; here young and old intend to do, and choose to do, what they did yesterday and before. The latter is actually the most common human action, and a reason why good habits are desirable. This classification of Weber's has proven useful in the social sciences in many different contexts.

Full-fledged systems thinking in the social sciences belong to the latter half of the twentieth century. The anthropologists then talk about the cultural system, sociologists about the social system, and psychologists about the personality system. Titles of some of the important books in social sciences now include the word "system," for example, *The Social System* (Parsons 1951), *A Systems Analysis of Political Life* (Easton 1965), *Soziale Systeme* (Luhmann 1984), and *Social Rule System Theory* (Burns and Flam 1987), *Comparative Economic Systems* (Conklin 1991). It must be said, however, that these books rarely attempt to empirically show that their topics have the strict properties of systems that we have already presented.[6] Likewise, there are books displaying analysis in their titles that contain several presentations of sophisticated systems, for example, *Analytical Sociology* (Hedström and Bearman 2011).

For nearly a century the mainstream of social science has itemized human life into four areas, a corporal, a psychological, social, and a cultural level. Or, in the words of anthropologist Clifford Geertz:

> Attempts to locate man amid the body of his customs have taken several directions, adopted diverse tactics; but they have all, or virtually all, proceeded in terms of a single overall intellectual strategy: what I will call, so as to have a stick to beat it with, the "stratigraphic" conception of the relations between biological, psychological, social, and cultural factors in human life. In this conception, man is a composite of "levels," each superimposed upon those beneath it and underpinning those above it. As one analyzes man, one peels off layer after layer, each such layer being complete and irreducible in itself, revealing another, quite different sort of layer underneath. Strip off the motley forms of culture and one finds the structural and functional regularities of social organization. Peel off these in turn and one finds the underlying psychological factors — "basic needs" or what-have-you — that support and make them possible. Peel off psychological factors and one is left with the biological foundations — anatomical, physiological, neurological — of the whole edifice of human life (Geertz 2000, p. 37).

Social scientists have usually assumed that these layers, in addition to being separate, consist of systems. I believe it is time to question both their separateness and their universal possession of strict systems properties.

By old-fashioned *analysis,* starting from a few products of the language brain, we have sketched, in this work *The Many-Splendored Society,* a comprehensive edifice of social life. The small steps in this endeavor have been simple propositions, the somewhat larger steps have been limited modules of propositions often called social mechanisms. The totality may have some, or all, attributes of a system — this should be empirically tested.

So far, many of the systems that fill social science literature are not tested as strict systems.[7] Some may be branches of the great tree of delusion. Needless to say, as a scientist one should never take the existence of a system for granted, not even those working in universities organized in departments with scholarly disciplines presumed to be systems!

## A Note of Caution to Politicians

In the summer of 2009, the world's top political leaders, the so called G8 Group, had a meeting in which the agenda essentially concerned two simulations from scientists working with systems. The first topic of their deliberations was the global financial crisis triggered by the securitizations of US sub-prime mortgages. Such mortgages had been encouraged by legislation based on a major consensus in which Republicans had slightly more stressed the virtues of responsibility that come with ownership, and Democrats had rather more stressed the needs of affordable housing for low-income families. The securities had been guaranteed based on simulations undertaken by Wall Street banks and rating agencies. These simulations were inadequate in the selection of variables entering the model. Some were apparently also fraudulent in packing toxic mortgages into the bonds sold. Others had not paid full attention to the interacting results of a situation, for example in which a multitude of regions of the United States simultaneously experienced unmanageable falls in house prices and an increasing number of forecloses.[8] All in all, the models used by Wall Street banks were not holistic enough; exactly what one could expect from a world populated by MBAs.

The G8 Group in 2009 also had to cope with conclusions from the Intergovernmental Panel on Climate Change (IPCC) a panel of scientists and politicians sponsored by the United Nations who had made a simulation about future global change of temperature. They concluded that recent demographic changes, shifting life styles, and living conditions have affected the climate. In the past century, humankind had experienced global warming due to our manufactured production of carbon dioxide ($CO_2$) and other hothouse gases. They held that we faced a further rapidly approaching global warming in the new century. We will deal with a major presentation of this in mass media,[9] and also with its possible corruption of science by the body politic[10] and social movements of environmentalists in civil society.[11]

The conventional thinking about thermal energy of our globe had long been focused on the sun and on the ocean streams such as the Golf Stream warming Western Europe. The creation of hot planetary magma by a solar explosion placing planets in orbit at a given distance from the sun determined basic levels of temperatures, and that the hotness then varied by fluctuating solar activities. Furthermore, in time, the rotation from the same solar explosion created ocean streams such as El Nino and the Gulf Stream that affected local climate. The history books talked about ice ages and their meltdowns. Variations in secular decline in heat from the magma, once created in our exploding sun, now under the crust of the earth, also revealed in volcanic eruptions darkening the atmosphere was not mere folklore.

This level of common sense about the climate had existed for years among the older educated generation at the time of the G-8-meeting..

Based on the IPCC-reports, however, the G8-meeting made the far-reaching political decision that the temperature of our globe should be allowed to rise, at the most, just two degrees Celsius above the pre-industrial level, that is, roughly to the temperature prevailing 250 years ago. They foresaw the use of costly and, due to the economic crisis, very uncomfortable measures to accomplish this. A delay, they said, would be even more costly and uncomfortable for humankind.

The G8 Group rested their case on studies in the science of climatology, as reported by IPCC. No one assumed that the heat from the human-produced carbon dioxide ($CO_2$) could be absorbed by warming the oceans rather than by heating the atmosphere. No one recalled that swings of the average magnitude of 2° Celsius and more have occurred many times in the history of the planet, and they had then causes other than human activity. No one mentioned that the multitude of variables and their innumerable iterations over time, ads distortions from chaos theory leading to instability in the predicted climate change. No one mentioned that the IPCC-models in climatology may have overlooked some variable,

We may note again that the conclusions of the science of climatology that informed the G8 meeting were not based on, but happened to concur with a magic principle that creates a public opinion of human omnipotence about global warming. “There is a being behind all things that happen,” says the fourth principle of magic, familiar in millennia of human thinking, and still a lingering part of the gut feeling in most of us. We have warned all students of society about distortions of knowledge by such magic.[12] A summary is recalled in the section on “Illusions of Knowledge” above.[13]

The rapid global spread of the public opinion about global warming is unique in public opinion research. Of course, periods of global warming are not caused by magic; to a measurable extent they may be affected by humans burning fossil fuels. However, a lingering magical thinking supports rapid acceptance in world public opinion of the existence of man-made $CO_2$-warmings and warnings. After centuries of indoctrination in magic thinking, most people and even most elites, not just the G8 politicians, have accepted the idea that there are human beings also behind the recent global swings of temperature. Politians should be aware that great support in public opinion may depend more on magic than facts.

Our sense morale from the G8 meeting in the summer of 2009 is this: systems thinking in science is great, but be aware of two faulty turns. The problem with existing scientific simulated systems is often that they are not sufficiently holistic and not sufficiently précis. First, we may not have made out what is the “whole” that is the starting point for the systems approach; there are things we do not know that we do not know.[14] Second, nature mocks at the most complex simulation models by giving them a measure of instability.[15]

Decision makers in the G8 meeting in 2009 ought to have been warned that these two weaknesses apply to the economic model and as well as to the model of climatology on which they relied. Are there components of which we are unaware, or have incomplete knowledge about? Are there instabilities inherent in the calculations? These questions apply both to the simulation models of the Wall Street rating agencies and to the models of the UN climate panel.

## Notes to Chapter 21, Rationalities in Science

[1] Ch 21 (Vol 4) Rationalities in Science, Systems in Social Science, p 103

[2] Ch 28 (Vol 4) On Applied Natural Science: Enter On Applied Natural Science Enter Engineering [TECH], [NAT], and [ANIM]

[3] Ch 11 (Vol 3) Vocabularies of Justification, p8ff

[4] Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: Sideshows Embedding Alien Cardinal Values, p 255ff

[5] Ch 4 (Vol 1) Vibrations in Symbolic Environments: Instrumentality: Firm Principles or Accepting Compromises, p 150-151

[6] Ch 21 (Vol 4) Rationalities in Science, On Systems, p 97

[7] Ch 21 (Vol 4) Rationalities in Science, On Systems, p 97

[8] More on this in Part 1 of The *Pursuit of Wealth and Order,* the planned 6th Volume of *The Many-Splendored Society*

[9] Ch 25 (Vol 4) Journalism and Science: News and the Cracking of Secrets, Working with Tracks and Frames, p 183

[10] Ch 29 (Vol 4) Science in Deep Collaboration with Other Societal Realms: A Collaborative Merger of Science and the Body Politic, p 258ff

[11] Ch 7 (Vol 2) Leadership and Collectivities: The Shifting and Expanded Foci of the Environmentalists, p 159ff

[12] Ch 3 (Vol 1) Language and Its Distortions: Five Principles of Magic, p 106ff

[13] Ch 20 (Vol 4) The Contemporary Pursuit of Science, Illusions of Knowledge, p 80

[14] Ch 21 (Vol 4) Rationalities in Science, 106

[15] Ch 21 (Vol 4) Rationalities in Science: On Chaos, p 108ff

# 22. Stratification and Rewards in Science

The advance of knowledge is a different process than the advance of wealth and order and other cardinal values. As students of society, we can now explore how scientists consolidate and advance their standing in the scholarly community. This process is not the same as the manner in which businessmen and politicians achieve their standing. Furthermore, we have enough background to begin to study how the scholarly community advances or loses its standing in relation to political, economic, artistic, religious, and civic communities.

In market transactions, both buyers and sellers are satisfied that they will achieve the best of deals, given the circumstances; otherwise there is no deal at all. In the modern body politic, the number of votes in an election can garner a candidate a paid seat in an assembly and give the power and prestige to rule through legislation. Such general differences in the rewards offered in different societal realms are indicated in Row F in the Periodic Table of Societal Realms.[1] In business, a special profession, the accountants, check and certify the wealth achieved. In science, the task to certify a scientist's contribution to knowledge is left to other scientists with the same or related specialties, and to the editors of academic journals and publishing professionals in university presses or other issuers of scholarship.

## Ranks and Honors in Science: the Name of the Maker

Scientists are ranked on a scale of competence (Row E in the Periodic Table). The term competence includes not only a ranking, i.e. an evaluation, but also a field of knowledge (or area of jurisdiction, as is the case of a court). A scientist may be more or less competent in his field, and is nearly always relatively incompetent in other fields.

A key to honor is the prescribed use of the Name of the Maker. In science, this is applied as the Name-of-the-*First*-Maker, *eponym*. Here, a firmly established pattern links the name of the scientist to an original contribution to knowledge. Anders *Celsius* and Daniel Gabriel *Fahrenheit* are remembered as pioneers in measuring temperature. Marie Skłodowska-*Curie* and Pierre *Curie* have their last name as a unit of radioactivity. Wilhelm *Röntgen* has his name attached to the use of ionizing radiation to see inside the skin or many other surfaces. The field of electricity is full of similar honors:

André-Marie *Ampère* measures flow of electric charge;

James *Watt* measures the rate at which energy is used;

Alessandro *Volt*a measures electric potential;

Georg Simon *Ohm* measures electric resistance;

Charles-Augustin de *Coulomb* measures electric charge;

Michael *Farad*ay measures storable electrical charge.

In social science, one can use the same honorific naming of concepts. We know, for example, *Pareto optimum* as a state of an economy (or any social system) in which no one can be made better off by making someone worse off. In the present text we have practiced this use of the Name of the Maker when we designated symbols (or words) as *Saussurian* ones, after the linguist Ferdinand de Saussure, if they pointed to notions (such as other symbols or words). We called them *Meadian* ones, after the pragmatist philosopher George Herbert Mead, if they pointed directly to shared images of social, physical, or biological realities.[2] This is not exactly the way these famous scholars originally defined the terms. However, as with the designations of electrical units, my purpose is also to convey honor for their lifetime of scholarly work.

In the life sciences, we have named a theory *Darwinism* after its author. It holds, among other things, that species developed because of their relative reproductive advantage. We discussed this theory above[3] and its lack of acceptance by the American public.[4] In social science, we have named a theory *Marxism* after its author. It holds, among other things, that class struggles will develop in capitalism, and that the working class will eventually be victorious. We have earlier discussed the extent to which research supports Marxism[5],and we mentioned the issue above.[6] This theory should not be confused with Marxist *ideology*, a body of political justifications for the promotion of the victory of a proletarian revolution.

Mathematical constants are often named after their discoverer. The oldest is *Archimedes' constant*, or *pi* ≈ 3.14159, i.e. the ratio of a circle's circumference to its diameter. Named constants also appear in social science; we have, for example, written about Robin *Dunbar's number* in this text.[7] The number 150 is the approximate maximum of others in an encounter that ordinary persons are able to identify.

In principle, any scientist, well-known or a minor figure, who publishes an original finding receives special honor. This takes the form of a Name-of-the-First-Maker. Honor is not equally divided in the case of an article by a team of several authors, except in some acknowledged instances in which the authors are presented in alphabetical order. The main rule is that the order in which joint authors of a scholarly paper is listed indicates their relative contribution to the research involved. Nobel laureates, however, tend to list their names last, once they have won the prize, that is.

## The Scholarly Requirement to Honor Colleagues

Any new scientific report is expected to recognize, in text or footnotes, the authors of the more relevant ideas forming parts of the new discovery, technique, or argument. This forces every researcher to honor the precursors of his own achievement. At the same time, it makes an automatic routine of the day-by-day distribution of honor amongst scientists.

Scientific citation is not a simple game of "Who said it first?" You can take the book you are now reading as an illustration. Already in its second chapter[8] you were told that in presenting thoughts and evidence from other authors, we have tried to cite or refer to those authors who first formulated some basic ideas or, at least who formulated them at an early stage. However, this is not enough. Preferably, we site only those, who are pioneers in discovery, and at the same time, have given us evidence that they understood the importance of their own ideas. The world is full of people who happen to have said something original without realizing its significance.

The citation of contributing scientists used to be put in footnotes in scholarly publications. A more modern means, also used in this work, is to provide the reference of author and year of publication in the text within a parenthesis, for example, (Weber 1922). Then the reader knows without turning to the footnotes that we honor Weber. The details of the publication are, then, easily located in the Bibliography under "Weber 1922." By this editorial practice, the honorific message, the tipping of our hat to Max Weber, is visible and is unavoidable by every reader of the main text.

Scientists actually do watch how they are cited, by whom they are cited, and how many times they are cited. Believe it or not, a scientist's own cited publications may be dearer to him or her than worldly possessions.

## Screening for Publication in Science Journals

In principle, scientific articles and monographs should get into print only if they contain some new knowledge or some new formulation about old knowledge. Anonymous peer reviews have a decisive say when an editor of a scientific journal publishes an article. Some journals are more read and cited than others, and to publish in these represents a special achievement. English, even somewhat broken English, is the language of science, and to publish in English has become a near-must for an aspiring scientist with a non-English background.

In the main and in the long run, the publications cited by other scientists establish a scientist's competence. To avoid perishing in science, you must publish; this is what budding scientists are told. Furthermore, your publications should also be noted and used by other scientists, or by experts engaged in applied science. To be sure, it is fine to have an article published in a scholarly journal. The hard reality is that about every third article published in such journals fails to make the final hurdle of scholarly achievement. These articles are never cited in other issues of scholarly journals! (Firm statistics on this matter are available only for citations in peer review journals.)

## Shortcuts to the Assessment of Status in Science

The rank of a scientist is in the main related to his or her publications that has received the attention of other scientists. Oral presentations at scientific conferences help, but written papers count higher.

The originality of a scientist's work can be rated, but only very approximately, by the number of citations made by other scientists. The success of a scientist is an accomplished fact when some of his or her publications find their way into the bibliographies of the papers written by the leading authorities in a field. There are statistical indices available of such rankings of scientific work. Unfortunately, the common indices of citation are mechanically calculated based on unanalyzed data in which negative citations may be counted as much as positive ones; no rating is made of their informative content. It shows a peculiar lack of rationality in the societal realm of science when such data can make or break scientific careers. A corrective impact is made when a scientist's standing in the eyes of his or her colleagues is used to modify and round off the message relayed by indices of publications and citations. The word of mouth replies to the more or less systematic question "What do you think of his or her work?" are often a factor at the time of appointments or promotions.

Honor to scientists may come also through other routes. Universities, entirely on their own, can grant honorary doctorates to scientists and to others, and thus add to their reputation. A plethora of prizes is also available to make the competence of a scientist visible. Some prizes are given for specific discoveries, others for a life-time of impressive work.

## On the Careers of Scientists at Research Institutions

At universities, publishing scholarly and scientific papers and monographs remains the main avenue towards a good career with good income. But universities, in contrast to other research institutions, have other missions than the main one of research.

The quality of a professor's teaching is also considered in the academic meritocracy, particularly if he or she has developed a new course for a department. Teaching skills, we recall, had their priority drastically lowered in the period during which Humboldt's ideas of a research university changed the old mediaeval teaching university. The departments were small in those days, and reading lists, not necessarily supported by courses, were the diets of the day for students.

In the present academic world, a published textbook has its own rewards in the form of royalties, and is usually considered a minor, but not unworthy merit for a professor. Popularization of research for the general public, and participation from a professional perspective in the public debate on current issues are encouraged and sometimes mandated at certain universities. However, they are not given much weight in ranking scientific competence for a major appointment or promotion.

A professor who is offered a research grant from partisan outside sources is not necessarily rewarded by his university. In a memorandum from 1970 on the criteria for university appointments and acceptance of outside research grants, the University of Chicago set forth that "(j)ust as research projects should not be undertaken simply because money is available for them in substantial amounts, so there should be no academic appointments simply to staff a particular project" (Shils 1997, 143). In the last quarter-century, however, such stricture seems to be falling out of fashion. Yet, the warnings are loud and clear. One survey of scientific papers found that 94 per cent of articles by authors with ties to the tobacco industry, in contrast to 13 per cent of articles authored by researchers without such ties, had concluded that passive smoke had no harmful effect on bystanders' health (Quoted in Bok 2003, 76).

Fewer universities nowadays turn down research grants of "substantial amounts" especially when they also include considerable charges for overhead. To attract and accept research grants, normally awarded on the basis of proven competence, is seen to be in line with the mission of a university. Here is a win-win situation for a breed of professors with a bent on being research entrepreneurs. Such a professor is both a Procurer and a Maker in the realm of science. Around such a professor, there are also job opportunities for doctoral students to learn the research trade, so the professorial research entrepreneur is also a hands-on Broker of new knowledge.

The highest form of university teaching has traditionally been the supervision of doctoral dissertations, and here those professors have opportunities to excel who are also research entrepreneurs. Research universities admit a certain number of doctoral students with the expectation that professors with research grants shall employ them while they work on their degree. To the students, this may be as valuable as an outright cash fellowship.

The recruitment of research entrepreneurs to the faculties makes university campuses similar to research parks of intelligence industries in the private sector. The latter, in turn, often locate close to universities, such as Silicon Valley in commuting distance from Stanford University.

## Linking Honor to Contextual Rewards

Scientists who have achieved a high level of documented competence attract job offers from more prestigious universities or research organizations, as these institutions have a policy of hiring the best they can obtain. This is the way research organizations stay ahead. Heads of departments with research activities are supposed to keep track of the yearly increments in competence among their staff and promote and raise salaries and benefits accordingly. Without such *contextual rewards with monetary value* added to scientific honor, their departments would lose staff to competing institutions.

Needless to say, it becomes essential to a scientist that contextual rewards of position, salary and perks, are in place. No one in the modern world can live on scholarly honor alone, at least not in the style that behooves a successful researcher. A good research institution has a generous set of contextual rewards, maintains a good correlation between these rewards and manifests scholarly honor, and gives the researchers clear rules for negotiating about their contextual rewards.

When a scientist who receives an attractive job offer from another institution tells his boss about it, the boss has the choice of saying ”Congratulations” or ”We will certainly match and improve on their offer, if you stay with us.” The experienced science administrator is prepared for such situations, and his response may be well considered. By saying ”Congratulations” to some of those receiving outside offers, the research administrator may realize that he actually lacks resources to match the offer. Or, he may hope to increase the competence of his institution by finding a still more competent replacement, or one more fit for the future line of research planned for his particular organization.

In this way, scientific institutions stay dynamic without tampering with the reasonable tenure rights of its staff. The system works best in large countries or regions with many research institutions, for example in North America or German-speaking Europe. In all societal realms, the leaders of organizations keep some sort of track of performance of co-workers. For the ambitious leader of an organization engaged in scientific research, this is essential. One should not imagine that the ivory tower is just tranquil contemplation.

From all of our remarks on stratification and rewards in science, it should be clear that scientific endeavor embodies a unique reward system without counterpart in other societal realms. Few presently active management consultants, accustomed to assist businesses or government bureaucracies, are well equipped to be of assistance to solve non-trivial problems of research organizations.

## Research Reporting: A Self-Correcting Spontaneous Order

The number of journals devoted to science and scholarship is one of the measures used to gauge the growth of the societal realm of science. The Royal Society in London started the first journal in the 1660s. In the first decade of the twenty-first century there were over 300,000 active scientific and professional periodicals worldwide, and libraries held an additional large number of defunct scholarly journals.

In the beginning, scientific journals had an editor or a board of editors as gatekeepers; such periodicals are now usually called ”professional journals.” Later, the role of gatekeepers was extended. Anonymous colleagues to the authors provide reviews of each manuscript submitted for publication. When their judgments determine what is to appear in print or on line we have ”peer review journals.” For scholarly books, the publishing companies also employ outside readers, but the process is not as formalized as for contributions to journals. Here an economic restriction enters: each book is to have a fair chance of recovering its publishing costs. There is no such requirement for a journal article. Journal articles are the totally dominating vehicle for publication in the natural sciences. In certain social science fields, such as psychology, sociology, and economics, journal articles are also most common. In the humanities, such as history, philosophy, literature, the monographs remain indispensable.

To publish is essential to the accumulation of scientific knowledge. As a principle, no article with research results is to be published unless it contains some new knowledge or perspective. However, replications confirming claims to important discoveries by others are also publishable, as are self-corrections and amendments to previously published discoveries.

The affirmation, corrections, and rejections of scientific results are not on the demand of any authority. These constitute a spontaneous order, listed as a Row marked with the letter I in the Periodic Table.[9] This spontaneous order is effective and ensures that science is self-correcting. This is our first illustration of what we repeatedly will find in our series *The Many-Splendored Society*: a societal realm organized so that spontaneous orders are a blessing to its cardinal value!

## Distortions in the Realm of Science and its Meta-analysis

In any large organization and social network, we know that the internal information normally entails some degree of distortion. We can respond scientifically to such distortions. This is one of the contributions of a social science dealing with the particular societal realm populated by scientists.

Social science has made discoveries about such distortions. We have reported some of these findings, by Nobel laureate Leonid Hurvicz and others, under the heading "Truth in Descriptive Discourse" in *An Edifice of Symbols*, Volume 2 of *The Many-Splendored Society.* A summary of these findings is presented as Proposition 9:3 and reproduced here.* The Proposition explains distortions in the reporting in the polity by sub-units within governments, as well as in the reporting in sub-units of big business corporations. We also noted one such distortion in public opinion research on voting.[10]

Clause (b) in Proposition 9:3 about The Limit of Knowledge about Others has an application valid within the entire realm of science. Observations might be shaped by one's spirit of discovery — i.e. the urge and joy to get a new discovery behind your name or your laboratory's name — thus creating a reporting of findings biased towards the desired outcome. Such distortions are not necessarily conscious or intentional. Nor do they normally encompass scientific fraud. In the most negative circumstances, they may refer to the fact that laboratories vary in their resources of rigor and of internal control of their scientific designs and measurement.

In the due course of scientific discourse, distorted findings are normally washed out. The requirement of replicability of scientific discoveries allocates the original claims of impacts of X on Y onto reasonable and sustainable levels. In the *long run*, this self-

* Proposition 9:3. *The Limit of Knowledge about Others*: If Dunbar's number is surpassed in encounters and the members' relations to one another have a low degree of familiarity, then (a) actions of the members, particularly speech acts, tend to occur which are, not only unknown to, but unpredictable by other participants; and (b) the members' accounts and presentations of themselves, their autobiography, and their situation have low barriers to dishonest editing. (Page 2: 123).

correcting capacity of science prevails and is sufficient. What is surprising is the fact that the “long run” may be many years and affect so many findings.

In 2005, John P A Ioannidis, professor of epidemiology at Stanford University, published an article with the provocative and easily misunderstood title ”Why Most Published Research Findings Are False” (Ioannidis 2005). This article does not prove the statement in its title, but it formalizes experiences, mostly in so called “meta analysis” which combines the results of many trials or replications of a research problem. Such reviews of the state of the art in a field of study have proven to be useful in assessing the present standpoint of science. Treating heart attacks with clot-busting drugs was a result, not of a new major experiment, but of a meta-analysis that looked at all of the relevant previously published research.

Ioannidis’ meta-scientific paradigm indicates a degree of erroneousness (or possibility of bias) in various settings. Here they are labeled with small letters to make them easy to refer to:

Errors in science occurs –

a) when and where the studies conducted in a field are based on a small number of cases;
b) when and where the effect measured is shown to be very minor;
c) when and where there is a very great number tested relationships, but a small number of them have been preselected for tests;
d) when and where there is great flexibility allowed in designs, definitions, outcomes, and analytical models, for example in randomization or curve fitting;
e) when and where there is great financial interest, and/or other vested interests, or some documented prejudice involved; and,
f) when and where a number of research teams are competing in the chase of reaching statistical significance for the same hypothesis.

When a number of research teams pursue the same problem, a team with positive findings can easily get into the scholarly journals first, and the teams with negative findings become mostly interesting to the editors and readers after a positive finding has been in print and reached a level of acceptance. Thus, swings of optimism and pessimism often tend to accompany the publication progress of the solution of a research problem under wide competition.

Case (c) is a warning in the pursuit of the fashionable "Big Data" approach to science that its promoters Mayer-Schönberger and Cukier (2013) should have taken more seriously.

To the students of the societal realm of science, meta reviews, often in passing, tell something important about the human and social aspects of research work, and of a prevalent and insidious operation of bias grounded in personal and institutional self-interest.

As accumulated samples get larger by replications of the original study, there is always a small, so-called "regression toward the mean." The effect of any outliers in the initial data set drowns in the shower of additional cases from the new samples. Therefore, one should expect that the replications of scientific experiments normally should show some discrepancy from the original report in any difference between an experimental group and the control group.

If this discrepancy is shown to be beyond the normal regression toward the mean, we may have a much more rare instance of real distortion, made possible by the limited knowledge about others in scientific organizations, assemblies, networks, and media of scholarly publishing. Some cases of large discrepancies between original and later research are reported in pharmacology. For example, later reports show a considerable decline of effects on human depression of the miracle drug Prozac compared to earlier drugs.

Our above Proposition 9:3 accounts for such distortion of descriptions as being common human behavior, such as putting yourself in a favorable light, a tendency from which scientists are not exempted.

The sense moral is not that the scientific method is wrong or arbitrary; rather that it must always be applied, as Max Weber sermonized in the quote above,[11] as if "the fate of your soul" depended on it. The very meaning of your short life on this earth is at stake; seriously remembering "thousands of years must pass before you enter into life and thousands more wait in silence."

We can only repeat here, on behalf of the societal realm of science, the strategic approach of the economist Leonid Hurwicz. He proposed the creation in business and civil service of "design mechanisms" that give everybody involved as a minimum, a main strategy for truthful reporting.[12] Transferred to the societal realm of science, this would usually mean establishing appropriate local rules for implementing the scientific method and the editing of scholarly journals.

The main experimenter may have some say in selecting amenable persons (or mice) to run a pre-test of his instruments of measurement. Under no circumstances, however, must the results from such a pre-test be added to the test or control groups of a main experiment, or, to the final sample of a descriptive study. This applies equally well to geographical points and heights in measuring temperature in climatological research as to selecting respondents in an interview survey. The experimenter should have no say or hand in randomizing cases for the experimental and control groups (our amazing procedure controlling for both known and unknown extraneous factors). Let a reputable computer program, or an outside researcher-statistician, do the randomization. In fitting data to a curve, one must not omit any known measuring point to improve the fit. No one researcher in a project group may, on his or her own, decide to exclude a case from final tabulation, or use in fitting a curve, even if the reason seems obvious. Document all exclusions in writing; anything that might look like "cherry-picking" among data is prohibited. And so on.

Designs to keep science honest may also have to be adjusted to the context of the research at hand. A political context to test a policy needs a design to guard against partisanship. A commercial context to test a product requires different Hurwicz-type designs to prevent profiteering. Remember the diverging findings due to sponsoring on the effects of passive smoking.[13]

Drug research is an area of science that is forced to take the problem of distortions most seriously, and in which "meta science" is a common practice. In welfare states with socialized care, there is a strong interest from governments to keep down the cost of medicine, and make sure that new and often more expensive drugs actually make a significant difference. In the United States, the health insurance companies and the Health Maintenance Organizations have (or should have) the same concern.

## Notes to Chapter 22, Stratification and Rewards in Science

[1] Ch 20 (Vol 4) The Contemporary Pursuit of Science: Table 20.1, p 84

[2] Ch 3 (Vol 1) Language and Its Distortions: Vocabularies with Meadian and Saussurian Symbols, p 94ff

[3] Ch 18 (Vol 4) The Emergence of Science in Europe: Natural Philosophers, p 24

[4] Ch 19 (Vol 4) Finding a Modus Vivendi and Ethos of Science: The Present Standpoint of Science as a Public Opinion, p 56

[5] Ch 4 (Vol 1) Vibrations in Symbolic Environments: Marx, p 136ff

[6] (Vol 4) Introducing Societal Realms as Basics, p 2

[7] Ch 8 (Vol 2) From Gemeinschaft to Gesellschaft: Numbers in Face-to-Face Encounters, p 170ff

[8] Ch 2 (Vol 1) The Proper Study of Humanity: First Difference: Cross-references, p 37ff

[9] Ch 20 (Vol 4) The Contemporary Pursuit of Science, 76

[10] Ch 8 (Vol 2) From Gemeinschaft to Gesellschaft: Public Opinion Polls as a Social Innovation, p 184ff

[11] Ch 18 (Vol 4) The Emergence of Science in Europe: A New Societal Realm of Science Emerges Showing an Early Affinity to the Realm of Religion, p 28ff

[12] Ch 8 (Vol 2) From Gemeinschaft to Gesellschaft: Truth in Descriptive Discourse, p 175ff

[13] Ch 22 (Vol 4) Stratification and Rewards in Science, On the Careers of Scientists at Research Institutions, p 114ff

# 23. Universities Then and Now

## What is a University?

Karl Jaspers taught philosophy at Heidelberg University until the Nazis suspended him in 1937. The Nazi ambition was to subordinate the universities and merge them into their polity. Also, their anti-Semitism purged the universities of Jewish professors.

After the defeat of Hitler in 1945, German universities found themselves in a shamble in intellectual terms, and in many places, also physically in a shamble. Jaspers was reinstated in 1946 as President of his university, which had not been damaged by bombs but much damaged by persecution and by a gross violation of academic freedom. Jaspers inspired and led the intellectual renaissance of his own, and of other German universities, by publishing a new edition of a book he had already written in 1923, *The Idea of the University.* This book opens with some words that can stand as definition of the modern university:

> The university is a community of scholars and students engaged in the task of seeking truth. It is a body which administers its own affairs .... it derives its autonomy — respected even by the state — from an imperishable idea of supranational, world-wide character: academic freedom. This is what the university demands and what it is granted. Academic freedom is a privilege which entails the obligation to teach truth, in defiance of anyone outside or inside the university who wishes to curtail it. — — —
>
> The university is a school — but of a very special sort. It is intended not merely as a place for instruction; rather, the student is to participate actively in research and from this experience he is to acquire the intellectual discipline and education which will remain with him throughout his life (Jaspers 1959, 1).

In the Middle Ages we had teaching universities like the University of Paris that was run by an assembly of professors, and the University of Bologna that was run by an assembly of students.

An organized seeking of truth at universities through original research that Jaspers writes about is a late phenomenon. The university has not always been what Jaspers described. Neither are the universities after Jasper's lifetime (1883 – 1969) what he described. Let us attempt to trace their coming and going.

*Table 23.1. The Complex of Academic Freedoms at the Time of Karl Jaspers (1883 – 1969).*

<table>
<tr><td colspan="2">UNIVERSITIES ARE ORGANIZATIONS IN WHICH -<br>1a. The realm norms of science,[1] for example, the rules of the scientific method, apply to the activities of the University. In the case of conflict with other norms — be they from the body politic, religion, or any other sources — the norms of science apply in the University.<br>1b. Collegiate assemblies of its professors (faculties) exercise the ultimate leadership in universities.</td></tr>
<tr><td colspan="2">Universities and their faculties are free to decide without the interference of others (state, financiers, labor unions, et cetera) about -<br>2a. The scientific fields, old or new, the University shall pursue.<br>2b. Who shall be appointed to teach and to do research in these fields.<br>2c. Who may be admitted to study at the University.<br>2d. The outside resources the University can receive in view of its mission of teaching and research that must not be compromised.<br>2e. The assignments and tasks serving the outside society which the University can accept in view of its mission of teaching and research.</td></tr>
<tr><td colspan="2">A professor at the University has -<br>3a. A voice and a vote in the assemblies of his faculty of his University.<br>3b. Tenure in his position at the University until mandatory retirement.</td></tr>
<tr><td colspan="2">A professor at a University is free to decide without interference from others, including the University administration -</td></tr>
<tr><td>in their teaching</td><td>in their research</td></tr>
<tr><td>4a. What they tell students in any teaching situations (Lehrfreiheit)</td><td>5a. The topics they may choose to research.</td></tr>
<tr><td>4b. How students are taught (tutoring, lectures, seminars, laboratory or coaching sessions).</td><td>5b. What to publish about their research.</td></tr>
<tr><td colspan="2">6a. What they say in public related to their field of learning.</td></tr>
<tr><td colspan="2">7a. Students are admitted to a University based on their achieved (not ascribed) prior qualifications.<br>7b. Students, if prepared, may take any course of study (Lernfreiheit).</td></tr>
</table>

## Traditional Academic Freedom

The institution of the university is engaged in the *teaching* of the present standpoint of science and humanities including some of its history, and is engaged in *research* to reach a future standpoint of science and humanities. There is a sense of progress around modern universities; of course, student progress from ignorance to knowledge. However, the volume of knowledge, itself, is also progressing through the efforts of the faculty to keep up with new research and, themselves, contribute to new discoveries.

Jaspers sees academic freedom as the central component of a university. This freedom is actually comprised of several bundles of rights shared by professors and students. We have listed seven groups with a total of sixteen rights in Table 23.1 as they appeared in Jaspers life-time. Please do not skip the table but read each item as if it were the heading or subheading of a short essay of its own.

With the content of Table 23.1 under our belt we first will look at how universities reached these remarkable freedoms. This is largely a European history. Then, we will turn to a discussion on how universities have departed from this model in contemporary days. The latter history is a more global saga of university education, mostly led by the United States. The development of university research and other research follows a parallel path.

## Enter Napoleon

About half of the traditional universities in Continental Europe were closed in the wake of the French Revolution; they were seen as belonging to an earlier aristocratic era.

In France, Napoleon recreated and transformed most universities into merit-based advanced schools designed to educate students for the professions. The privilege of the aristocracy to the higher positions in society had been eliminated by the Revolution. Just as a capable corporal could become general in Napoleon's army, so could a clever pupil of humble background in a French youth school become a man of distinction in the ranks of the state administration and the judiciary.

Napoleon created 30 regional *lycées,* university-level centers of learning with government scholarships for the students. Two thirds of the students came from secondary schools with advanced curricula; these schools had the role of identifying the students who had talent and ambition as candidates for further study. One third of the places in the *lycées* were reserved for the sons of officers and of state bureaucrats, a sign that Napoleon wanted to build up a new ruling class. In addition to the top-rank of *lycées*, France had a variety of communal and municipal *colleges* for higher education. A central bureaucracy, called the Imperial University of France, ruled over the entire system of higher education in France.

Napoleon's *Université Impériale* stood for a merging of the French institutions of learning and science with his body politic. In that sense, it is an administrative concordat and not intellectually comparable to the outright merger of religion and science that Thomas Aquino had made in mediaeval times at the University of Paris. After an initial enthusiasm, the Aquino-Aristotle synthesis dissolved, and we know why it did so from our Proposition 10:14.[2] Many cheered Napoleon's attempt in the beginning. In due course, it also failed. The hero who brought it down was a German who became an icon.

## Enter Humboldt

When the University of Berlin was to be formed in 1810, Wilhelm von Humboldt, an intellectual and diplomat, started a campaign against the then rather popular French transformation of the old universities. In a memorandum *Über die innere und äußere Organisation der höheren wissenschaftlichen Anstalt zu Berlin,* Humboldt linked up with the configuration of the best within the long tradition of European teaching universities — those in Bologna, Paris, Prague, Leiden, Utrecht, Göttingen, and Halle. However, like Napoleon's higher professional schools, the new university was to be a meritocracy, not an institution primarily reserved for established elites. As in France, selected youth schools with an academic orientation (here called *Gymnasium*) should prepare and screen the German students.

As a graduate of such a school, you could go to any university of your choice, study the subject of your choice, and change to another university of your choice before taking the final examinations for your degree. Such was the *Lernfreiheit,* the freedom to study, the rights of students in the evolving complex of academic freedoms.

In contrast to the centrally controlled French system, a professor at the new German university was to have unlimited freedom to pursue research and teaching in any direction his inquiring mind might take him. (It was always a "him".) Freedom of research and academic self-management were von Humboldt's two ideals.

## Priority of Research

In Humboldt's university, professors were to do research and to teach. Consequently, they functioned as both Makers and Brokers of knowledge. This had not always been the norm. Since the Middle Ages, European universities had been institutions for teaching; the professors were Keepers and Brokers of knowledge. The first generations in modern times of great research scientists also had other bases in society. Neither Galileo, Kepler, Faraday, Lavoisier, Darwin, nor Mendel were professors in universities, although some of them had appeared on occasion at universities.

Among the great pioneers of natural science, Newton and Linnaeus are exceptions. Newton became Professor of Mathematics at Trinity College, Cambridge, where he had been a student. In those days, professor meant teacher. In Newton's case, however, his teaching in mathematics is virtually indistinguishable from his research in the development of mathematics; we have mentioned his invention of infinitesimal calculus.[3]

Linnaeus, cutting short his start as a practicing physician in Stockholm, went back to Uppsala University as Professor of Botany. He personally designed his institution to include as much research as teaching. His *Systema natura* is a taxonomy that appeared in seventeen editions from 1773 to 1810. It claims that the huge variety of plants on this earth fitted into 24 classes. Linnaeus assumed that external similarity of the reproduction system of plants signaled their heredity and family. Now we know that such similarity must be located inside the DNA.

With Humboldt's university, priorities changed, and exceptions such as Newton and Linnaeus became the rule. The universities should now appoint and advance professors by virtue of their merits in research, not because of their ability to teach an advanced subject. Generally, one simply presupposed that they mastered, or could learn to master, such teaching.

## Humboldt's Recruitment of University Professors

In most organized endeavors, the recruitment of new staff is based upon a multitude of criteria of fitness, and a top executive leadership could decide such matters. Humboldt followed this practice when he worked in the Prussian bureaucracy and in diplomacy. He departed from this practice when he promoted a university organization. Here he took a first clue from the royal academies of science, where new members were recruited by the old members, and not by the King or any other authority.

The professors, themselves, should decide who should join their faculties. This also resembled the template used by guilds of crafts and commerce in German cities appointed Masters. However, guilds, like occasionally universities in those days, were free to let leadership positions run in a family, an anathema to Humboldt's new institution of science, in which considerations of a professor's pedigree should be irrelevant.

If proficiency in research and contribution to scholarship should be decisive, then other scholars could best determine this. Formally, the King should then issue the appointment document according to the sense of the faculty at the university.

Within a handful decades, this new priority came to attract a majority of prominent researchers in modern societies to universities. This is a major event in the history of science as a societal realm.

## Self-management of Universities

If freedom of research was von Humbolt's first ideal, academic self-management were von Humboldt's second ideal.

The German professors were given considerable autonomy in the daily running of their universities. He proposed that an assembly, the faculty meeting, should exercise the self-management of universities.

In the 1810s, the German kingdoms (*Ländern*) were latecomers in industrial capitalism. Merchant guilds were part of Humboldt´s cues in search of a new optimum form of organization for universities. They flourished in Berlin and Hamburg and other continental regions. Thus, rural business was in principal still prohibited, and in practice restricted. Cities still held a monopoly of most commerce. Its guilds, in turn, had a monopoly on their craft or trade within a city. An assembly of successful burgers with long training, and with the status of Masters in their guilds, ruled a sprawling nexus of business in the cities. Unlike the state bureaucrats who were tax exempt as being part of the court (i.e. the King's household), the burgers paid taxes, but kept the King out of their daily affairs. Such was the first part of its concordat with the polity.

Burgers contributed heavily with time and money to the guild system. The continental burgers had their own business schools, welfare institutions, and even their armed guards to keep intruders and thieves from looting and stealing. This was natural in an era when Kings used their armies mostly to fight other Kings.

The burgers constituted an estate (*Stand*), and as such had one of the chambers of continental parliaments. The nobility staffed another chamber, and the clergy made up a third estate with a chamber of its own. These three estates had separate assemblies that met periodically. They constituted the main advisories to the King, and shared power with the King as a parliament, or constituted a senior chamber in the continental parliament. Such was the second part of the concordat between the European guild system of economy and the political system of monarchy.

## Humboldt's Arrangement of University Leadership

Humboldt prescribed that the leadership of the new Berlin University should rest in its faculties organized as an *assembly* of colleagues. The faculty, should not only recruit top personnel to renew itself, it should keep the university open to all qualified students. It should decide the disciplines that should be organized as departments for research and teaching. Moreover, it should also have the ultimate say in the allocation of material and monetary resources. The raising of funds for the new type of universities belonged among the duties of the kings. However, decisions how to use the funds Humboldt thought should be located in the faculties.

In these ways, a university would differ from a formal *organization* with hierarchies of positions, like a government bureaucracy. Nor would it be an *association* of scholars and students like the University of Bologna or Paris. Of all the possible structural arrangements available in a society, the Humboldtian universities thus stand out as they explicitly selected a special design, the collegiate form of decision-making in the form of a facu*lty assembly*.

The collegiate assembly is a most congenial form for universities in view of the unique forms of property rights that characterize science. As we have repeatedly noted, scientists, by publishing their discoveries, give up their property rights to the latter in return for the visible honor of having made the discoveries. Humboldt is not explicit about this, but it appears to be a fact that *the assembly is the most congenial organization for a societal realm without private property*. In due course, when we have presented the body politic and all other major societal realms, we may explore and qualify this idea in a Proposition of social science.

*Details of Table 7.1 recalled with addition of 'Assembly' to the Communication Structures developed in the Chicago school of sociology*

| | Organi-zation | Associat-ion | Net-work | Assem-bly | Media | Mass |
|---|---|---|---|---|---|---|
| Are there established mutual channels of contacts? | Yes | Yes | Yes or No | Yes | Yes | No |
| Is there a common leader or sender of communications? | Yes | Yes | No | Yes | Yes | No |
| Are members appointed, hired or included by obligation? | Yes | No | No | Yes or No | No | No |
| Is there an outside border separating insiders from outsiders? | Yes | Yes | No | No | No, but Yes if sub-scribed | No |

After Humboldt's reforms, university professors definitely replaced the gentlemen scholars and academicians as the main pillars of science.

## Humboldt's Arrangement of University Rank and File

The second major prescription by Humboldt concerns the departments of knowledge. They should each be *one* institution with *one* professor in *one* subject. In other words, the rank and files formed a strict hierarchical structure in which the professor's decisions were the law.

Like the Masters of guilds, the German professors thus created and obtained monopolies for themselves. There was to be no challenge to a professor's scholarly authority from within his own university. As long as he kept to his specialty, a Humboldtian professor was protected from challenges inside his own university; he outranked any local challenger in his specialty. In addition, in his own institution he single-handedly could control the academic rewards of its personnel and students. It stands to the credit of the professional character these professors that instances of Sultanic rule and personal whims were rare.

The professors were no different from other elites, and they used their freedom to govern their universities by monopolizing the realm rewards, a universal regularity we know as Proposition 10:4. This central Proposition is cited in full on the first page of the Introduction to this Volume.[4] Thus academic institutions became overspecialized, not only because some scientific topic required such specialization, but also because professors want to keep their authority uncontested. This was an unplanned consequence and contrary to Humboldt's ideal of a unitary university.

Against this background one can understand the saying "what is truth in Berlin and Jena is merely a poor joke in Heidelberg." It was not until the scholarly networks of learned and professional societies and their journals first got into a cross-country scope (type: "The German Association of X Research") and subsequent grew into multinational "invisible colleges" (type: "The International Association of X Study) that the competence of a Humboldtian professor could be effectively challenged — or, more often, celebrated.

This development of scholarly networks and journals was an another necessary constituent in the success of the Humboldtian universities. These research universities became *assemblies* in the networks of science. Assemblies have border excluding outsiders, but no established leadership except for a chairperson: see Table 7.1.[5] Different scientific assemblies, e.g. faculties, constituted networks. They have their own mass media, the scholarly journals, As such, i.e. *netorgs* as listed in Row M in our Periodic Table of Societal Realms,[6] they secured a force in the expansion of a societal realm, a force presented in Clause (a) of Proposition 10:7 from Chapter 8, reproduced in the footnote here.[*]

The above gives a background in organizational theory for Humboldt's success. The Humboldt-type universities from the ninetieth century became fit to spearhead a growing knowledge base of their societies. The German universities became world leaders in scholarly creativity.

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[*] Proposition 10:7 recalled. *The Netorg System of Realm Expansion:* (a) A cardinal value grows and its societal realm extends its reach when networks dominate over organizations in the realm and, primarily, when networking organizations dominate. (b) It consolidates and defends its reach when organizations dominate over its networks (2: 182).

## Freebooting Scholars

By the end of the nineteenth century, the number of subjects taught at universities had multiplied. The clean and rigid lines in the Humboldtian system of the "Ordinarien-Universität"— with one specialized discipline, one institution (department in the US), and one professor — began to be a drawback to certain scholarly creativity. In the natural sciences, the frontiers for the microbiologist, the atomic physicist, and the chemist studying bonding interactions appeared in effect as a common research field, not three separate disciplines under three mini-pope professors. Among creative and passionate university people, the system incited them to become freebooting escapologists.

In the United States, universities coped with academic escape artists by creating interdisciplinary institutions and appointing interdisciplinary professors. In Europe, freebooters appeared by over-using the privilege of Humboldtian professors to decide over their research topic.

The most well-known freebooter in Europe among social scientists is Max Weber, born 1864. In 1882, he had become a lawyer and Dozent (Associate Professor) of Law in Berlin, his hometown. He moved briefly to be Professor of Economy at Freiberg in 1894, and then in 1896 to Heidelberg with the same title. He used the privilege of a Humboldtian professor to choose his own research, and Weber diligently pursued sociology. He overstrained himself and obtained a diagnosis of "neurasthenic," one of the favorite notions among psychiatrists long into the first part of the twentieth century.

After an extended sick leave, Weber lost his position in 1903 as Head of Economics at Heidelberg. For over ten years, he became an honorary professor without university duties, living on his and his wife's inherited money. Instead of seminars at the university, they had an intellectual salon in their home, attended by intellectuals such as György Lukács, Robert Michels, Marc Bloch, and Weber's wife Marianne, a prominent feminist scholar. With his colleague Werner Sombart, and with his wealthy friend and adult student, the industrialist Edgar Jaffé as financier, he took charge of a journal, *Archiv für Sozialwissenschaften und Sozialpolitik*. The journal became Weber's personal and professional stage. He could publish book-length articles. Thus, he had a competitive edge over sometimes envious colleagues in the universities, who less frequently appeared in this journal, and then with articles of more normal length. In 1909, he co-founded the German Society for Sociology (*Deutsche Gesellschaft für Soziologie*). Weber became concerned, and at times annoyed, over the many conflicts Humboldtian professors in the same subject but from different universities had with each other. However, the platforms of salon, journal, and learned society that he had created during his years as an honorary professor became the bases of his greatest achievements.

Unfettered by departmental borders, Weber could now study how societal realms differ, and how events in one societal realm have consequences in another societal realm. Thus, he embraced not only his old specialties of economy and jurisprudence; he took on political science, public administration, city development, anthropology, the huge field of comparative religion, and even a corner of musicology. All this he accomplished with an historian's sense of detail and turning points. His contemporary colleagues took note of Weber's work, and, as they should as good scholars, looked for its weaknesses. Some Humboldtian professors, however, were also irritated at his pretensions to master the ins and outs of their own specialties.

With Weber's work as an unconstrained freebooting scholar, the grand-level of general social science got its most important contribution so far. The text that you now read hundred years later, *The Many-Splendored Society,* has been inspired by and has many references to Weber's work from that late period in his intellectual biography. This creative period extended into the years of World War I when Weber was drafted to run a military hospital. His creativity continued two-three years after the war when he returned to university teaching. He had placed much of the family fortune in war bonds that lost their value with the defeat of Imperial Germany. Again, he had to take university appointments for a living. Pneumonia (or Spanish flu) ended his life in 1920 at age 56.

## Exporting Humboldt

The Humboldt's scheme for a university in Berlin took shape and proved its attraction to its faculty and students and the Prussian state in a few decades after its founding in 1810. Almost all subsequently founded universities were deeply influenced by the University of Berlin as it had developed toward the middle of the nineteenth century. In addition, almost all universities already in existence were changed by ideas inspired by Humboldt and the example of the University of Berlin (Shils 1997). Not only Central Europe got Humboldtian universities, but also Scandinavia, Eastern and Southern Europe. The British and French universities were more immune to the new ideas, but far from totally unaffected.

The German university model was copied in the Imperial universities of Japan. Japan and Germany might appear as unlikely allies in World War II, but the fact is that their administrative and technological elites had graduated from very similar universities.

In the United States, the Humboldt model for universities was first introduced at Johns Hopkins University in Baltimore in 1876. Other universities followed suit. The result was that some concepts in higher education in the United States expressed in words such as “university,” “university town,” “university student,” “professor,” “doctor,“ and “degree” became the same in Europe and the United States, give or take variations in spelling. However, by the mid-1900s, many had obtained very different meanings and functions on the American continent.

Let us recall some differences.

## Differences between Universities in Europe and North America

The heading here could also have read “Modifying Humboldt’s university.” The rigidity of the specializations with local monopolies for professors that characterize Humboldt’s model for a university was a source of strength in its beginning. Weber’s deviation was an exception.

However, in the international discussion of the model, particularly after World War II, serious weaknesses began to appear, as summarized by Nybom (2007), Wittrock (1993) and others. Neither in teaching nor in research did the model become permanent. Instead, an American model of university organization became dominant.

### Heads, Chairmen, and Departmental Councils

Humboldt, himself, had only a short period during which to run Berlin University hands on; his career was that of a diplomat and as a celebrated, independent philosopher. Actually, the collegiate control of the university administration that he had introduced did not require a strong leader with a long mandate.

The strong leaders in the German universities were not necessarily the Rectors, but the professors who ruled their respective departments as regimes characterized by a *sultan-type will and whim.*[7] Big departments may have had meetings similar to faculty meetings, but the leadership had neither advisory boards, nor decision-making councils to deal with.

In many of the large American universities with several professors in each department, a slow shift took place in the middle decades of the twentieth century. The departments "Heads" at the big universities became department "Chairmen," ruling with the help of small "Councils" elected from the professors of the department in question. In 1967, when I was recruited to be Chairman of the Department of Sociology at Ohio State University, such a council was established.

These departmental councils varied in power. Faculties, the office of the university President and his central bureaucracy, and, ultimately the Board of Governors saw to it that the departmental councils did not assume more power than afforded the old Heads of the departments. Above all, the administration guarded that their university should be an international research university, not merely a state teaching institution.

In parts of Europe, departmental councils appeared in the wake of student uprisings 1968. In Sweden, the Minister of Education, Olof Palme, saw to it that the councils included representation from students and from the non-academic staff. This reform was short-lived.

## State or Private

Each state government in the American union has its university with highly subsidized student fees for state residents. The Big Ten in the Midwest are all bigger than any private university, as are those in California and Texas. However, only a dozen of the first 100 American universities were established by the states. Protestant clergy or churchmen dominate among those who founded the rest. Some of their colleges have survived, and have become exceptionally successful universities. Among them are Harvard founded 1636 by an Episcopal immigrant, Yale from 1701 founded by a Congregationalist, Princeton from 1746 and Columbia (then called King's College) from 1754, both Presbyterian in origin. An Anglican evangelist began fundraising and building the University of Pennsylvania, but the school became organized by Benjamin Franklin as non-denominational. It opened in 1740 as the first full-fledged university in the New World.

Later, superrich industrialists created private universities as projects of philanthropy. The University of Chicago opened in 1890. It was conceived by a Baptist group, and financed by oil magnate John D. Rockefeller as a secular institution. Stanford University started in 1885 by Leland Stanford, a cross-continent railroad builder and politician.

The federal government founded the West Point Army Academy in 1802 and The Naval Academy in Annapolis, MD in 1845. Beginning in 1862, the federal government planted so called land-grant colleges in all states, some southern states got two, one for black students, and one for white. These universities had a full regular curriculum, but also agricultural sciences, and "extensions" of networks serving local farmers. As planned, exceptionally productive American farms were a result.

There were, at the turn of the millennium, more publically funded colleges and universities in the United States than privately funded, but most of the highest-ranking universities are private. A main difference between the European and North American universities is their principals or responsible authority, in Europe the public sector, in America for a fairly long time, a rather even mixture of public and private sponsorship.

## University Rectors and Presidents

Only a few of the actual differences between Universities in Europe and America have been denoted by different words. One instance is the top position. The head of a university is called "Rector" (and in some places "Rector Magnificus") in Europe and is called "President" in the United States. Rightly so, because their functions are vastly different. In Europe, a professor elected by and among the university faculties usually filled this office. The Rectors handles the main contacts with the Ministry of Education that provides the budget. Rectors had small staffs that put the budget into operation; the main power, we recall, was vested in the faculties. The Procurers of funds for the European universities were, with almost no exceptions, located in the body politic.

In America, the university top position is a chief executive, often without professorial merits, elected by a board of directors, and charged to lead a staff with internal administrative duties and fund-raising. The President of the University has been a supplementary Procurer of funds in state universities, and the main Procurer in private universities. Several American universities have a highest academic officer, sometimes called Provost, who has the natural authority in academic matters that the university president lacks.

## University Towns

Europe has a limited number of locations housing universities. These university towns have obtained a special ambiance, as have the university areas in big towns, such as the Quartiers Latin in Paris. Like Hansa towns, and other guild-based towns with monopolies on trade, the university towns had a monopoly of advanced learning, and eventually a near-monopoly of research. The German states (*Länder)* controlled the establishment of universities and promoted the reorganization of old universities to the new Humboldt type. Regional governments provided the finance. The universities competed, as mentioned, for students from all of Germany, a circumstance that may have enhanced quality.

In the United States, the universities underwent a transition from a German model patterned on a guild-economy to an American model of a free market society. Institutions of higher learning became ubiquitous, not restricted to special towns, nor prohibited from operating in rural areas, and not necessarily financed by public money. You may find them as a rural extension, or monopolizing a big park called a "campus," or, on an ordinary city street in a building next to an apartment complex or beside an office edifice.

Martin Trow, American sociologist of education, published in the 1980s a guided tour of colleges in a *manufacturing* town, Grand Rapids in Michigan. The town had then 250 000 inhabitants and as many suburbanites and exurbanites. Its own university was Valley State College with 9 000 students, then offering MA-degrees but not Ph.Ds. In addition to this college, Trow found ten other:

1. Michigan State University -- a branch of the big land-grant state research university [in the university town of East Lansing];
2. Western Michigan University, a regional state university;
3. Ferris State College, a regional state college, like Grand Valley;
4. Aquinas College, a private Catholic institution;
5. Davenport College, a proprietary college offering a bachelor's degree in Business Studies;
6. Jordan College, a proprietary college;

7. Grand Rapids Community College offering degree credit courses at the level of the first two years of the baccalaureate, plus many non-credit vocational studies;

8. Calvin College, a private church-related college;

9. Grand Rapids Baptist College, a private church-related college; and

10. Kendall School of Design, a proprietary college.

(Trow 1991, 168).

You cannot find a place anywhere outside the United States that is like this; a rich local market of learning that is not a university town. The American university breakout from the bonds of an economy of merchant guilds and/or from a state government is a major step in the creation of the modern societal realm of science. It is as important as the previous breakaway of universities in Europe from the medieval synthesis of religion and science.

The European states remained the sponsor and driver of universities. In the United States, the local states and the private sector shared the costs, for a long time rather evenly. Higher education is much more a concern of central governments in Europe than in the United States. It is striking that seven or eight of the top ten universities in the United States are private, and they have a record of being an inspiration to the big state universities.

Let me note in passing that I visited Grand Rapids at about the point of its development as "a knowledge society." I participated in a team lead by Michael Maccoby, head of The Program on Technology, Public Policy and Human Development at Harvard University. We were there to study the achieved excellence in leadership and self-government at Westinghouse Furniture Systems, an industry with much automation in their production of state-of-the-arts wares for creating office landscapes and a modern labor union.

Was it just the management, the union, and the consulting experts that had achieved its famous new production skills? No, my thought afterwards is that a precondition for the undeniable success at Westinghouse Furniture Systems was that all its personnel lived in a community with numerous exercises of continuing education. This made the acquisition of new decision processes and manufacturing skills a cool routine. Here lies one of the secrets of the competitive success of the United States.

## Students and their Credits and Degrees

European students stayed longer, usually two years longer, in the preparatory schools before they entered a university. American students began college as late teenagers and the campus provided them with organized living arrangements *in loco parentis*, "in the place of a parent." A Dean of Students is a regular officer of the institutions of higher learning in America. The students in Europe were young adults, expected to take care of themselves. Student life in Europe is much less governed by university rules than in the United States.

American students progressed mainly by taking courses. In Europe, students at a Humboldt-type university were usually given reading lists and a limited number of grand lectures by the senior professor. As a rule, the latter also conducted a final examination, often orally. In the United States, students were put into courses, each ending with a written examination. This form of controlled progress in American education restricted the *Lernfreiheit* of students. In Europe, such restrictions had usually been practiced only in medical faculties.

The American universities invented a coinage of knowledge called "credit." This coin has two sides, but unlike an ordinary coin, the sides measure different values. The dual unit of academic credit keeps track of the time spent in courses and measures the amount of fees paid to the college or university. To obtain a degree, the American student had to accumulate and pay for a certain number of credits, as well as prove accomplishment through exams after each course. The American system further restricted student rights to mobility between colleges and universities through limiting the number of credits a student could transfer from his or her former school. The receiving university also required a substantial number of credits (now meaning fees to its own coffers!) to grant a prospective degree to a student.

Two degrees prior to the doctoral degree, in the US called Bachelor and Master degrees, have been common in many other countries. In Europe, most countries have given two levels of doctorates. In France, we thus have Docteur de Université and Docteur d'État; the latter usually requires a second thesis. Germany has Doktor der Philosophie requiring a Ph.D-dissertation and Habilitation that requires a *Habilitationsschrift,* and provides the bearer with the title "Dr. Dr."

Since 1919, the Institute of International Education (IIE) in New York has evaluated course-work and degrees of foreigners seeking study (or work) in American universities. European countries have no counterpart to the IIE that provides criteria for how foreign students best fit in the levels of study at their universities; in fact, they generally tend to downgrade most foreign academic merits. The voluminous success of American universities in offering higher education for foreign students is a model in the internationalization of science. European countries having no IIE, in thoughtless nationalism allows their academic institutions to devalue foreign training and degrees, making life difficult for foreign students — and for learned immigrants as well.

## Changing the Scale of Teaching

In the 1880s, several American universities began to develop Graduate Schools in which the curriculum included the advancement of skills to evaluate research undertaken by others, and in which qualified students received training for their own research, their doctoral and other theses. Such was the birth of the American "research university." In 1915, the American Association of University Professors codified the academic freedoms. They were modified in 1940 and 1970 in a Declaration of Principles on Academic Freedom and Academic Tenure.

In Europe, the Humboldtian idea of just one professor with one subject in one department broke down after World War II. On the American scene, except in medicine, modeled after Johns Hopkins University, the idea never became widespread. Here, as a matter of course, there could be several professors in one and the same subject. More obvious, the ranks of de facto *lecturers* with teaching skills, having various academic titles, became customary and numerous at American universities and colleges.

## The Mass University

The changing scale of the entire realm of science is a major reason for the demise of Humboldt's type of universities. During the twentieth century, the student bodies of the old universities grew tenfold or more, and the number of colleges and universities multiplied exponentially. By the end of the century, different regions of the United States had between a third and a half of each new generation of youth finishing some type of undergraduate education. In all rich countries, we note a similar trend. Mass education of undergraduates and less emphasis on research training and basic research and discoveries became the fate of most universities in the latter half of the twentieth century.

As mentioned, by the beginning of the twentieth century, the United States had created a university and college system based on mixed public and private sponsorship. By contrast, the universities in Europe and Japan were part of the public sector, and thus excessively dependent on the body politic. The American lead toward the mass university relied on the fact that the country from the beginning had the structure of freedoms for higher education that allowed rapid expansion (Trow 1991).

In the starting decades of this expansion, the famous professors at research universities accepted the fact that undergraduates in their departments deserved to have, not only committed teachers, but also some of their tutoring by the ones who occasionally could speak about their research. On balance, students learned to accept this teaching by individuals who were spending their waking hours thinking more about their own research than about teaching. With continued expansion of research universities, the chance for undergraduates to see professors in their classrooms declined. The likelihood that adjuncts and graduate students did the teaching increased.

## Enter More Centers of Research, More Off than On Campus

The concept of a professor as a man of learning, locally unchallenged, living in solitude and freedom, was an image that would soon change. With the expansion of science, this form of organization would have to be modified. Research proved to be an activity that was very amenable to teamwork. A special breed of professors emerged, the research administrators.

A traditional research enterprise is not organized like a copy of state bureaucracy, or like a business firm on the market, nor like a hospital in a welfare state.

The experience of the many Kaiser-Wilhelm-Gesellschaften in Germany became a good model for organizing research. These institutes were founded in the first half the twentieth century to conduct research independent of government departments as well as independent of the German state (*Länder*) universities. They contributed to make Germany the world leader in advanced research. After World War II and their demise in the Hitler era, they were reorganized as Max Planck Institutes. An American counterpart from the war years to these institutes is the federally funded Lawrence Livermore National Laboratory, now independent, but for many years run off campus by the University of California.

During and after the Second World War, an increasing number of large and small research institutes emerged in many countries, and, more important, outside their university campuses. The biggest one may have been Los Alamos National Laboratory that housed the Manhattan Project and its historic product, the first nuclear bomb. Some others belonged to the defense effort, for example Rand Corporation, sponsored by the US Air Force. Still others, like the legendary Bell Laboratories, the research and development arm of American Telephone and Telegraph Company, had a commercial base.

We note a substantial flight of researchers from universities to industry in many post-war instances. The pharmaceutical industry has recruited a number of top university researchers from medical colleges in fields such as chemistry, physiology, and pharmacology. In their new industrial setting these individuals are not only Brokers of university knowledge, they are the Makers of new knowledge. Likewise, Business Schools at the universities have seen their promising researchers, destined to be promoted from junior faculty status, instead, take on assignments in international consultancies, such as McKinsey, requiring them, not only to apply what they have learned at the university but also to develop new knowledge. The same may happen when they take jobs in international market research houses, such as GfK or IPSOS.

Engineering universities have seen the same brain drain to fields of industry. In 1982, Saab, an airplane corporation, received an order from the Swedish government to produce military aircraft, the JAS 39 Gripen. It had these requirements: the aircraft should (1) belong to a new generation of airplanes, “flown by a computer” rather than relying on conventional aerodynamic steering. It should (2) fulfill the three military tasks: fighting other aircrafts, bombing, and surveying, and it should quickly execute changeovers on the ground between these missions. It should (3) be able to take off from and land on ordinary paved highways, and (4) it should be inexpensive in construction and operation (i.e. have only one motor). The procurement required a considerable amount of original research, and the company recruited and assembled the necessary departments of a technological university on its own site in the city of Linköping. Gunnar Eliasson, himself a professor of economics at the Royal Institute of Technology in Stockholm, is generous in assessing the importance of this competitor to his own university:

> Altogether this allows us to talk about the aircraft industry as a technical university that spills modern and advanced technologies and educated engineers with experience from top-of-the-line engineering product development and manufacturing process techniques.
>
> It is quite possible that the value creation around aircraft industry generates more social value per invested krona than the technical university because it has taken R&D closer both to the development of products that function and to final product markets. It is therefore surprising how much attention in research that has been paid to academe as a spillover source compared to the attention paid to advanced firms .... From the point of view of social value contributions to society any concern about costs should first be directed at the academe (Eliasson 2010, 244).

## The Multiversity

In the United States, a growing number of academic and semi-academic units have been joined to some universities and their backyards. Today, under the same umbrella, there may be many research institutes, professional schools, centers for applied science, centers for advanced studies, et cetera. In addition to the allocation in the state budgets, they have a diverse base of financing, including proceeds from an endowment, student fees, alumna/alumni donations, grants from foundations, and big contracts to do research on behalf of business and government.

The University of California, which became one of the leaders, had a visionary President, Clark Kerr, who aptly called his creation a ”multiversity.” This was an untidy collection of establishments in which traditional university departments were a minority. This also had a multi-campus structure. A clear view separated the few campuses with top research institutions from the undergraduate state universities, and the latter was kept separated from the vocational community colleges. This turned out to be a good way to keep the total educational cost down. Moreover, it made the University of California a miracle of scholarly creativity.

By obtaining their financing from many sources, not only from student fees and California state taxes, Kerr and his faculties could successfully resist both excessive demands from the student revolts in the 1960s as well as from Governor Ronald Reagan's attempts to restrict academic freedom. In general, the diversity of financial support in American universities has increased their ability to live and survive as independent institutions practicing academic freedom.

Several European universities have become mass universities of a scale comparable to the American ones. In the main, they have managed to expand by means of state financing. In terms of percentage of GNP at the turn of the century, Europe spent about half as much on university-level education as did North America, and the share paid by student fees is less in Europe. Few European universities have been able to resist government interference in the selection of areas to be taught or not taught. The typical European state-financed universities have been forced or cajoled by governments to cater to local and regional policy, and often also to undertake pet partisan political projects in the fields of energy, the environment, state welfare, and sometimes American-type gender studies. Humboldtian self-government of universities is fading everywhere, but politicians and their education bureaucrats call more tunes in European than in American universities. Few universities in Europe have the level of protection in receiving public money without significant political interference in their missions, as is the case in the long privileged history of Oxford and Cambridge. Here the top financial officer, the bursar, and other “gentlemen fellows” have traditionally joined ranks with faculty members to run the university.

At the time of this writing, many European, particularly, Mediterranean universities, while now with as big enrollments as their American counterparts, cast big shadows of their former selves in terms of the quality of their research, teaching, examination results, and career prospects for their graduates. The German university system, to name only one in the core of Europe, is usually underfinanced by their Länder. At one time, Germany could claim the best universities in the world; in the first decade of the new century, you find some thirty-five to fifty other universities ahead of the top-ranked German ones on comprehensive international ranking lists, some of them in the Far East, where the expansion is rapid. A promising German note, however, is that the technological universities in eastern Germany, favored in Communist days, have added social sciences and humanities, partly including large “departments of communication" without forgetting the engineering aspects of communication.

The old image of universities as the epicenter of European *culture* (as the Germans conceive it) and European *civilisation* (as the French express it) is still good rhetoric, but represents a lessening contact with reality. Oxford and Cambridge in England, however, keep their standing.

## Social Science Think Tanks

Research missions in the form of "universities without students" are often called "think tanks." Think tanks may specialize in all fields of knowledge, from animal health to global warming; from packaging of consumer goods to airline safety. Here we shall take note of some think tanks in the social sciences.

The governments of the richest countries in the world have sponsored a common think tank in Paris, the Organisation for Economic Co-operation and Development, OECD.

A Center of Advanced Study in the Behavioral Sciences was established in Palo Alto, California, financed by the Ford Foundation. A counterpart in Europe is found in the Wissenschaftszentrum Berlin für Sozialforschung (WZB) financed by Stiftung Volkswagenwerk and German taxes.

National think tanks such as the Brookings Institution in Washington DC, began delivery of scholarly research of national and political relevance in 1916.

Of the government-financed think tanks in Europe, the Adenauer, Ebert, and Naumann foundations in Germany have outright partisan missions in their use of applied social science, each serving the research needs of a major political party. These foundations have the names of former party leaders.

Privately founded think tanks in Washington DC are usually also politically partisan. However, they are not formally associated with political parties as in Germany, but with political ideologies. The Heritage Foundation is conservative, while the American Enterprise Institute and the Foreign Policy Initiative may be counted as neoconservative. The Center for American Progress is liberal, Cato is libertarian. The venerable Brookings Institution may be called establishmentarian. In foreign policy, the Carnegie Endowment for International Peace is liberal, and the Council on Foreign Relations is more establishmentarian. Chatham House in London counts as the most notable think tank in Europe in the field of security and international affairs.

The political connections and commitments of think tanks often make it difficult for readers of their publications to separate recommendations based on research from recommendations based on ideology. The researchers employed at think tanks also suffer from this, for example, when their genuine findings and discoveries do not turn out to be references in scholarly journals and monographs. The recent trend in publications from think tanks to separate the research base by using subtitles should be encouraged.

The above remarks on the political orientation of various private think tanks apply to the time of this writing (2012) and may change if new sponsors and donors get on their boards of governors. Or, they change if and when their boards simply decide to hire staff with other specialties and other political persuasions. Generally speaking, however, it is usually difficult to change the original statues written by the donors of a private foundation.

The highly varied examples cited above signal that Humboldt's design in his important memorandum to draw most research and all major researchers into universities is a by-gone chapter in the history of science. Universities must now admit that there is as much research done outside their campuses as on campus. This does not mean that campuses no longer have a unique openings for knowledge.

## Can the Ethos of the University Survive?

The ethos of the university is the search for truth in the humanities and science. This thesis of Jaspers about the truth mission of universities also has a negating aspect. Universities must negate any non-truth from confabulation, defensive bilge, and magic, and fend off the intrusion of priorities of non-science realms in its own core work.

A few words, avoiding different philosophical controversies about the nature of truth, may be used to formulate criteria of serious intellectual acceptability in a university:

”Don't believe anything for which there is no reason or no evidence, and, above all, avoid stating it with conviction!”

“Listen to and respond to a teacher’s views, and participate in settings — seminars, assemblies, or arguments in serious publications — in which you can present and defend your views either face-to-face, or in signed contributions, against opponents among your fellow students!"

A campus of a modern multiversity for mass education, in spite of its meandering and bewildering content, will retain Jaspers' idea of university so long as staff and students can test the quality of their presentations and conversations against the above two criteria. Needless to say, when students are numerous, it takes special efforts and costs to maintain old-style small assemblies that are seminars rather than big lectures.

The two criteria of intellectual acceptability mentioned above include both an ethos of skepticism and the organization of seminars conducive to skepticism. Skepticism is typical of both science and of young students; both are inclined to challenge established doctrines. Students and faculty members, particularly younger ones among the latter, who are brave enough to turn against what seems to have become obsolete positions of science, rightly use skepticism. Also, skepticism is called for when staff and students fail to apply intellectual caution in their encounters with engaging social movements bent on grand measures to save the world.

Those women and men who turn into social critics or into other public intellectuals have usually been aided by an education based on the ideals of intellectual acceptability as found at a good university. Self-made intellectual critics without formal education may also rise to varied and often acceptable callings — remember for example, Jean-Jacques Rousseau. But other self-made intellectuals who have gone public have easily turned into charlatans who go hopelessly astray into doomsday science[8] or similar nonsense, although they may claim modern technology in the dissemination of their aims.

Adolf Hitler is the worst internationally known example of a self-made public intellectual gone astray. He had started as an artist in Vienna. After service in World War I, he presented himself in Germany as a revanchist determined to revoke the Versailles Peace Treaty. He proclaimed himself "Führer," and managed to become a sultan type charismatic leader,[9] of a militant avant-garde of the Arian race, destined to subjugate Slavic peoples to annihilate Jews, and to crush a Jewish conspiracy they thought were in the process of taking over the world.

Timothy James McVeigh, the Oklahoma bomber, is a local example. He thought himself called upon to stop a "U.N.-run New World Order," poised to take over the United States and the world.

More recently, Anders Behring Breivik, a Norwegian terrorist, presented himself as a Commandant for Knights Templar, a virtual network of militant nationalists working to stop a Muslim takeover of his country.

None of these three men had experienced a university education that provided them with the organized skepticism inherent in our two criteria for what is intellectually acceptable. This is no proof of the merits or justification of a university education, but it is some food for thought.

In the new century, objectivity on American campuses became a concern of conservative students. They formed the organization, Students for Academic Freedom (SAF), to protect fellow students from the teachings of liberal professors, eager to include controversial material supporting their ideology in the classrooms. The SAF also voices its complaints to state legislators. Their call for legislation is, of course, the anathema of academic freedom. Please argue your case on campus! And, judge your own account and your opponents' account by the above criteria of intellectual acceptability.

## Do Minorities Have an Exclusive Track to Knowledge about Themselves?

The North American colleges and universities have been remarkably successful in recruiting students from all walks of life, and their student bodies have a striking ethnic variation.

Pressures from other sources than the state — such as social movements in the larger society, industrial fields, and other special interest groups outside the universities — have been active in shaping undergraduate education in the United States. Students can select from a huge variety of vocational programs, but also from programs such as Latin American studies, Afro-American studies, Asian-Pacific-American studies, Native-American studies, women studies, gender studies, et cetera. "The shortcomings of all these para-academic programs," states Tony Judt (2010, 202), "is not that they concentrate on a given ethnic or geographic minority: it is that they encourage the members of that minority to study *themselves* — thereby simultaneously negating the goals of liberal education and reinforcing the sectarian ghetto mentalities they purport to undermine."

Apart from the fact that a merger of the societal realms of science and morality has dim prospects,[10] a legitimate moral need to redress wrongs should not be allowed to corrupt science. As we have noted,[11] simply because you believe in empowering African people, you are not allowed to fabricate facts and claim that Aristotle stole his ideas from a library on African soil — the library in Alexandria was not there in Aristotle's time.

In the study of disadvantaged minorities, it is often assumed that insiders in these minorities are the only ones who can tell the true conditions prevailing in these groups. If so, it would make sense that black professors man black studies, female professors teach gender studies, Muslim professors stake responsibility for Muslim studies, et cetera. This, however, is contrary to the constitution (CUDOS) of science.[12] Scientific statements should be judged by their merits of evidence, not by their pedigree of continent, color, ethnicity, sex, religion, et cetera.

At many times, it is true that insiders in a disadvantaged social category may have better access to observations and data than have outsiders. However, in the *interpretation* of such data in the form of documents, interviews, recordings, et cetera, any social scientist with a trained language brain can participate. The "current standpoint of science" represents a consensus about the evidence shared by the most competent scientists, be they insiders or outsiders.

Robert K Merton's detailed and sophisticated discussion from the 1970s of the dilemma of insider and outsider knowledge remains unsurpassed (Merton 1972). The many complications of this issue should not make us forget the general rule that mandatory mergers of any two societal realms are inherently unstable. This should hold also for attempted mergers of social science and morality that purports to give the evidence from and about disadvantaged minorities a special highway to certification as the present standpoint of science.

## Organizations for Research

### A Shift of Modes of Research

In *applied research,* a university organized as overspecialized professors in specialized departments is less conducive to success. Practical problems in other societal realms than science rarely or never have the same borders as have university departments. Several typical social problems — take race relations as an example — require expertise in biology, psychology, anthropology, sociology, economics, political science, and jurisprudence. The typical engineering problems for industry require interdisciplinary competence. A system of automobile collision avoidance requires expertise in optics, electronics, robotics, and mechanics.

When traditional universities took on applied research of some scale about practical problems, they normally had to collect staff from several departments. The interdisciplinary work did not add much to publications in the specialty of a professor, particularly junior faculty who need for their promotion more publications in the core of their chosen specialty. By interdisciplinary work, graduate assistants learned early to cooperate with other disciplines, which is a useful skill for new generations of researchers. However, their particular and specialized department nevertheless judged their doctoral efforts.

Thus, traditional faculties of natural and social science were not particularly suitable for applied work. To be suitable for such problems the universities would have reorganize, using schools of engineering and medicine as models; the latter are much more accustomed to applied research. However, for large-scale applied research requiring a crossing of many disciplinary boundaries, even the university structure for engineering and medicine is not automatically optimal. The most dramatic response to this difficulty was the creation of the above-mentioned "multiversity," loaded with special schools and institutes.[13]

Every American campus however, now has at least some specialized schools. They have turned out legions of physicians, nurses, and para-meds, engineers, technicians, ecologists, and numerous others who practice natural sciences professionally without doing any research for publication. Likewise in social science, we have social workers, social relation therapists, PR (public relations) and HR (human relations) consultants,, and others, including some political scientists and many economists, make a living applying social science.

In numbers, applied scientists dominate over the pure researchers in the contemporary societal realm of science. This has brought an increased understanding among the public of the nature of scientific practices.

## Mode 2

The increased involvement in applied work has affected the process of research, the very core of the realm of science. Here enters another mode into sciwence, simply called Mode 2, or *research in the context of applications*. This is a major change in organizing the realm of science in society.

A visible number of international scholars — Michael Gibbons, Camille Limoges, Helga Nowotny, Simon Schwartzman, Peter Scott, and Martin Trow — argued this case in an important memorandum originally requested by Swedish research authorities in 1994. The title of this work is *The New Production of Knowledge,* reprinted many times, the latest as Gibbons et al. (2011). Together with a much enlarged sequel, *Re-Thinking Science. Knowledge and Public in an Age of Uncertainty* (Nowotny, Scott and Gibbons 2001), it has initiated a revision of our views of the realm of science that some people think is reminiscent in terms of importance as that of Humboldt's 1810 memorandum.[14] However, there are also thoughtful critics of the memorandum who point out that its views fit authoritarian governments better than liberal democracies (Gustavsson 1997).

Increasing volumes of research-based new knowledge in the new century is generated in "the context of application," a fact well documented in an anthology edited by Carrier and Nordmann (2010), and a fact said to change methodologies, transform concepts, and reorient academic culture. To a considerable extent, the new mode of scientific research appears driven by economic and political forces seeking hegemony over the realm of science. The science policy of the European Union and its Commission is a case in point.

## The Citadel of Basic Research

The citadel of the societal realm of science remain Mode 1 and its closely guarded CUDOs..The Humboldtian university structure of overspecialized professors in departments and faculties is still a good ground for *basic research*, and I would argue that for this purpose it is the best ground. Basic research does not follow a time schedule. Compared to business organizations, the pace of time in most faculties is unhurried. Findings in basic research often emerge when the focus is on some neighboring problem (Merton and Barber 2004). Such serendipity has a friendly home in faculty research. Segments of basic research fit well into graduate assistants' education and into their progress to a doctorate in a chosen specialty. Even the best-informed scholars about the modern mode of research in the context of applications admit that

Mode 2 has made "surprisingly small contribution" to basic science (Nowotny, Scott and Gibbons 2001, 11).

There is an ill understood risk of losing the collegiate decision making process in research, essential when dealing with basic research that is judged by scientific criteria alone without regard to practical, political or economic criteria. If a faculty structure is lost, budget and personnel become matters for a chief executive called the President or Director, together with his or her line of staff, rather than the colleagues of researchers and their assembly in departmental and faculty meetings. Ylva Hasselberg (2012), an historian of universities, has elegantly revealed the change.

There is a trend in many places to dispense with collegiate control of research. This trend, more or less inadvertently, is favored both by government and business because it is a modus vivendi in the polity and the economy; they just do not know better, nor do their consultants.[15] Moving research from traditional universities into institutes in the public or private sector illustrates this trend. Changing the organizations of the universities themselves into research and consulting services for their regions rather than for the growth of knowledge is another aspect of the same trend.

## Leadership of Research

No administrator of research can guarantee scientifically interesting and sound discoveries. The best one can do is to organize work in a laboratory to make possible discoveries of a kind that is of particular interest, and to ensure that any discoveries outside this particular area are not lost due to over-efficiency or negligence. This is a unique aspect of leadership in scientific laboratories and institutes. The societal realm of science has to cultivate a much freer work environment for researchers than the one existing in business and in public administration. This illustrates our general thesis that leadership is not a universal skill, as is commonly assumed, but dependent on the relevant societal realm.

Scientists who have achieved a high level of documented competence attract job offers from more prestigious universities or research organizations, as these institutions have a policy of hiring the best they can obtain. This is the way research organizations stay ahead. Heads of departments with research activities are supposed to keep track of the yearly increments in competence among their staff and promote and raise salaries and benefits accordingly. Without such *contextual rewards with monetary value* added to scientific honor, their departments would lose staff to competing institutions. We have described the process above.[16]

Local collegiate faculties usually hold and dispose of some research funds for their members. In recent decades, such internal funds from university endowments and/or outright government grants to local faculties have dried up. The big money comes, instead, from external research councils. These research councils, be they public or private, control larger funds and have a national or even international reach. They grant funds on a competitive basis to many research establishments. Such councils are considered very rational — by bureaucratic and market criteria, that is. The research councils accept the fact that universities incur and require a sizable amount of fixed costs, so called overhead, to house the research they sponsor; this satisfies university administrators.

Living together in a local community and working together on a campus in this community, professors in assembly (i.e. their faculty meeting), is a proven and competent decision-making structure in matters of research. The collegiate university faculty knows better than any central research council does, whether a scientist in their midst has a great passion for research, or not. The assembly is also familiar with a member's execution of his research, circumstances that are rather unknown in distant councils. To allow faculty funds for research to dry up is not at all rational in the overall pursuit of new knowledge. To give research funds to be distributed by the central administration of the university is practical, but it is not necessarily compensation for missing faculty funds. We have heard that certain hospital environments can be dangerous to your health. Likewise, universities with weak faculties and a powerful President's Office can be dangerous to independent creativity.

In 2011, the Swedish government gave the option to state universities to abandon the rule by collegiate assembly and adopt the bureaucratic form. We do not yet know the outcome of this legislation.

Universities opting out from collegiate self-government will, in their search for new knowledge, be like any research institute in the private sector or in the central government. Or, believe it or not, in the military. The executive traditions in these sectors may certainly require that the employees become good at producing research reports that meet the budgets of time and money. However, on the day of the deadline, they run the risk of discovering that the content of a research report is dead dull. Several interesting insights or hunches, made in passing by their research team, may lay by the wayside. The latter are wasted hypotheses that did not happen to fit in the council-approved plan for the project, or did not fit in the mindset of the boss in the President's or Director's office.

On the larger scene of the entire societal realm of science, the ranks of university professors still provide most of the peer reviewers and the lion's share of leadership in learned societies, most of the editors of scientific journals, and most of the chairs at scientific conferences. The downside of this is that ranking professors spend an inordinate amount of time reviewing and evaluating the research of others. Their dominance in these activities means that they are the central Keepers of knowledge in society. In addition, of course, they have dissertations to supervise, not to mention ordinary students to teach. As educators, they are supposed to train the most competent people in all realms of society. Thus, top-ranking university professors face an overload of expectations as major Brokers of knowledge. Their original and official task as researchers, i.e. Makers of new knowledge, has taken a back seat to their roles as Keepers and Brokers of knowledge. In places without faculty funds for research, they are also Procurers to science, writing thoughtful applications for the funds that are actually required to do their appointed basic job.

In spite of their professorial overload, many professors get irritated when we hint that modern societies have more research outside university campuses than on campus. Monopolists become unhappy when reminded that they have lost a privileged corner. So were the guild masters when the market economy replaced their monopolies.

## Notes to Chapter 23, Universities Then and Now

[1] (Vol 2) Introduction: Plato on Realm Norms, p 61ff

[2] (Vol 4) Introducing Societal Realms as Basics: A Checklist for the Study of Societal Realms, 8

[3] Ch 18 (Vol 4) The Emergence of Science in Europe: Scientists and Their Academies, p 44

[4] Proposition 10:4 recalled. *Monopolization of Cardinal Values*, p 3

[5] Ch 23 (Vol4) Details of Table 7.1 recalled. Addition of 'Assembly' to the Com-munication Structures developed in the Chicago school of sociology, p 131

[6] Ch 20 (Vol 4) The Contemporary Pursuit of Science: Table 20.1. Science and Other Societal Realms, p 76

[7] Ch 7 (Vol 2) Leadership and Collectivities: Advisory Staffs and Decision-Making Staffs, p 123ff

[8] Ch 19 (Vol 4) Finding a Modus Vivendi and Ethos of Science: European Doomsday Science and Its International Bent, p 60ff

[9] Ch 7 (Vol 2) Leadership and Collectivities: Advisory Staffs and Decision-Making Staffs, p 123ff

[10] Proposition 10:4 recalled. *Monopolization of Cardinal Values*, p 2

[11] Ch 3 (Vol 1) Language and Its Distortions: Enter the Defensive Bilge, p 110ff

[12] Ch 20 (Vol 4) The Contemporary Pursuit of Science: A Short View of Science as a Social Institution: CUDOS, p 73

[13] Ch 23 (Vol 4) Universities Then and Now: The Multiversity, p 159ff

[14] Ch 23 (Vol 4) Universities Then and Now: Enter Humboldt, p 139ff

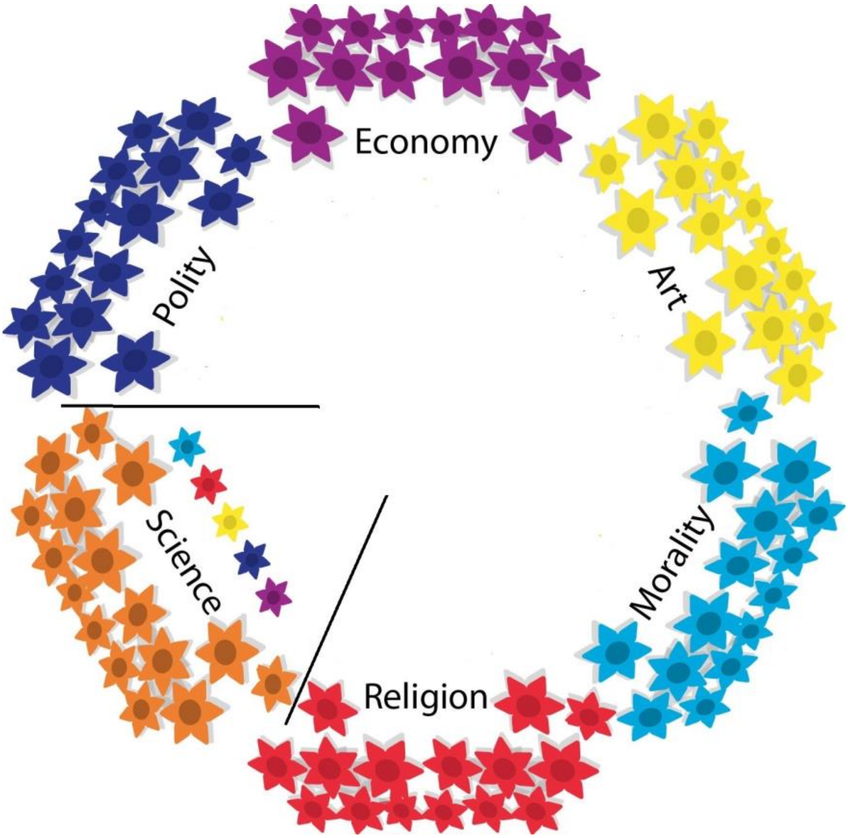
[15] Ch 7 (Vol 2) Leadership and Collectivities: Realm Leadership, p 101

[16] Ch 22 (Vol 4) Stratification and Rewards in Science: Linking Honor to Contextual Rewards, p 115

# 24. Procuring to Science

To perform its tasks, the societal realm of science needs elements from other societal realms. Science is no exception. This is obvious in all societies and it emerges with great force in modern city-life.[1]

*Figure 24.1. Procuring to Science. Detail of Figure 10.2.*

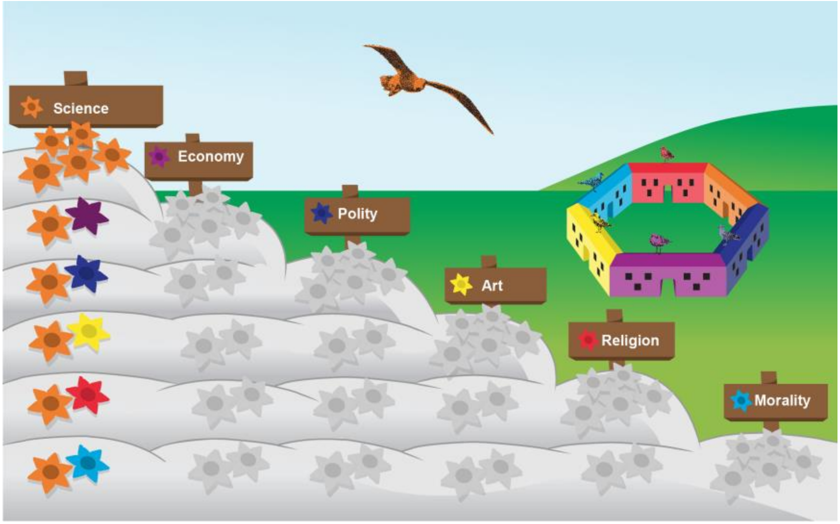



Most of all, the societal realm of science needs money from business who buys its services, and/or and from governments collecting taxes for public goods. From the body politic, scientific activities also need some special permissions, legislation, and services. The latter need not be large tasks, but together with growing public research budgets, most modern governments have opened Ministries of Research and Higher Education.

The contemplation inherent in the research process may need a fitting working environment with buildings of sandstone dressed in ivy; thus, the arts of architecture and landscaping get involved. From the societal realm of morality, science needs an ethic that prevents cruelty to animals and people who are the subject of testing and research.

The garden of science thus must learn to integrate many alien sideshows with its passion for cultivating discovery. Figure 24.1 provides an illustration. The seagull symbolizes academic freedom.

*Figure 24.1. The Rock Garden of Science Includes Plants from Other Societal Realms*




The role of Procurer of resources from other realms of society to the realm of science is not standardized. We shall focus here on the procurement of money to the societal realm of science. We will treat procurement of other cardinal values than money mainly in the chapters that deal with these values in the next two volumes of the *Many-Splendored society*.

## Financing the Modern University in the United States

In the late 1940s and during the following three decades, a massive injection of federal support was granted to colleges and universities when returning World War II, Korean War and Vietnam War veterans were offered higher education. The 1957 appearance of a Soviet satellite, Sputnik, stimulated legislation providing more funds to education in mathematics and science. In the same period, the different states of the Union, particularly in the Midwest and West, allocated funds generously in their budgets to their university systems.

During an oil crisis and subsequent recession in the 1970s, Congress could no longer support research at the prevailing rate. By the 1980s, the yearly increases that state legislators had given their prestigious research universities — with all their ivory towers and superb football teams — also became history. This happened not just for want of funds, but because state budgets began to take on a larger share of welfare programs of a modern nation. The United States then experienced what European welfare states already had documented. The welfare items in the budget are like young cocoons in an alien nest; they crowd out the old established expenditures.

When both federal and state support of the American universities weakened, the universities turned to their own resources.

A great American source of university cash, namely tickets and TV-rights to the broadcasting of college athletics, became strained to their limits. College athletics, mostly football and basketball but lately also soccer, is part of the college financing system. Each year, spectator fees and television rights bring in several billions of dollars to American universities. There is nothing like that in Europe. Coaches have (non-published) deals with the admissions offices about relaxing the meritocratic rules of admission to the schools. They also have special calls on fellowships in order to recruit a quota of players that will deliver the spectators and the dollars. The coaches guard this privilege. They would lose slots in their deal with admission officers if they choose too many players from regular admission; the latter thus become discriminated. Of course, coaches also want to prove that they had good judgment in filling their quota by showing the administration their chosen quota players on the team. To some extent, this vicious circle undermines the quality faculties expect from their admission offices, and sometimes the quality of the athletic teams as well.

Alumni giving was already well organized in the 1970s, but could be marginally improved. Fees from the extension of general adult education, however, had room for expansion. Internet education opened a new avenue towards an academic degree by distance training, inexpensive to produce and potentially providing not particularly high fees but many fees. Executive seminar series were a good source of funds for certain universities with well-known business schools. Eventually, the patent portfolios that the

Bayh-Dole Act[2] had made possible began to generate income for several research universities. One might summarize the above by saying that the research universities maintained their standing by what the former President of Harvard, Derik Bok (2003) called *commercializing*.

The public research universities in the United States used to charge modest fees from in-state students and a higher fee from those out of state. The tuition fees paid by American freshmen to public institutions of learning in 2012 covered about half of their university's total revenue. When their parents had entered the same colleges 30 years ago, the latters were satisfied when student fees accounted for about a quarter of their revenue. By this steep rise in tuition fees, the last few generations of American undergraduates and their families had to pay and continue to pay through the nose, and via long-term student loans, the enormous costs for keeping up the overheads of the advanced research universities. At the same time, observers began to note the prevalence of larger classes, instead of larger teaching loads for professors, duller lectures by research-oriented professors, and repeated refusals to provide tenure to those whose main forte was skilled teaching.

When, as mentioned, a larger share of teaching was also assigned to adjuncts at the research universities, it clearly looked as if undergraduates in the United States obtained better value for education in smaller colleges with lower fees, less glorious libraries and laboratory facilities, but with a staff committed to teaching that had only a modest, or no research, budget. Numerous students, furthermore, have turned to community colleges with even more unpretentious facilities, often with many part-time teachers who hold responsible professional jobs in the local community.

The federal government has stepped in to ease some financial burdens of the students. In 1980 — late by European standards — a federal Department of Education came into existence in Washington DC. In 2010 it provided for $125 billion in loans to college students and $32 billion in Pell grants that do not have to be repaid. This provides groundwork for a U.S. "concordat" on education.[3] It enables students to have a free choice of societal realm for future participation and/or work. We find several such concordats, legislative contracts between societal realms.

We may note about the North American system of education that a degree from a college or university has no uniform meaning.

To evaluate a given Bachelor Diploma you have to know the name of the college, statistics on its alumni, and the rating of the school on nation-wide tests. It would also be helpful to know the list or name of the courses taken, and the student's grades. A BA degree, itself, is no guarantee for employment on the North American job market, but may be essential for being granted a job interview.

## Financing Run-of-the-Mill-Science

In the United States, there is a slow-growing realization that you cannot buy and pay for research findings in the same way in which you buy and pay for other goods for an enterprise or for use by an arm of government. Research findings do not automatically follow any business plan. A recent illustration is the slowness in constructing the much-wanted effective electric batteries for heavy work. Nor do research findings emerge according to politically approved plans. The attempt by President George W Bush to divert stem cell research in The United States by prohibiting the part financed with public money is a case in point.

Of course, politicians and business executives in any country who desire to investigate a certain subject, can order and pay for the work. To buy new research outright is risky. Not only are delivery dates and budgeted amounts more uncertain than in most other purchases, the delivery itself of any new useful research finding is uncertain. To be safe, the typical buyers of research results can invest in rights to use established patents. Alternatively, they can copy what consultants have found working well in other settings, not subjects to patents.

There exist many false hopes about the relationship between science and politics, as well as about science and other realms. Some altogether too smart science entrepreneurs play on these false expectations, and make extravagant promises in return for big appropriations.

It is well established by Nobel laureate Gary Becker (1993) that investment in higher education increases personal lifetime income. However, deceptive argument is that a big governmental budget for scientific research automatically leads to more riches for the country, i.e. increases in national GNP. Science is international, and scientific findings upon publication are available worldwide. The exception, as we noted, is patents.[4] Patents, however, are a minor fraction of all findings reported in the scholarly journals. (The exact percentage is hard to calculate for many reasons. For example, scientific journals may include information of patented findings in their articles, a good way of advertising the existence of a patent.) Many new patents have little or no connection with new advanced academic research. As we soon shall see, innovations also — and normally — grow, not only by new scientific findings, but also by new combinations of already existing findings.[5] These new combinations may see the light of day in tinkering activities far from both universities and research centers.

Royalty from patents is not a normal part of the reward system in science that we have described above.[6] Furthermore, whether income from a patent accrues to the GNP in the country of the inventor is a very open question. The answers depend on the prevailing business climate, tax system, and the opportunity structures that we call 'competence blocks' and which we write about in volume 6 of *The Many-Splendored Society*.

## Research Councils

We have some fragile mechanisms that permit politicians to determine the overall scope of the allocation of tax money for scientific research, but not the details about how such funds are to be used, which is left to the community of researchers. We deal here with what we have called a concordat, a legislative contract between societal realms.[7] A research council is such a concordat. An example is The National Science Foundation (NSF), an independent federal agency created by the US Congress in 1950. There are also research foundations with private (non-government) funds operating like research councils. An example is Stiftung Volkswagenwerk in Germany.

The core of the research council model is the work of groups of scientists, usually called "panels," that rank projects proposed by other researchers in terms of scientific merits. The panel is the voice of the research community that is heard in a research council, not the voice of politicians, or of businesspersons, or even of council administrators/bureaucrats.

The panel system of research councils can be rendered less effective by the tendency of panels to secure and even monopolize available rewards of the realm. (Such processes are involved in Proposition 10:4 cited above.[8]) Most research councils that I have encountered have too many panels, not quite as many as there are scientific specialties, but many more than is rational. This multitude is exactly what professors usually favor in order to monopolize their rewards and power, something we have noted[9] as one of the unforeseen results of the self-organization of the Humboldtian universities. In such a case, dead-end specialties survive and new specialties may be blocked from the support they deserve. Research councils and foundations with few panels, but manned by a balance of researchers and scholars who have a broad view, a wide network of colleagues, and who have expertise in several fields, apparently deliver the best decisions of support to research.

The existing research councils are not always a perfect system for financing research. Research undertaken in non-university hospitals, museums, private-sector institutes, research departments of industries and government agencies, all these are, mostly, unrepresented in typical publically financed councils, which is an unnecessary limitation. European research councils, in particular, have obvious difficulties in adjusting to the fact that an increasing share of research takes place outside the universities. If you attended a meeting or read the minutes of the research councils in the Nordic countries around the millennium, you would think that practically all research in Scandinavia is university research, particularly professorial research. In our terminology from rows N and O of our Periodic System of Societal Realms,[10] the typical research councils in the new century are imbalanced. They are overrepresented by the Keepers of knowledge, scholars who are representing what is already known. Makers of knowledge, i.e. the passionate researchers, who have a daily concern with what is still unknown, seem amazingly rare on the councils.

Self-censure, favoritism and fashion may certainly affect the work of a research council, and their presence suggests that professors and other leading scientists staffing the councils are not, altogether, the independent thinkers they believe they are. But research councils form the best practice we have. It provides opportunities for individual projects that cannot fit into big, politically approved research programs.

The council system is clearly better than the rigid and centralized system of sponsoring research practiced by the Commission of the European Union. The Lisbon accord of the European Union harnesses the realm of science with the narrow view to make Europe *economically* competitive with North America and the Far East. This is one of several instances when the European Union is sadly ignoring the many-splendored base of European history.[11]

Research councils work best for medium-size, run-of-the-mill projects; they often have difficulties to come to terms with highly visionary and virtuoso applicants. Nor can they, within their regular yearly budgets support very expensive, occasional projects, such as those requiring new equipment and instruments for a space or deep sea exploration, what we call Big Science.

## Big Science

As we have noted, the Humboldt-type university was a magnet attracting researchers. However, some research institutions never did find a place for their most significant research work on university campuses. The fate of astronomical observatories is an illustration.

In 1576, a gentleman scholar named Tycho Brahe received a manor from the King of Denmark. It was located on the Isle of Hven in the middle of the Baltic Straits connecting the Baltic Sea to the Atlantic. Here he founded his first observatory, Uraniborg. Typical of the times, he installed an alchemical laboratory in the basement. The sponsors were as interested in the prospect of making earthly gold as in the prospect of exploring the heavens.

Brahe constructed other telescopes in his lifetime. In the Imperial Castle of the town of Benátky nad Jizerou, located two hours journey from Prague, he built his last observatory at the request of the Emperor. This is where his assistant, Johannes Kepler, using Brahe's data from Denmark, developed the laws of planetary motion.

Observatories continued to be projects of royal courts. In 1674, Charles II built the Greenwich Observatory outside London. He also instituted a position of Astronomer Royal. Likewise, in the New World, the initiative to establish observatories came from the government. In 1830, the United States Naval Observatory was started. In its early research agenda, practical matters, such as navigation and time keeping, had priority over astronomical modeling and the exploration of the very distant universe. In the late twentieth century, the outer space agency of the United States (NASA) sponsored Hubble, the first big telescope placed on an orbiting satellite. To serve the science of astronomy, this telescope penetrated deep into the universe for data, and sent its data back to the hazy earth below its orbit.

Before 1700, the world had 10 observatories. The nineteenth century added about 80 new observatories. Most of them were created for private persons. They became located on their estates, or donated to favorite towns. Some, however, became attached to universities.

In 1897, the pioneering astrophysicist George Ellery Hale at the University of Chicago founded the Yerkes Observatory financed by Charles T Yerkes, the magnate of the Chicago city rail transport. This observatory was perhaps not too big for the campus area of those days; nevertheless, it was located in Williams Bay in Wisconsin where the air was clearer than in the booming industrial city of Chicago. This outpost of the university became "the birthplace of modern astrophysics."

The twentieth century added some 280 observatories all over the world. This growth rate has apparently stabilized; the 1990s saw another 47 and the next decade, 2000 – 2010, added 48. University campuses became the home of the smaller telescopes serving teaching needs and some research. The very large ones would have to be located outside campuses. For Chicago University, a private institution, this had not been a problem. The huge Hobby-Eberly Telescope from Pennsylvania, named after two benefactors of Penn State University, one politician and one businessman, faced a more complex situation, forecasting the complexities of supporting Big Science from different states. A state institution runs into legal obstacles when operating installations outside state territory. With ingenuity, Hobby and Eberly managed to locate their telescope in West Texas on the Jeff Davis Mountains where the sighting was better than in the home state. McDonald Observatory named after its donor, a Texas banker, has been located there since the 1930s, and it became the home of the Hobby-Eberly Telescope. In due course, the University of Texas, along with Penn State and other universities as collaborators operated this site.

In an effective manner, the Hobby-Eberly Telescope has gathered a huge amount of different light, something that has advanced outer-space spectroscopy, the study of the composition of the universe and its bodies. This is an early example, not only of financing across state borders, but of organized *cooperation* in research between universities, something different from the normal, informal *competition* found in university research.

The search for good observing conditions to make the most of the big, expensive telescopes has led to the location of observatories on the Mauna Kea in Hawaii and on the Teide Volcano in the

Canary Islands. Both sites have a bundle of telescopes of mixed ownership.

The Teide Observatory in Izaña on Tenerife opened in 1964 and in the following decades became a major research center in which European countries located about a dozen telescopes. They are members of Instituto de Astrofísica de Canarias, a successful administrative body recognized by the Spanish government.

On the Mauna Kea, there is a smaller telescope with a diameter of 2.2 meters for faculty and doctoral students at the University of Hawaii. Canada, France, and the state of Hawaii have joined in establishing a 3.6 meter scope. The Japanese have a huge telescope, 8.3 meters. Seven countries have joined in an almost as large (8.1 meters) telescope and observatory with a forward-looking administration in the form of The Association of Universities for Research in Astronomy, Inc. Its owners come from the United States, Canada, United Kingdom, Australia, Argentina, and Brazil. The corporation administers research capital, has a time-share schedule, and promotes a common research culture.

On Mauna Kea there are also two huge instruments for submillimeter astronomy, i.e. the span of waves in space lying between the waves easily observed by optical telescopes and the waves best observed by radio telescopes. Observations in this range need both technologies, and require a relatively vapor-free location, like the Mauna Kea at 4000 meters over the ocean. The larger of the two submillimeter installations is operated by Canada and the Netherlands, the other is operated by Taiwanese and US interests.

Radio telescopes do not depend on clear skies; their effectiveness rests on many antenna points in areas with little interference from earthly communications, such as local radio and cell phones. The SKA telescope, planned for the 2010s will have 3.000 antennas spread over nine African countries, plus some over Australia and New Zeeland. A huge computer will coordinate their signals. The promoters claim that this system will be sufficiently sensitive to detect airport radar on a planet 50 light years away, should such an installation be found. This effort takes place in a relatively secular period of our history, but with a colossal scientific curiosity about what might be hidden in the known heavens.

Certain sciences other than astronomy have also had to move central research facilities out of university campuses, either to their back yards, or to locations that are more distant. At the opposite end of the interest in astrophysics is the interest in particle physics. In the 1950s, Lawrence Berkeley National Laboratory was established as a neighbor to the University of California. The Laboratory housed a straight-line particle accelerator, the Bevatron, active 1954 – 1993. Here the proton was discovered, and a number of short-lived particles. To study the latter, the researchers needed high-energy circular accelerators. They could not fit on the Berkeley Hills campus — or in a university budget.

The frontline in particle research moved from the Bevatron to the Tevatron, active 1983 – 2011, housed in the Fermilab outside of Chicago and to The Large Hadron Collider (LHC) outside of Geneva, Switzerland. The latter had been under construction for ten years when it started at full speed in 2010. This installation was built by the European Organization for Nuclear Research (CERN), financed by 20 European states. It has a scientific committee organized as an old-fashioned academy with members elected on scientific merit regardless of nationality and, thus, including scholars who are not citizens of the member states. The LHC occupies a 17-kilometer tunnel under the Swiss-French border. In 2012, CERN confirmed the discovery of "The Higgs boson," a long sought-after crucial confirmation of the Standard Model of physics.

In Texas, the United States started an even larger research facility, the Superconducting Super Collider. After having spent about two billion dollars, Congress withdrew its funding, for political and budgetary, not scientific, reasons. Parliaments are apparently not effective bodies to deal with Big Science. They are, after all, assemblies of members looking after the interest of their constituents, national or local, and do not normally deal with special and costly issues of worldwide benevolence. If the issue had been the construction of a collider in each state of the Union, then Congress would be an ideal body to authorize construction. Apparently, we must turn to the central zone of society to find a broader understanding of Big Science than the one reflected in a political assembly, elected to be the representative of the entire adult population. This is also, what we found regarding patents.[12]

In the United States, the National Ecological Observatory Network (NEON) program has been started which, when completed, will have 60 observation points spread over the entire country executing over 500 standardized ecological measurements. By moving into reliable Big Science, climatology will hopefully definitively shake its ballast (or image) of being a science of dooms based on too many guesstimates in its full simulations of the many interactions of carbon dioxide, vapor, clouds, snow, ice, et cetera. A

Global Monitoring for Environment and Security (GMES) is a much-needed European Union project of Big Science for the long-term monitoring of the health of the entire planet by satellite. Budgetary constraints in the European Union nearly strangled this project. The EU gives 40 percent of its budgets to subsidize farmers (mostly French) but has managed to give a fraction of a single percent to more accurate monitoring of the perceived threats to the environment of us all.

## Conclusions for Big Science

What might the above cases of Big Science tell us about the future of the entire realm of science?

The societal realm of science has long been an international realm with its learned networks, assemblies, and publishing media operating worldwide. In past centuries, the universities have served the realm of science well, but their mold is broken, as we have seen, by other homes for research, particularly by Big Science. We have seen varying examples in the study of astronomy and sub-atomic physics of the emergence of multinational formal organizations for Big Science research. We need to compare these organizational models and to evaluate their merits. Those who believe that there is only one universal form for the management of international collaborations in science are probably charlatans.

Science as a societal realm is fundamentally different from other realms that have already developed formal international organizations. Collaborating universities and other research bodies differ from the existing international counterparts in other societal realms. They have little in common with the dioceses of the Roman Catholic Church in the realm of religion. They are not like multinational corporations dominating the major stock exchanges in the global economy. Nor does international scientific collaboration resemble political agencies working under the umbrella of United Nations, or the voluntary, non-government humanitarian organizations, such as the Red Cross in the societal realm of welfare and morality.

An international vehicle in the shape of a globally active formal organization for Big Science cannot be a copy of any of the above. How an international mix of support for science will stand in the future realm of science is not yet clear. The optimal international vehicles for Big Science may emerge only after more trial and errors. So far, the emergence has been as confusing (and sometimes inefficient) as the organizational development has been in the past half-century of foreign aid to eradicate world poverty and world epidemics. We know that the choice of structure is not trivial; there are very significant general differences in collaborations between formal organizations (such as states), voluntary associations, media, networks, and assemblies.[13]

Two things, however, seem likely. First, the optimal mix in an international organizational vehicle for Big Science will not be a copy of multinational corporations, or a copy of governmental bureaucracies. Thus, the scientific enterprise should go its own way and should be wary when accepting directives from consultants, both from the economy and from the body politic. Second, unplanned consequences of any chosen design are likely to appear.

## Spin-offs from a Flywheel

The projects and instruments we call Big Science have been necessary to achieve the basic knowledge of physical science. Big Science, like any science, has an impact called "spillover" or "spin off," i.e. applications in other fields or problems than those for which the original research project was designed. In 1947, a particle accelerator built by General Electric discovered "Synchrotron radiation." Bevatron and Tevatron and other instruments took hold of the discovery, and it was fully explored. This discovery (as of July 2012) resulted in 2,510,000 references on Google to articles and to news concerning its applications, ranging from medicine to archeology.

The original discovery in this case was like a "flywheel." Decades after the discovery, the wheel continues to run and spin off innovations.

No one can, or should, guarantee that the innovative spin-offs from a project of Big Science will always recover the cost of the project, nor generate "the Big Profit," i.e. a huge multiple of its original subsidy or procurement-costs for embarking on the research.

However, innovations from Big Science do come in unprecedented numbers, varieties, and contexts. Some become building blocks for new technologies in the growth cycle of technology in which a combination of old inventions forms novel modules.[14] Economists and accountants rarely include this factor in the calculations of the value of spillover from innovations. Critics say that the whole process is a lottery; however, if so, it is a dynamic lottery with an exceptional number of winning tickets of entirely new knowledge, new riches, and new ways of human fulfillment. Only some of the winning tickets are on sale in the form of patents; passers-by can pick up many for free. "The economic value of these spillovers to firms and society, however, depends on the local receiver competence, or the local ability of whoever comes by to capture and commercialize them," says Gunnar Eliasson (2010, 35).[15]

The finest prize for innovations in engineering in the world is the bi-annual Finnish Millennium Technology Prize. In 2008, Tim Berners-Lee received the prize for an innovation at CERN made in 1991. At CERN, over 10 000 physicists and engineers from many parts of the world participated in the emerging facility for research on new particles. Berners-Lee had not found any new particle; his job was in the computer division. He developed a new way for the participating physicists to communicate with each other. It became known as "www," the World Wide Web, and has since spread into numerous applications changing our lives and reshaping physical, biological, and social realities; a true spin-off from a flywheel. A fair share of the readers of this book may have found it as a download from the web.

## A Note on Internet Usage

It might be helpful to recall and stress that the Internet began as a medium for exchange of scientific information and nothing else. At first, it merely replaced information exchanged by letters and by conversation in encounters by scientists. Soon it became a full-fledged medium replacing newsletters and eventually some of its web sites contained new peer-review journals. As always in science, the information exchanged has no ownership and does not bring royalties; therefore, all files with scientific information transmitted over the net were freely shared as a matter of course within an established network of scientists.

This situation changed when the Internet grew and became a major medium for other than scientific communication. The conflicts over file sharing of copyrighted songs, pictures, and literary products on the Internet is not due to the ill will of the parties, but is caused by the differing reward systems in science and in the arts.

The above controversy should not be confused with the controversy over free speech on the Internet. A tradition of full freedom of speech implies that political messages on the Internet are freely shared. Countries without a tradition of free speech filter and censor non-violent political messages on the Internet as a matter of course. This is what we by definition have labeled 'uncivilized'.[16]

This ends our effort to describe how the realm of science procures funding for its missions.

## Notes to Chapter 24, Procuring to Science

[1] Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: Sideshows Embedding Alien Cardinal Values, p 255ff

[2] Ch 27 (Vol 4) The Use of Patents: The Bayh-Dole Act, p 223ff

[3] Ch 10 (Vol 2) Societal Realms and Their Relations: Concordats, p 319ff

[4] Ch 27 (Vol 4) The Use of Patents, p 207

[5] Ch 28 (Vol 4) On Applied Natural Science: Growth of Innovations, p 219

[6] Ch 22 (Vol 4) Stratification and Rewards in Science, p 109

[7] Ch 10 (Vol 2) Societal Realms and Their Relations: Concordats, p 319ff

[8] Proposition 10:4 recalled. Monopolization of Cardinal Values, p 2

[9] Ch 23 (Vol 4) Universities Then and Now: Humboldt's Arrangement of University Rank and File, p 132

[10] Ch 20 (Vol 4) The Contemporary Pursuit of Science: Table 20.1. Science and Other Societal Realms, p 76

[11] Ch 1 (Vol 1) The Losing Spell of Augustus: The European Union, p 33ff

[12] Ch 27 (Vol 4) The Use of Patents, p 207ff

[13] Ch 7 (Vol 2) Leadership and Collectivities, p 93ff

[14] Ch 28 (Vol 4) On Applied Natural Science: Growth of Innovations, p 219

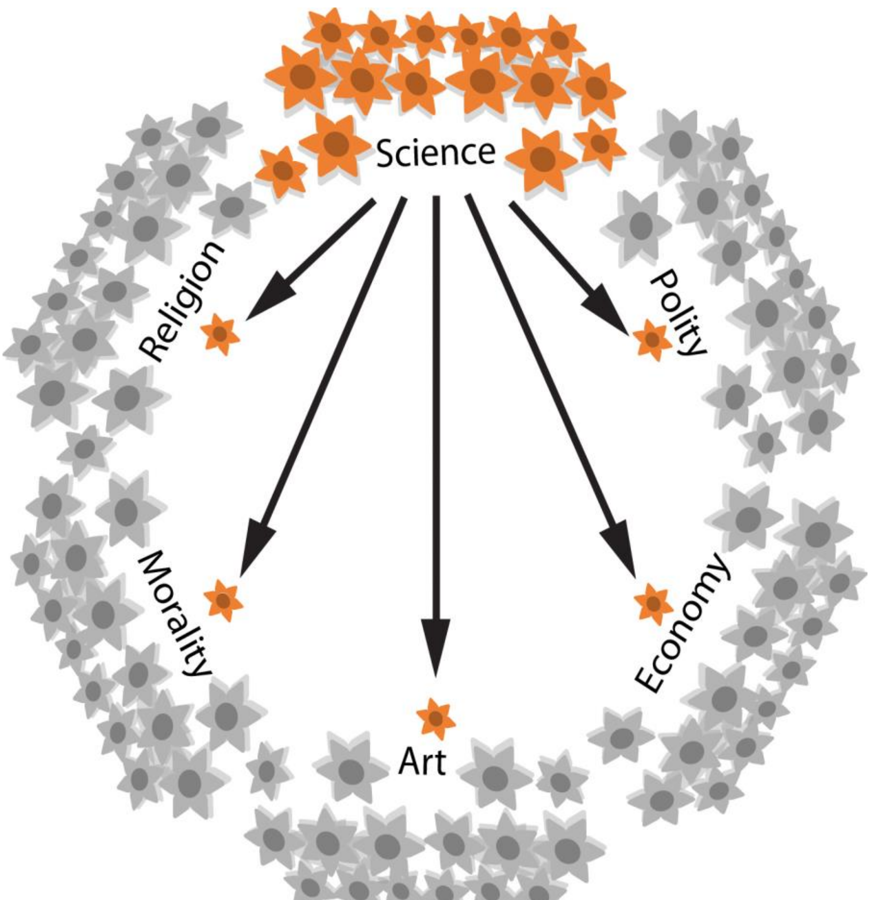
[15] In *The Pursuit of Wealth and Order*, Volume 6 in the series *The Many-Splendored Society* we shall deal with such local competence blocks.

[16] Ch 17 (Vol 3) Justifying and Compelling Vocabularies Writ Large: Civilization: Compelling Vocabularies instead of Violence, p 174ff

# 25. Journalism and Science: News and the Cracking of Secrets

Providing knowledge to other societal realms is a major task of science. The border between science and the other realms in our Periodic Table is not closed. There is much cross-border traffic. Experienced procurers and providers are at work, as are ordinary members of the public.

*Table 25.1. Providing Service to Societal Realmsfrom Science.*




We shall complement our exploration of the societal realm of science by a look at the nature of the field of journalism that also provides knowledge to all societal realms. A general conception is that journalists, as they present the daily news, are Brokers of knowledge to the public, just as the scientists are. The reality is more complex.

Journalists live a life different from scientists, you might even say, different from all other professionals. To begin, here are some observations that originally were placed elsewhere in our work.[1]

## News

Reporters and their editors always have to find something new to show or write about. They would like to be the first to report an emerging issue or crisis. Like scientists, they gear up to be the first with a discovery and its publication. Unlike scientists, however, journalists are expected to contribute something to a feature or a news article every day, or to every issue, or to every broadcast. They have a ravenously hungry monster to satisfy with new events, new faces, new conflicts, and new fashions. Most journalists do not have an enviable work situation. They cannot be satisfied with the usual and the stable, nor the important but hardly noticeable trends, as this does not make news. The latter is essential stuff for scientists, but not for journalists.

The knowledge that fills mass media and what we call "news" is mainly a collection drawn from perceived *changes in the fabric of reality, be they material or technological, biological, or social.* Epidemics are news; new medical treatments are also news. Nuptials and funerals are news. Changes in the form of threats to the accustomed social fabric are particularly qualified as news: crime and violence, deceit in high places, accidents and disasters, divorce and sexual excesses, particularly among the celebrated, death or sickness of leaders, war and revolutions. Normal and familiar social functioning is not a valued topic for journalism — clean air does not make much news, polluted air does. Doomsday science[2] makes big news, normal science tends to make duller and smaller news. The fascination of mass media with doomsday science belongs to the negative side of the media balance sheet.

The journalistic competition for news is as severe as is the competition for discovery in science. With science, however, this is a marathon race compared to the 100-yard dash for daily news.

Science has many more specialties than journalism, each requiring its own concepts; sometimes the latter are presented with mathematics rather than with words. In science, everyday topics tend to be complex and related to previous work of other scientists, as is documented for every reader of the present text. The great advantages of journalism over science are its speed, broad coverage, wide accessibility, and its entertaining presentations in everyday language, even of complex topics.

## Selection of Topics and Their Sources

Both scientific knowledge and journalistic information are public and must be open to public scrutiny. Ideally, journalism is based on facts, but its methods of selecting and controlling facts are not necessarily those of science, not even those of notoriously loose social and cultural sciences.

In serious news media, reporters cannot present a story simply because they like it. Their stories should normally have a so called "news peg," or "trigger," an actual and recent event of relevance or interest to the audience. The corresponding process in scientific work is to relate a new project to a theory or to a finding in a recently published research project. Many media nowadays, however, are apt to allow a personal experience of a reporter as a trigger, making mass media full of subjective experiences.

Reporters cannot base their stories merely on their opinions; reporters must have a *source* for what they present. In this way, they face problems familiar to historians, anthropologists, psychologists, and other scientists using case histories and participant observation.

A main difference is that the scientists must archive and share sources with other scientists even in difficult situations,[3] while the journalist may keep sources totally protected and secret. Journalists in the best Western tradition do not have to disclose or show anyone how their information was obtained, or who their sources are, or what work notes they have. Only an editor-in-chief or a legally responsible publisher can request this information, a privilege they rarely exercise. The credibility of journalists is, therefore, rightly seen as more precarious than that of scientists and scholars who must document their methodology, use archive, and make their source material available.

A chief editor and/or a legally responsible publisher is expected to guard the anonymity of the sources of her or his journalists, including whistleblowers who may not have had clean access to their sources. Free media should resist any attempts to reveal sources to different powers, including the courts. This was once the very meanings of a “free press.” If the jurists in free countries do their job — in this case a difficult job — the protection should nowadays extend to all media, whether or not they use printing presses as their technology of messaging. When the text of the law says “press,” the jurists must read “mass media.”

Editors must separate news from editorials, and, of course, from advertisements. Furthermore, hard news must be split from news analysis, and from what are uncertain assumptions, or from the journalist’s personal feelings.

In photo- and TV-journalism, the latter distinction has not (yet) emerged. A photograph is not truer than a thousand words. However, a picture is generally more expressive, it conveys emotions better than words do. A photographer in his news work usually conveys more of his own emotions than does a writing journalist.

Editors must separate day-to-day news events from staged events, i.e. events arranged by the media themselves, for example, when their media host debates or when they sponsor sport galas.

## Accuracy

The accuracy of journalism is a popular issue. In one of Tom Stoppard's plays about the newspaper world, there is a woman who irritates a journalist by talking about a reporter as a mechanical doll that one can give away as a Christmas present: "Wind it up and it will get it wrong." A modest amount of news in the papers or broadcasts on the radio or TV is, strictly speaking, inaccurate or incomplete in some minor way. Those, who have been present when news does break, know that there is usually something omitted or, much less often, something mistaken in the presentation in the media. As we will see, the chosen “angle” or “frame” requires some omissions, i.e. exclusion of certain circumstances.[4]

The inclusion of something incorrect in a news story is usually due to the fact that news media is an industry with short series. “A new [*New York Times*] is born every day” is an old promotion piece of newspapers. In a nutshell, this is the background of most inaccuracies in news journalism. If a manufacturer were to produce a new model of a vacuum cleaner every day, there would be more complaints about its faults as there are complaints now about shortcomings in the news media. Errors are, in a way, built into the mechanics of particularly the daily mass media, and they are not an expression of the journalist's incompetence or ill will, as affected parties are apt to think. One can simply take a statistical view of media errors and try to keep them at a reasonable level and then, as the New York Times does, correct them in the next print-run or issue, or the next refiling of a web story.

A scientific text passes two portals: it must pass a peer-review by other scientists before it is printed, and after it is printed, it should be subject to post-controls, usually replication per-formed by colleagues in other laboratories. Texts in journalism need to pass only one screening point manned by superiors in the home editorial office. The bosses may let material from their most experienced journalists pass without review; this is not an entirely safe practice. We all have bad days when we can use help.

An internal public opinion makes itself felt in the editorial offices and the studios of the mass media. It reverberates easily through the typically open editorial landscape of news desks. It affects the process of news selection and presentation. The amount of self-censorship is considerable (Zetterberg 1992). More than anything else that I can imagine, research into the opinion climate of editorial offices would illuminate the mechanisms of media power. What we have so far of penetrating insights into this milieu comes, not from social research, but from thorough American court proceedings in connection with libel trials, such as Westmoreland versus the Columbia Broadcasting System and Sharon versus Time (Adler 1988). The title of Renata Adler's book is *Reckless Disregard,* an apt indication of the opinion climate in the editorial offices at the time of these events. Who dares to make a scientific study of what is it like at the time of other events critical for a medium and its victim?

## A Monopoly

### Restrictions at the Gate

Through their professionalization, journalists have acquired a monopoly that gives them the power to decide how to utilize space, particularly in *one-way* mass media, such as an established newspaper, magazine, or TV-network,

A one-way medium, provides a monopoly area for its functionaries. An ever so qualified MD cannot write about health issues in his morning paper; at best, a medical reporter interviews him. The same may be the fate of a celebrated environmental scientist. Not only are the elites in the realm of science kept out of the monopoly space of journalists, but also the elites from other realms. A powerful business executive is not allowed to write about his or her branch in a major paper in a Western-style democracy. A business journalist does the writing. The latter may, if luck prevails, interview the most knowledgeable executives. The most knowledgeable military officers do not present the war news, a war reporter does. The public may write to the editorial dustbin of opinions called "Letters to the editor." Here readers can take the initiative to bring matters that are close to their hearts to public attention. However, also at this page, a journalist keeps the gate, admitting some letters and keeping others out. The same is true for op-ed pages; journalists, not outside experts, are the gatekeepers.

## Restrictions inside the Gates

There are restrictions that professional journalists accept for handling their monopoly-type control of space in news media. As professionals, journalists are expected to respect certain rules, for example:

Four norms rule the daily work of a professional journalist: (1) "Be as objective as you can!" It is difficult to stem all your biases and your own philosophy of life, but you can approximate this goal. (2) "Be balanced!" Let all sides of a controversial issue be heard, not only one. (3) "Be fair!" Be honest and not misleading about ideas, persons, and practices with which you (or the opinion climate in your editorial office) tend to disagree. (4) "Accept and publish corrections" from those in the know.

The first and third norm are found also among scientists, and set principles that are honored in academic circles.

The second norm presents news media with almost unsolvable problems. This norm tends to give lay views on an event or an issue the same voice as expert views, and minority views the same attention as majority views. Moreover, it runs counter to the dictum of effective mass communication, i.e. to tell one story at a time under one heading and to stick to this chosen editorial angle.

The fourth norm is the same for journalists and scientists. Scientists accept corrections more easily, since this adds to their ranking in citation indices. Journalists seem to have many more ways to say that a publication of a correction is unnecessary.

## Working with Tracks and Frames

A story dubbed "Climate-gate" by skeptics to global warming emerged at the time of my preparing the first version of this text for publication. Hackers had found about ten years of research data with long-term temperature measurements at the Climatic Research Unit (CRU) at the University of East Anglia, using a Russian server. They put the researchers' emails and data on the Internet for all to see. This material was confirmed as genuine. Let it be our illustration to news presentations. News presentations are very different from presentations of discoveries at scholarly conferences and in science journals.

The emails revealed CRU's routine treatment of raw data from time series of temperature. They told about excluding reports from stations judged as less relevant, and the use of proxy data such as annual tree rings in lieu of lacking thermometer readings. Such procedures are accepted in science, but require consistency and full transparency. Needless to say, one should not have to wait for hackers to provide the latter.

Some emails also contained belittling remarks about colleagues who had reached different conclusions from their climate research than had the CRU. This is not unusual in any conversation among scientists. The emails revealed attempts to prevent reaching print in peer review journals, what the CRU leadership considered as misleading conclusions by opponents. Such is the backside of the nature of peer reviewing, to keep bad science from being published. There were also emails calling for the erase of past emails, perhaps so that they would be unavailable to journalists or adversaries under the British Freedom of Information Act. An effort to clean out from the Wikipedia some conclusions about the warming of Europe in medieval time was also mentioned in the hacked documents.

The flow of news at the time was full of stories about global warming caused by emissions of carbon dioxide from fossil fuels. A UN conference in Copenhagen on climate change was to take place a few weeks later. The CRU had had a big hand in reports from the Intergovernmental Panel on Climate Change (IPCC) sponsored by the United Nations that a man-made global warming was under way, and that its main cause was human emission of carbon dioxide. On these reports, the UN conference in Copenhagen should base far-reaching and expensive decisions for the world community. It was impossible for mass media to ignore "Climate-gate."

Some tracks available to editors to tell about Climate-gate are listed here. They make up a long menu.

1. Editors of mass media are accustomed to report law breaking, and one of their first impulses in presenting Climate-gate was to take the crime-track and tell about a crime of hacking. HACKERS STEAL DATA ON CLIMATE. Media accustomed to support claims of the UN climate panel apparently continued the mention of stolen data also in their further reporting on Climate-gate.
2. Cheating in research is not necessarily a statutory crime. In most instances, it is a matter for the discipline of an academic community. Universities and other academic institutors are fully capable of closing careers of cheaters. Some distortions by scientists are probably unconscious. Media are accustomed and prepared to report wrong-doing and crack cloaks of secrecy.[5] Some announcers about Climate-gate on a television channel said SCIENCE FRAUD? – with a barely audible question mark. Hints of research fraud were subsequently used as a track among climate skeptics, the underdogs in climate debate at that time.
3. Some mass media have special editors for science news. They could take an intra-science track of scholarly self-correction.[6] SCIENTISTS CALLED TO REANALYZE CLIMATE DATA. The British Guardian was one of the few dailies with this track.
4. Many media took the Climate-gate story as a partisan attack in the ongoing debate over the extent of and response to man-made global warming. Editors know that swords crossed are more interesting to readers and viewers than are brotherly consensus. It had been known over several years, namely that Western journalists (more than the public) favored $CO_2$-reductions to cope with global warming, Nevertheless, their professional journalistic instinct remained that controversies should be publicized. Their track then became THE SKEPTICS HIT BACK.
5. Many media took a track to focus on the political consequences of Climate-gate. Would it affect the outcome of the big United Nations summit on climate? CONTROVERSY HITS COPENHAGEN CONFERENCE. As it turned out, only the spokesman from Saudi Arabia cited the hacked data to deny

global warming. Nevertheless, it remains likely that several other delegates came away from Copenhagen and Climate-gate with a dose of disbelief in the UN reports.

6. Finally, it is always an attractive track for editors to personalize a news story. CLIMATE PROFESSOR TAKES TIME OUT. There were calls for Professor Phil Jones, the head of CRU, to resign. He did step aside during the official British inquiry that eventually cleared him from wrongdoing.
7. The whole set of stories on Climate-gate generated numerous comments, news analyses, and editorials attempting to assess the consequences of the event for the scientific status of climate research, the veracity of IPCC reports, the competence of United Nations to cope with climate change, and the future relations between rich and poor nations. My own hope is that the rhetoric of man-made global warming may have taken a good step away from the influence of the false fourth principle of magic[7] that makes us believe that behind everything that happens in the world is always a being, and not a force of nature or a spontaneous social order.

Media researchers will undoubtedly analyze Climate-gate both for the content and the statistics of these and other tracks of reporting. Media editors are not unfamiliar with battles for recognition among large research organizations; such battles become news and the parties are usually eager to tell their sides to the media. The availability of multiple tracks in Climate-gate made it possible for a majority of editors to brush over issues of misleading research reporting and of bias in research publicity.

To the insiders in an editorial office, the chosen track, "the angle" signaled by a heading, is a conscious device to help the audience to get a grip on a story. At the same time, the chosen perspective greatly influences how the media audience perceives reported events.

The choice of a track is an important source of editorial power. It structures the public's conversations about events. PR-agents hijack this power when they spread stories in the media with tracks that put the (wrong)doings of their clients in a most favorable light possible.

## Frames

The many tracks in mass media can be sorted in a smaller number of so-called "frames." They are recurrent models for presenting news. Using codebooks of Pew Foundation researchers, we can label the seven tracks we illustrated about Climate-gate.

Tracks 1 and 2 are so-called Wrong-Doer Stories, 3 is a Straight Story, 4 is a Conflict Story, 5 is a Conjecture Story, 6 is a Profile Story of a Newsmaker, and 7 are several so-called Reality Check Stories.

The 'frames' in journalism correspond roughly to 'plots' in the study of folklore, for example, they resemble the 31 plots that make up the total of Russian fairytales that Vladimir Propp analyzed.[8] Frames do not qualify as "the present standpoint of science." Frames are simply ways of storytelling, some of which can be called scientific; most of which are irrelevant in scientific discourse.

One frame of the above selection qualifies as social science. The Straight Story conforms to one of Kenneth Burke's discoveries.[9] It is worth repeating in the context of journalism that the question openers — what? who? how? where? when? and why? — prompts us to describe each separate aspect of a social event: the acts, the actors, the means, the scene, the time, the motivation. Burke discovered that together they provide a full account. None of these six questions can be omitted if the description shall be exhaustive, and to add more questions adds confusion rather than illumination (K. Burke 1945, xvii).

Many other frames, more or less consciously used in journalism are simply effective ways of telling stories, including lies.

## Two Specialties of Journalism

### Cracking Secrets

Scientists and journalists are different also in their priorities. This difference is visible in the semantic square of Knowledge versus Ignorance.[10] Scientists focus on the vertical axis; they hate *ignorance* and want to replace it with the present standpoints of science. Journalists focus on the horizontal axis; they hate *secrecy* and want to reveal deceptions.

There is much to do along the horizontal axis. For example, we know that "persons are inclined to act to restore their customary evaluation by anything available in their repertoire of actions."[11] Journalism is an organized way to expose them. The mind of a good investigating journalist is always set on "the power and the lie," to quote the title of the autobiography of a famous Swedish TV-journalist (Ortmark 2013).

American journalism developed "muckraking" in the late nineteenth century in a magazine called *McClure's.* One of its journalists, Lincoln Steffens, collected his exposés in a book (The Shame of the Cities. 1902/1957) revealing misuse of power, lies, and corruption of the high and mighty. Journalism is not immune to swings of fashion, and after the exposure of the Watergate scandal in Washington under President Nixon, the muckraking tradition confirmed its place of the highest regard in journalism.

A search for scandals and for opportunities to scandalize people is central in the modern media world. In the previous Volume of *The Many-Splendored Society,* we studied victimization and redemption. The sad fact the highest feat of journalism has a back side of potential ostracism.

Editorial offices feel strangely elated when they have competed in bringing a victim down, be he or she highbrow or lowbrow. Middle-brow victims seem to be harder to hate, and harder to enjoy seeing falling, both for the persecuting journalists and their audience. Our conclusion remains as stated:

When mass media publicize a person as a failure or deviant, the editors and their audience are fueled by needs to restore or enhance their own self-esteem and to uphold the order that upholds society. The acting of the journalists is lubricated by appeals to constitutional liberties allowing them to investigate, ostracize and victimize the powers that be, by references to the public's right to know. In fact, the journalists officiate in ancient and often murky rituals with vocabularies of ostracism and redemption. Sadly lacking in both classical scholarship and modern social psychological education, journalists are often not aware of what they do in their "drives."

The revelation of secrets in high places is not the only *raison d'être* of journalism.

There is a German tradition of journalism and media that regards their ultimate task to be to convey a *Weltanschauung* — a philosophy of life to the audience. When Karl Marx was editing his *Rheinische Zeitung* and later, as a part-time London correspondent for the *Herald* in New York, he saw his task in this light. Generally speaking, newspapers speaking for and selecting news to promote a single ideology obtain smaller circulations than those with more general content. An editorial and an op-ed page yes, but not a whole paper promoting a philosophy of life.

A British tradition of journalism thrives on telling its stories dramatically. That means news or reportage with intrigue, drama, be it tragedy or comedy, and a sense of immediacy and presence. This tradition has a form close to literature,[12] but it is strictly non-fiction — as is science.

## Publicity Rewards and Punishments to Societal Realms

What we had said about journalism so far does not seem to qualify more for our social theory than any other profession. But one thing about journalism is unique and makes it especially relevant to our study of the many-splendored societal realms.

Journalism lights the way for the stars and heroes, the successful in all societal realms — the body politic, the economy, morality, religion, art, as well as the stars of science — and for life areas, such as entertainment, tourism, sports, family events, and social life. Publicity is part of the reward system of the stars of all social realms. The stars, thus, make the most of journalists. The journalists, in turn and usually without mercy, take ad-vantage of their contacts with anyone who happens to have stellar or demeaned names and/or have records of high ambitions or disgraced records. Journalists are exploited, and they exploit. However, their work as controller of an important part of the reward systems of the different realms may even push the stars to a life in the margins of society.

A journalist's life is tough when involved in cracking secrets and handling publicity reward and punishments. There are days when interviews are refused and phone calls not answered. The public image of a "hack" has rarely been flattering.

A strong collegial spirit among journalists compensates the threatening marginalization. To obtain due appreciation, journalists do not normally turn to their readership or audience, or to their board of directors, nor to the objects of their investigations and interviews. In old days, they had late working hours, and like typographers, were forced to spend time with each other when others socialized. They turned to each other — even in recent days they often marry within journalistic circles. In other words, they usually produce with an eye to their colleagues. It is satisfying to journalists that their stories get into print or on the air immediately. It matters less that surveys show that readers and viewers just as quickly forget most of what mass media publish. Likewise, that many rankings of professions by pollster show that journalists come close the bottom in inspiring confidence among the public.

Informal, honorific reward systems usually exist amongst the staff of an editorial office. Honor to a fellow journalist comes from having many contributions flashed on the front page or in the introduction of a newscast. Such phenomena are unknown in the reward system of science.

## Handling Priority Honors by Journalists and Scientists

There is a big market for news and features, unknown to most readers and viewers. This makes for a difference between the reward system of journalism and that of science. Journalists can claim intellectual property rights, copyrights, for their products. Free-lance journalists survive on this market by selling what they create and own. The copyrights of employed journalists may be routinely assigned to their employer-media in return for salary and support, but they may be activated when texts or photos are resold to other media. With a good employment contract, a journalist hired to work in an editorial office may, then, share in the proceeds.

As we have noted, a scientist, by contrast, sacrifices economic gains from his discoveries and analyses in return for the honor of being formally remembered as the first who identified and understood their importance. When using previously published material about a discovery, it is not required in journalism, as in science, to give credit to the original authors by name and reference. Journalists may have bylines so that they can build personal reputations, but they are not usually cited by other journalists who subsequently build on their stories. Articles and photos in media from news agencies are required to be identified as such. There is also some willingness to mention the source in the form of another mass medium. But the original journalist in the latter is more rarely mentioned by his or hername.

## Mutual Exploitation and Corruption

Journalistic practice has the power to seduce and corrupt science and scientists. It does make a difference to a scientist when major media publish his findings and when small peer-reviewed journals of his specialty publish them. The latter is most prestigious in the scientific community, but the former attracts more attention and fills the minds of many people and of the scientist himself or herself.

Scientists and journalists, who leak scientific findings in mass media prior to normal publication with peer reviews, tend to forget that even the latter publication is a preliminary suggestion that it is an addition to "the present standpoint of science." The full acceptance of a scientific finding comes not until it is replicated and has been used by other scientists. Such things, of course, are of little interest when journalists in mass media decide their menu of daily news.

One should be routinely skeptical of scientists who spill findings to the mass media before they have been accepted for publication in their own journals. At the time of this writing, such leaks to big media, concerning threats to health and the environment, are common. When editors in the mass media uncritically exaggerate these leaks, we see a self-serving relationship between scientists and journalists similar to corruption between businessmen and politicians.

Editors of scientific journals are supposed to act as scientists. In fact, they are easily influenced by journalistic ideals. They prefer articles showing change ("news") of established positions of science, over replications that confirm what has already been published. This clearly violates the scientific norm of the necessity of replications. More on this in our section on Meta-Analysis.[13]

## Getting Science Right in the Media: The Alar Scare

Alar, the commercial name for the growth hormone daminozide, is used to keep apples on trees for a longer period of time in order that the apple growers have more time to harvest the apples.

In 1973, the Journal of the National Cancer Institute reported that Alar caused cancer in mice. By 1986, a broad concern regarding the use of Alar on apple trees had spread throughout the US. There were grave concerns that the remains of chemicals in fresh apples, apple juice and apple sauce could damage humans. The outcry resulted in some major food stores announcing that they would not accept Alar-treated apples. The Alar Scare and similar events mobilizing the American public to promote change are reviewed by Charles T Solmon and his co-workers at Michigan State University (Solmon, Post and Christensen 2003).

The Environmental Protection Agency (EPA) remained skeptical — concentrations of numerous substances cause cancers in mice

— and did not prohibit this chemical. But in 1987 a group of citizens comprised of pediatricians and lobbyists sued EPA in the courts for not prohibiting Alar. They wanted, in other words, to apply their own laws, when it comes to determining what comprised cancer-inducing consumption. Their ads showed the figure of a skull placed on top of an apple.

Time Magazine had placed a broad, black line over an apple on one of its cover pages which reminded one of ”No Smoking” or ”No Parking” signs. In February 1989, Meryl Streep, the brilliant actress, became spokeswoman as regards the Alar Scare and testified before Congress in Washington D.C. The influential TV program, ”60 Minutes” broadcasted two programs about the danger of Alar.

Well, such is the way news editors often react. One begins and the others follow suit without having or taking the time to make a further investigation of the issue. After the TV programs in 1989, however, the Environmental Protection Agency (EPA) also gave in. The US determined to prohibit the use of Alar on the grounds that the risk of ”long-term exposure” could result in ”unacceptable risks for the health of humans”. This was a total victory for the activist groups and their social marketing campaign. In June 1989, Uniroyal, the only manufacturer of Alar, decided voluntarily to discontinue all domestic sales of Alar for use in conjunction with foodstuffs.

Convincing, scientific evidence of the risk of cancer and careful, exact calculations of the limit in terms of risk-filled consumption of Alar-sprayed apples had not this time been a part of EPA's documentation and assessment. The apple growers could, with time and through expensive contra-campaigns, show that the EPA's decision was incorrect. An organization, also functioning as a lobby, by the name of the American Council on Science and Health (ACSH) worked diligently to change the public's perception of Alar. Towards the end of the 1990's, they had won. The New York Times and some other newspapers had to get on their knees and admit their mistake. The TV companies' denials were less visible to the public. But the term ”Alar Scare” lived on in the Americans' memory and reactions at least for a couple of decades, and was used as a warning signal in the evaluation of news trends.

The Alar Scare has an important byproduct in the form of a sense moral. Stop romanticizing the campaigns of civil society! They do not automatically contain truth just because they have arisen in the civil society. Remember that a scientific ethos is skepticism: always be skeptical as regards over enthusiastic or ”dooms-day-pronouncing” scientists. Journalists and their editors can certainly learn to avoid Alar Scares, whenever the practice and the economic health of their medium provide resources for a routine checking of sources. When the protests of civil society provide grist precisely to their mills, politicians have, of course, more difficulty in refraining from agreeing in public with the current, popular interpretation. Still, the ideal politician and civil servant, does it even need to be said, do not allow themselves to be heated up by the media but first listens to various experts and then, later, make their assessment.

We have written about other aspects of journalism in other volumes of *The Many-Splendored Society*, for example, on choice of vocabulary in presentations,[14] on structural conditions of mass media,[15] on justifications to publish, for example on privacy,[16] and on promotion of general equality.[17]

## Notes to Chapter 25, Journalism and Science: News and the Cracking of Secrets

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[1] (Vol 2) An Edifice of Symbols, 2nd edition, chapter 8, Organizations, Networks and Media: Media

[2] Ch 19 (Vol 4) Finding a Modus Vivendi and Ethos of Science: European Doomsday Science and Its International Bent, p 60ff

[3] Ch 20 (Vol 4) The Contemporary Pursuit of Science: Secrecy in Research to Protect Personal Integrity, p 84ff

[4] Ch 25 (Vol 4) Journalism and Science: News and the Cracking of Secrets: A Monopoly: Working with Tracks and Frames, p 198ff

[5] Ch 20 (Vol 4) The Contemporary Pursuit of Science: Secret Knowledge, 81

[6] Ch 22 (Vol 4) Stratification and Rewards in Science: Research Reporting: A Self-Correcting Spontaneous Order, p 117ff

[7] Ch 3 (Vol 1) Language and Its Distortions: Five Principles of Magic, p 107

[8] Ch 5 (Vol 1) Linguistic Forms and Usages: Freedom in Social Reality, p 188ff

[9] Ch 5 (Vol 1) Linguistic Forms and Usages: Descriptive Dynamics, p 199ff

[10] Ch 20 (Vol 4) The Contemporary Pursuit of Science: Figure 20.1, p 85

[11] Ch 5 (Vol 1) Linguistic Forms and Usages: Evaluative Dynamics, Proposition 5:5, p 293

[12] More on this in Part 1 of The Pursuit of Beauty, Sacredness and Virtue, Volume 5 of The Many-Splendored Society

[13] Ch 22 (Vol 4) Stratification and Rewards in Science: Distortions in the Realm of Science and its Meta-analysis, p 118

[14] Ch 3 (Vol 1) Language and Its Distortions: Vocabularies with Meadian and Saussurian Symbols, p 96

[15] Ch 7 (Vol 2) Leadership and Collectivities: Media, p 146ff

[16] Ch 12 (Vol 3) Ideological and Universal Justifications: Media Justifications, p 39ff

[17] Ch 12 (Vol 3) Ideological and Universal Justifications: The Swedish Creed, p 63

# 26. Providing a Knowledge Base for Education

Science has its chain of Makers, Keepers, Brokers, and Takers, the functionaries transmitting cardinal values in all societal realms. To develop new knowledge is the main task of the Makers of science. One secondary task is to make sure that this knowledge is taken up in the education of new generations. This requires libraries and textbooks and special teaching institutions, a school system. Universities have tried to implement all these tasks by providing a single place, the campus, where research is done, stored, and taught. Teaching colleges have been attached to universities. From them the Brokers of lower education for children graduate as certified teachers.

## Providing Classical Learning

Around the middle of the 1700s and for more than a century thereafter, the so-called *new humanism* guided the philosophy of education in the German-speaking areas of Europe. A concept of "humanism" was introduced into the school debate by the pedagogical reformer Friedrich Immanuel Niethammer (1766—1848). The new humanists believed that the key to bringing up good citizens lay in antiquity, in the legacy from Athens, Rome, and Jerusalem. Bracing quotations in Latin from the Romans would steer youth toward that which is right, true, and beautiful:

> Whoever, in the manner prescribed, reads the classical authors and also studies the foundations of mathematics, acquires a disposition to differentiate the true from the false, the beautiful from the distorted; his memory is receptive to pleasant thoughts, he becomes adept at grasping the intents of others and at skillfully expressing his own, he acquires many good maxims to improve his reasoning and will.

Thus wrote a pioneer of humanistic pedagogy, Johannes Mattias Gesner (1691 – 1761), as quoted by Sjöstrand (1954, 186).

Professors in the new discipline of pedagogy did maintain many ideas from mediaeval schoolmen, and they wrote learned volumes and encyclopedias about classical heroes and events, and were explicit about the wisdom that youth could obtain from studying them. These professors were themselves "learned," and wanted their students — at least those who continued their education beyond the elementary level — to be "learned," i.e. with an ability to read texts in the original Latin and Greek, and sometimes, particularly if they aspired to the clergy, in Hebrew as well. The model for a growing interest in virtues of citizenship was to be found in antiquity, in antique heroes and in Christian saints, not in the present.

Few humanists opposed this view. The celebrated Friedrich Schiller (1759 – 1805), at several points, called for a more realistic approach to the classical world, an *Entzauberung*, a programmatic disenchantment with antiquity. The term Entzauberung was later made fashionable by Max Weber who extended it to include the replacement of all old beliefs — magical, aesthetic, moral — with rationality and with the present standpoint of science.

The attempt to offer generations of youth ideals and "significant others"[1] from the classics ran out in the sand. Wilhelm I, the nationalistic German emperor, declared in 1890 at a school conference which he himself had initiated: "It is our duty to educate young men (sic) to become young Germans, not Greeks or Romans." In our days, Entzauberung erased also German nationalism.

## Providing a Whole View of Culture by Great Books

After World War II, educational systems in many countries favored early specialization. That which had formerly been called *studium generale,* "general studies," and which preceded occupationally geared studies, was accordingly cut back.

A heroic attempt to re-establish general studies with a new (or rediscovered) pedagogy was made at the University of Chicago, a private university. Its *studium generale* was a set of courses in certain subjects all having a tradition of basic research. In small, compulsory seminars, all freshmen read, discussed, and analyzed the most important original works in philosophy, physics, history, and social studies. The aim was not that the students should learn about the entire series of "Great Books" chosen by Robert Maynard Hutchins and Mortimer Adler. Most of the 54 books were works in Western humanism from Homer to William James in their original (but if necessary translated) versions. Some original scientific texts by Aristotle, Newton, Huygens, Lavoisier, Fourier, Faraday, Darwin, Marx, and Freud were also included. Rather, the goal of the seminars was to develop critical thinking, not only through exchanges with fellow students and teachers, but also by virtual exchanges with the pre-eminent thinkers of the Western world.

Different and sometimes watered-down versions of the Chicago model of "Great books courses" soon came to Columbia, Harvard, Yale, and Brown, and to other colleges and universities in the United States with ambitious undergraduate programs. Most of these programs have been met with declining interest, and have waned in importance. They have suffered from some students' desires to choose easier courses, and their contents became subject to criticism by feminists and multiculturalists as an ultimate bias and celebration of Western white males.

I would think that any many-splendored society would benefit from a splendid education based on a balanced selection of great books on its college curriculum. At least in the social sciences and humanities, the present generation cannot command a scholarly field from its latest textbook.

## Providing Enlightenment by Schooling

The Enlightenment ushered in the idea that schools ought to be in the service of scientific knowledge. The main purpose of schooling was no longer the inculcation of general virtues, religious beliefs, artistic taste, political or administrative skills, or the practices of commerce. Their first duty was the dissemination of the current standpoints of science and technology. This is a narrow idea; it includes public health but not public culture.

With the Enlightenment, however, the perspective of education in Europe and America was shifting from an emphasis on the concerns of religion and of the state toward a fast-growing, increasingly autonomous pursuit of knowledge and technology on scientific grounds. Gradually, living languages crowded out classical languages in the school curricula. Physics, chemistry, biology, and mathematics crowded out many school hours of philosophy, religion, history, and literature.

The German *Realgymnasium*, assigned natural science and mathematics a special curriculum in secondary education, leaving the traditional classic *Gymnasium* curriculum relatively intact and able to cope with the considerable advances made in the humanities. Just as many European countries had copied the Humboldtian university, they also introduced the Realgymnasium curriculum as an alternative in secondary education.

The Enlightenment's view of education was not entirely materialistic. The tasks of schools — irrespective of the subject — was not only to impart knowledge, but also to train students how to search for truth and understand the approach to life of the subject matter studied. Schooling should not necessarily be dependent on the prospects of getting a good paying job or prestigious position after graduation, even if the latter were welcome and viewed as natural results. The ideal was that schools would provide an exciting place for serious young people to develop their intellect. Without personal intellectual development, a pupil or student — or a teacher — would find life rather boring. An insight or a personal discovery can turn a grey day or sleepless night into a joyful experience.

Realization of the educational ideal of imbuing schools with learned content and ideals from the realm of science has been frustrating. School education has unintended consequences. The first consequence that one thinks of is how education imparts knowledge and skills to the total society. It is, of course, false to think that the dissemination of knowledge brings with it only that which is good for society. Extended education has also given us more well-educated criminals who know a good deal about law, about the chemistry of making bombs and about hacking computers.

During the two hundred years that the Enlightenment has been with us with some force, the Western world has seen many highly educated individuals — some even well-known participants in public service and public debate — who have been charlatans or almost charlatans. Without incurring personal risk, they have mixed proven and unproven ideas, without clarifying the difference. What they express as "politically correct" or "correct in polite society" — or any publically applauded consensus in a certain period — is not necessarily "scientifically correct" on the basis of the criteria of the present standpoint of science. What is religiously correct about diets and about cows in the city streets is not necessarily correct in the science of public health. What is morally correct about prostitution, or sexual relations generally, is not necessarily correct from the point of view of the life sciences with their knowledge of inherited sexual preferences.

One must remember that "the current standpoint of science" is a movable landmark. At the time of this writing, some views on significant causes of climate change actually seem to move from having been proposed as scientifically correct to be primarily politically correct; windows seem almost closed to possibilities of their corrections into new standpoints of science.

Minerva, the goddess of science, is strict and demanding in her sphere, but she has not been overly successful in enforcing her rules in public and private life.

## Providing Applications to the Social Sciences

In a book dealing with societal realms such as the one you now read, it is of particular interest to look at the sciences that specialize in particular realms, for example, economics, political science, and theology.

To a considerable extent, economics is an applied science centered on the goal of a sustainable maximization of the cardinal value of wealth. Looking at the micro-level of encounters, the economists who are followers of Leon Walras' general equilibrium show how prices transplant and travel through networks of markets manned by Brokers, accumulating increasing wealth. Looking at the macro-level of total societies, Schumpeterian economics shows how wealth grows by investments in and by the activities of entrepreneurs (Makers). Keynesian economists, among other things, show how wealth grows by the presence of well-heeled consumers (Takers) willing to spend.

In many modern countries, a number of economists act as the self-appointed priesthood of the market economy. When someone mentioned "economic science" or "political science" to the great Chicago scholar Edward Shils, he sometimes quickly retorted, "You mean science in the same sense as Christian Science." He had noticed that many economists proposed a belief system about the perfection of humanity that they confused with the perfection of capitalism, or political scientists confused their belief system with the perfection, say, of American-style democracy.

Political science has fewer theories with the formal elegance of economics, but it has a good body of non-mathematical theories. The cardinal value of the body politic is order. Some political theories have assumed that achieving and maintaining order in society is best served by "republicanism." Republicanism stands for a non-hereditary rule, stressing the power and the civic virtues of citizens. We began our writing of *The Many-Splendored Society* in this tradition by sketching such an order of the ancient Roman Republic.[2] Recent political theory assumes, with John Locke, that "the consent of the governed" (of which Takers usually have the majority) is a most efficient means of achieving and maintaining order. Both these traditions of thought have led a number of political scientists to act as a self-appointed priesthood of democracy. To be bishop in the church of democracy is certainly an honorable profession, but it should not be confused with the role of a scientist.

Theology can be a pure science of religion. However, nearly always throughout its history, its practitioners (Makers, Keepers, Brokers, and Takers) appear as partisans of a specific religion.

There are helpful basic research and confirmed theories about the economy, the body politic, and religion. However, most research in these fields is applied; the vision of economists and political scientists is narrowed to the concerns of wealth and order, respectively. Economics and political science cannot fully account for a many-splendored society having cardinal values, other than, and in addition to, wealth and order. Economists and political scientists have little of significance to say about the nature and growth of knowledge, beauty, sacredness, and virtue. Theology which can say something about sacredness is also mostly applied, used to train clerics, be these Brokers rabbis, priests, or imams, who are to deliver divine messages to their congregations.

Wherever we turn in the social sciences, there is more applied research and applied knowledge than basic research and generalized knowledge.

## Providing Scientific Knowledge to Functionaries of Other Realms

In China, Confucianism joined the efforts of acquiring knowledge with the administration of order in society. The result was a system of literati who were certified by scholarly examinations to serve as government officials. The absorptions of literati by the state were, at least occasionally, so deep that one can talk about an attempted merger of Chinese science and polity.

In the West, Napoleon's, Humboldt's, and later Kerr's type of university assumed the privilege of educating leaders for the various realms within modern society, not only the polity.

During the time of feudalism in Europe, the political elite had been educated through the practice of allowing selected young men to attend the court. During the time of the guilds, the economic elites were recruited through the practice of selecting men to serve as apprentices to a master. This was characteristic of the universities that were reformed or created in Napoleon's and Humboldt 's spirit; their open admissions, not only reproduced and renewed the academic elite, but also educated almost all other leaders of society. In the twentieth century, a university education remained of limited or no significance only for the recruitment of trade union leaders, stockbrokers, and pop singers. In all probability, however, a central zone of a modern society functions best when its members are educated and share a similar symbolic environment, with roots in university campuses.

University researchers would probably become more effective scientists if they did not also have their teaching function. However, in such a case the universities would lose in the balance of power in society. As long as an academic meritocracy is accepted for the recruitment of political, economic, and other elites, the professors can assert themselves, not only within their own territory, but also in relation to politicians, entrepreneurs, and other elites they may have educated.

My forecast is that the universities, as we know them, will eventually lose their position as spindles in the societal realm of knowledge. As knowledge grows, the pressure for a division of labor will be too great. The research university was an efficient structure when less than three or four percent of young men and women of each generation attended university. When 30 or 40 percent attended, as took place in many countries after World War II, this structure became less efficient, less appropriate for both research and teaching. In the United States, volumes of teaching take place in community colleges where faculties have little or no pressure to continuously publish research. In Germany, volumes of advanced research are located in Max Planck Institutes. In the twenty-first century, a bifurcation is emerging of universities, on the one hand, into colleges for advanced mass teaching with a scientific outlook, and on the other hand, into research centers of excellence with or without graduate study.

There are also other ways, in addition to neglecting teaching, for the benefit of research that can cause universities to lose in the balance of power. Max Hortheimer (1937) observed that students and professors had a simple choice as scholars: either to search for an understanding of things as they were, or to be critical of them. He argued forcefully for ”critical theory” in philosophy and the social sciences. When some university institutions became, in practice, outposts for radical political movements — as was the case in much of the Western world around 1968 — a number of talented students were attracted to the radicalized institutions. Others, equally bright, bypassed such institutions. Fed up with the radicalization of campuses, they dropped out of their universities.

When, in Sweden in the 1990s, I first wrote down these thoughts about universities, some of the conservative dropouts from universities with campuses and faculties steeped in the 1968 mentality, had been recruited to become prime minister, minister of education, and editor-in-chief of the country's largest conservative newspaper. The lesson for the universities involved may be: if you want to be relevant for the total society, you should stick to the search for truth, critical or not, and leave the organization of activism in the realms of power, money, and welfare to others. So-called "critical studies" — being critical of current knowledge *and* critical of current shapes of societies — are welcome, but universities should not give tutoring and degrees in activism as such.

## The Certification Game

Applied scientific knowledge becomes more permanently integrated into the social structure through courses leading to a written document assigning recognition of competence, or providing *certification* to practice, in branches of applied science. Such certified know-how has become a pre-requisite for an ever increasing number of jobs. Most students in advanced societies seek to qualify for such recognition after completing compulsory school, in order to enter into a wide range of occupations. An increasing number of new and old non-academic jobs are certified in advanced countries. They may be cooks, electricians, welders, barbers, beauticians, pediatricians, managers of old-age homes, animal wardens, security guards, et cetera. Certification is provided by the state, or by industry organizations. Lacking that, some independent schools provide special diplomas. In earlier days, only the traditional academic professions, such as priests, jurists, accountants, physicians, engineers, and teachers, required such certifications.

The certified are *technocrats*, a word that is not synonymous with engineer. Technocrats have specialized knowledge; they have become the group in society administering production, caring, teaching, and communication. They have taken over more and more from the bureaucrats, who are the agents of the leadership's ubiquitous desire to govern and control. Among the latter, we find the officials of the state and local authorities, the ombudsmen of organizations, and the head linemen in companies. They ground their thinking in the instructions of the powers-that-be. Ultimately, these grounds may be decisions taken by governing boards, resolutions passed at a congress, or other authorities. The technocrats, on the other hand, may justify their positions on the grounds of reason and facts, acquired as a result of their special competence and schooling.

A technocrat wants to be able to question whatever he considers to be superstition within his area and therefore requires freedom of expression. Bureaucrats in administration, on the other hand, argue only in terms of the goals that their superiors have established; moreover, they are apt to regard freedom of expression at the workplace as nothing more than an annoying factor.

In many areas in democratic states, the liberation of the technocrats from the bureaucracy of the powers-that-be has been evident. However, in authoritarian and totalitarian states, the process is constantly threatened by one of the key characteristics of Stalinism: the subordination of technocrats to the bureaucrats of the political administration.

Are the schools for young people steered to a greater or lesser extent by bureaucrats (school authorities) than by technocrats (teachers)? The answer suggests a paradox. The very system of education that has transformed larger segments of the total society from bureaucratic rule to technocratic rule is, itself, often ruled in painful detail by a bureaucracy!

# Notes to Chapter 26, Providing a Knowledge Base for Education

[1] Ch 15 (Vol 3) Self-images: Multiple Selves, p 102ff

[2] Ch 1 (Vol 1) The Losing Spell of Augustus: Gaining Hegemony, p 11ff

# 27. The Use of Patents

## Legislative Links Between Knowledge and Money

Legislation about immaterial properties such as engineering patents and artistic copyright represents a great invention by Western jurisprudence, a genuine contribution of the body politic to the realms of science, art, and economy.

As we have repeatedly underlined, a scientist relinquishes the property rights to his work when it is published in a scientific journal. There is an exception to this rule. A temporary property right can be granted in the form of a patent. The remarkable social design of the patent expands the public knowledge in some sciences into economic pursuits. Outsiders may share the advantages of this knowledge by obtaining a license from the owner of the patent.

Patent rights and other intellectual properties are legal products of special interest to innovative persons and their settings in society. Some such critical positions in society are mentioned in Proposition 10:8, reproduced here.* For the study of patents, we should focus on Makers of knowledge and on their Procurers in the economy. For the study of copyrights, we should focus on Makers of artistic beauty-et-cetera and their Procurers in the realm of arts. We locate them in Rows N and S in various tables in our presentation of societal realms[1] and also in The Periodic Table of Societal Realm reproduced above.[2]

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* Proposition 10:8 recalled. *Grand Functions of Societal Realms:* Over time, any societal realm of society tends to receive (a) four internal positions: those that create, preserve, distribute, and receive its cardinal value. These are manned by 'Makers,' 'Keepers,' 'Brokers,' and 'Takers,' respectively. Furthermore, any societal realm tends to receive (b) two external positions: those that export its cardinal value to other realms and those that import alien cardinal values from other realms. These are manned by 'Providers' and 'Procurers,' respectively (2: 183-184).

In advanced countries, it is possible to patent genuinely new industrial advances of production, products, or processes. To begin, a patent involves *publication* of an innovation, as required in all scientific discoveries. The innovation, henceforth, is no longer a secret, but the patent gives the owner control — a kind of *private property* — of the commercial use of the innovation during a period of time, usually 20 years.

A patent means that the body politic grants actors in the realm of science or technology a right to use an innovation as their private property in commerce that is enforceable in the judiciary. A patent, thus, involves a three-way agreement between these societal realms:

Science ≠≠≠ Economy

Science ≠≠≠ Polity

Economy ≠≠≠ Polity

The sign (≠) used here signals difficulty for these realms to reach a consensus and triple the signs (≠≠≠) indicates considerable difficulty.[3] The current state of general inefficiency and delay in patent procedures may be due to this difficulty.

## The Bayh-Dole Act

Patent rights have proven a most useful legal device to link science and economy, promoting growth in both. Growth in the economy may owe more to technological patents than anything else that the body politic can provide. The US Congress in The Bayh-Dole Act of 1980 brilliantly recognized the importance of patents. It allowed universities and non-profit research organizations, as well as small businesses, doing research under government contracts, to apply for patents in their own name and keep the profits.

More or less watered-down versions of the Bayh-Dole law have been introduced in several other countries. However, the rules for commercialization of inventions by European professors are fragmented; different countries vary in their practices, and even universities in the same country may vary. The general right in Bayh-Dole for a small business to patent work financed by government is virtually unknown in European legislation. The strong socialist political parties in Europe have generally been against any such "give-away" to small business, and big labor unions in Europe have usually distrusted the self-employed and tried to keep them out of benefits, be they welfare programs or other favors.

With or without references to Bayh-Dole, university professors everywhere may see to it that their employment contracts regulate income from patents from their research at the university facilities. For example, at Tel Aviv University, 40 percent of the accrued income goes to the inventor, 40 percent the university, and 20 percent into a research fund.

## Administration of Patents

The administration of the legal device of a patent is, at present (2011 – 12), given low priority by elected politicians in both the United States and the European Union. In the United States, the Patent Office is underfunded and understaffed, and the, of old, frequent phrase "patent pending" indicates delays and backlogs. In Europe, it took a nearly half-century to realize the old dream of an all-European patent, or, at least a common patent for all 27 members of the European Union. It happened in 2012, after incessant delays by commissionaires and national politicians – or more correctly, nationalist politicians, since a main hang-up was the language of the patent text.

Speaking generally, Patent Offices in Europe are manned by careful professionals taking the required time to examine the originality of the claim, and whose verdicts are rarely challenged. To obtain a patent in the United States is easier, but not necessarily a faster process. Here the patent office routinely and quickly approves patents without demanding many specifics. However, in too many cases, a US patent is not fully validated for safe exploitation until patent lawyers and judges have challenged it in the court system. At the end of such a court process, claims for compensation in a US patent suit are normally reduced to a handful of percentage points of the huge amount initially claimed for damages. Still, considering the more frequent court validations, the total cost of securing a significant US patent may be huge compared to securing a European patent.

The cost of litigation intimidates many inventors from defending their rights in US courts. An abnormality of jurisprudence, the so-called "American Rule," dated from post-revolutionary days is still in effect. The Peace Treaty between the Americans and British in 1783 allowed British citizens to come to American Courts to recover what was owed to them from the days America was a British colony. To reduce such claims the state legislatures in the United States were quick to enact laws to the effect that a losing claimant must pay, not only the cost of his litigation as in Britain, but also the full amount of the American defendant's legal costs. This "American Rule" effectively kept out many smaller claims from ever being brought to the courts of the new country.

A US firm that illegally uses a patented innovation can get by without paying a license fee to a poor inventor who cannot afford the risk to seek a court order, since it may cost him/her also the defendant's (bloated) legal expenses. The United States may be the homeland of effective anti-trust legislation, but presumed illegal users of an innovation may long go unpunished while conspiring with one another to refuse to pay the license fees to an inventor who may not have enough money for the hazards involved in seeking remedy from the courts.

## David and Goliath on the Patent Market.

A political scientist, Carl-Johan Westholm, Chairman of the Swedish Inventors' Council, has provided a concrete insight into a cartel problem in the international market for patents. He pleads a case history of a successful inventor's insoluble problem.

If a robber takes money from a bank, the bank calls the police who take over the case and its detective work. If an inventor is losing money to an infringer, the inventor must enlist a lawyer and pay for his work and for the supporting investigations and material the lawyer has to muster in court. In this way, the inventor hopes to recover the money invested in the invention and to collect some profit.

Sometimes, a patent-holder can have more legal troubles the more valuable the invention. An example is the Swedish researcher Dr Håkan Lans, whose navigation system became a world standard for aviation (VDL Mode 4) and mandatory world standard for maritime traffic (AIS, Automatic Identification System). He, personally, borrowed the funds for all research and development, and he and his investors expected that if the system would be technically successful and accepted, it would also be commercially successful. As a result, the investors promised to assume all risks if the technology failed. However, they trusted Dr Lans, and they were right: few inventors can reach world standard, still few, mandatory world standard — but Lans did just that.

After a few years, the manufacturing companies, in particular, one world market leader, refused to pay royalties, arguing that it had been discriminated because some other competing companies did not pay. However, if Dr Lans and the patent-owning company, GP&C Systems International AB, had begun suing other companies for patent infringement, then those companies would readily be able to refer to the market leader, who refused to honor the patent. This was a Catch-22 situation; it is less expensive for large users of patents to pay legal costs, than to pay the inventor, so the inventor is squeezed by a cartel of potential purchasing companies. The anti-cartel laws in both the US and the EU, are against cartels of sellers, but not against cartels of buyers dealing with a single seller.

## Turning Patents into Business

When a patent runs out, the knowledge lodged in the patent is free for all to use. During the patent period, however, the owner enjoys established rights of intellectual property. He can keep the utilization of his discovery for himself, license it to be used by others for a fee, or sell it where patents can be bought and sold, pass it on to heirs, or simply give it away to anyone. Similar rights are given to copyright holders.

Common forms for the exploitation of a patent are to sell or license it to some established and forward-looking corporation that complements or improves its existing or planned production lines. Or, the inventor and patent holder may sell a patent to an entrepreneur who puts it to use in a new business. If no one wants to buy a license, some inventors start a new business of their own to make the most of the patent; they usually have a long way to prototype, production, and marketing, each step requiring more effort and capital than the previous.

A researcher who agrees to work for industry should accept that his research remains secret not only during execution but also for some months after the report is delivered to the sponsors. The latter period of confidentiality gives the sponsor time to decide whether or not it is worthwhile to apply for a patent.

In advanced countries, new firms based on new patents, together with others firms in similar positions can be put in "incubators" run by financial interests with all types of management competence in-house. In these incubators, the budding companies grow until product design, marketing, and sales channels are in place and functioning with enough volumes making the firm and its patents attractive to new owners and investors. The incubators shorten an otherwise long path between invention and market.

## Patents as a Weapon in Business Competition

A portfolio with active license-fee patents can be held, not only by the individual inventor, but on a larger scale by corporations. Such portfolios of patents are essential in much of everyday production that is sold to households, businesses, health services, governments, et cetera. However, in the US some granted patents are so broad that they allow patent holders to claim sweeping ownership to what for several years has been routine business by other firms, or even cover seemingly unrelated products built by others.

In some circumstances, patents are held by a corporation simply to keep the competition at bay, a practice slowing down third parties, economic growth, and the general progress intended by patent legislation. When General Motors went through a reconstruction after the 2008 – 09 financial crisis and a government bail-out of the company, it put its subsidiary Saab on the market to cut its losses and to raise cash. But GM refused a good bid to sell Saab to a leading Chinese auto corporation. GM did not want to see some valuable patent-supported production processes and auto parts in Chinese hands. Its long-term plan was to expand its own production in China, which has the world's most expansive car market in the new century. Instead, it sold Saab to Europeans at a lower price and with restricted clauses about the GM proprietary technologies and auto parts. When the Europeans, in turn, wanted to sell the Saab enterprise to China, GM balked and invoked the restrictive clauses.

The long hand of modern finance has recently also extended its grip in patents. In finance, patents and copyrights are classes of economic assets. Financial firms securitize patents and copyrights, i.e. bundle them to be sold and held as bonds. This may be a growing market, at present, without much transparency and regulation.

In the new century, shares of portfolios of patents, like earlier portfolios of copyrighted music, may be held also by private investors, totally unrelated to the original creators, as a class of wealth and as an alternative to investments in stocks and bonds and real estate. Whether this is an advantage or disadvantage to science and art is an open question.

## Patenting Natural Processes and Mathematical Formulae

It was long an established praxis that no patent office could grant exclusive patent rights for two phenomena: laws of nature and mathematical equations. This good praxis is no longer self-evident. Patents are issued for the composition of parts of natural bodily processes, and patents (not just copyrights) are sometimes issued for computer versions of mathematical algorithms.

A process of undermining the very institution of patents is underway in the beginning of the twenty-first century (Loughlin 2008) . Patent rights are about to go haywire due to the rule bending initiated by vested commercial interests. The invaders assume that scientific regularities, such as a part of the genetic code, can be patented, and that such ”property rights” can be defended in the courts. Of course, technologies to identify, measure, and change the genome should be patentable. But should patents be issued of a gene itself, or a sequence of them found in the human body? In fact, at the time of this writing, corporations do have patents to some genes, yours and mine.

In 2012, on the application of Greenpeace, the European Court of Human Rights in Luxemburg[4] overruled the issue of a patent to the German neuroscientist, Oliver Brüstle, who had found a way of initiating the development of nerve cells from embryotic stem cells. This kind of research is not affected by the court ruling. Professor Brüstle is rightly famous for his discovery and he is honored, as such, in the scientific community. However, the court ruling indicated that “on moral grounds” he will not be allowed to obtain personal riches from a commercialization via the patent of a normal process found in the human body. The interests of private industry in this field will probably take other turns, if this ruling by a court whose jurisdiction applies to states, not individuals, is put into practice worldwide.

The Brüstle ruling will not change the fact that a major break has already occurred in the tradition that patent rights are restricted to engineering products and processes that are original and marketable. Extensions of what is possible for an inventor to patent may turn the bold spirit of discovery into an anxious monitoring of the avoidance of the use of immaterial rights on behalf of powerful patent holders. In extreme cases, this may actually push normal university teaching with laboratory exercises into criminal activity. This breaks a key norm of science; namely, discoveries of the laws of physical nature and similar natural biological processes are to be offered *for free* to all colleagues; this is the first clause of CUDOS.[5]

There are also varied legal devices at play in the extension of patent rights of complex products to be valid on a market beyond the original period of (some of) its constituent patent. In the contemporary discussion of patent rights for scientific and technological innovation, we note an erratic and deteriorating protective tendency of intellectual properties.

## Patents: A Task for the Central Zone?

The low priority given to patent administration by governments on both sides of the Atlantic illustrates a general weakness of a democratic polity to respond to the needs felt strongly only in the central zone of society, and not in society at large.

Those qualifying for patents and copyrights, The Makers (Row N), as we called them, are a much smaller group than others in society, the Keepers, Brokers, and Takers (Rows O, P, and Q in the Periodic system).[6] Thus, they are grossly underrepresented in the electorate, and this is also normally reflected as inadequate representation in legislatures. At the same time, Makers are clearly overrepresented in the central zone of society where the stars of all the societal realms are found. The Makers are likely to benefit in a society organized as a federation of societal realms, in which the central zone has a decision-making facility for certain appropriate common issues such as patent rights. Such a facility should be an option in a many-splendored society.

## Notes to Chapter 27, The Use of Patents

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[1] Ch 9 (Vol 2) Societal Realms and their Functions: Makers, Keepers, Brokers, and Takers, Table 9.3. The Internal Functions of Realms and their Manning, p 254

[2] *Ch 20 (Vol 4) The Contemporary Pursuit of Science: Table 20.1. Science and Other Societal Realms, p 71*

[3] Ch 10 (Vol 2) Societal Realms and Their Relations: The Valence of Societal Realms, Table 10.1, p 320

[4] (Vol 2) Introduction: Courts of Human Rights, p 84ff

[5] Ch 20 (Vol 4) The Contemporary Pursuit of Science: A Short View of Science as a Social Institution: CUDOS, p 80ff

[6] Ch 20 (Vol 4) The Contemporary Pursuit of Science: Table 20.1. Science and Other Societal Realms, p 79

# 28. On Applied Natural Science

## The Impact of Technology on Civilizations

Great civilizations have emerged along big rivers where engineering feats in the form of flood control for agriculture and long distance rafting or sailing could be established. Natural energy was harnessed from the flow of water and the blowing of the wind. Thus, human life changed to increased complexity in places along the Nile in Egypt, Euphrates and Tigress around Mesopotamia, along the Ganges in India, around the Yellow River in China, and all over the place in the Andean region in South America with several smaller rivers (Coulborn 1959).

The great South American civilizations did not seem to have used wheels, but otherwise this technology has been independently invented in all great civilizations. In Mesopotamia wheels may have existed centuries before Archimedes.

In Europe, Francis Bacon (1561 – 1626) thought that printing, compass, and gunpowder were the most decisive inventions that shaped his times. They had existed in China for centuries before their appearance in Europe. Among other things, creative Chinese engineering around and after 1000 CE, gave the world silk, paper, printing, gunpowder, compasses, lacquer, ceramics, and some cleverly wrought iron. We have already touched upon the impressive story of Chinese technology reaching its peak under the Sung Dynasty.[1]

The engineers of India excelled during the same period in more abstract pursuits based on practical needs, and discovered algebra and geometry, and methods of clocking time. Thus, they pioneered in what is nowadays a very prestigious academic field, mathematical engineering.

All these early inventions changed life in these civilizations. In the more recent European-American civilization new technologies mark three industrial revolutions.

### Industrial Revolutions

An industrial revolution is a combination of a new technology with new social arrangements. The first industrial revolution in Europe started in the late eighteenth century with the technology of the steam engine and the social organization of the factory. It also gave us transport by rail and steamers.

A second industrial revolution came at the end of the nineteenth century when combustion engines and electric engines reshaped the factories. The combustion and jet engines enabled transportation by trucks and cars and eventually airplanes. With electric start motors, the automobiles could readily be used without a chauffeur cranking the motor to a start. A mass market opened that eventually included both men and women. The electric devices reshaped not only factory work but also the offices and households and everyday living.

After World War II it was thought that the next technological revolution would be called ”the atomic age.” It was heralded by a big monument in Brussels. One kilogram of coal produces energy amounting to 3kWh, while one kilo of uranium provides 50 000 kWh, that is 16 700 times as much. But the technology to harness this huge energy did not integrate well with existing small scale technologies. Atomic energy has not led to a new industrial revolution, at least not so far. We shall shortly deal with the fate of civilian nuclear power.[2]

Instead, a third industrial revolution, micro-electronics, emerged in the second half of the twentieth century with the digitalization of all kinds of communication, print, music, pictures. Products and packages get identities in bar codes and animals get digital identities in chips, anything living can get a record of its unique variation from the DNA of the species. Most important, this revolution gets at the core of civilized living, the use of communication by symbols. Even ordinary speech becomes more binary.[3]

## Enter Engineering [TECH], [NAT], and [ANIM]

The immediate energy we require, and its efficient use for a physical task, is found in our bodies. For example, an erect stature and straight vision made humans more apt and skilled than other animals in throwing things.

At the time of Archimedes (287BCE – 212BCE), the father of Western engineering, one talked about ”the mighty five” technologies. They were the inclined plane, the wedge, the screw, the lever, and the wheel shaft. These great tools brought technology into physical and biological reality. It happened, for example, when the farmer began to cultivate his field by a domesticated horse pulling his plow and when his harvest was brought home by a horse-drawn wagon. The main justification for using tools and domestic animals was to get energy over and beyond human body energy. Some domestic animals also became a source of meat, milk, et cetera, more easily acquired than that from the hunt.

Technological advances were on the human scene long before science had begun its progress. Old engineering tasks, such as making cloths, building fireplaces, creating cooking utensils, and providing weapons for the hunt and the wars, were crafts not very formalized.

Also, at the first schools of engineering in the modern era, study was organized around practical tasks, such as construction, road building, shipbuilding, and mining. Only later on did proper science come to the fore. The curriculum, then, included such specialties as mechanical engineering, chemical engineering, electrical engineering, outer space engineering, et cetera, i.e. disciplines defined by the areas of knowledge in natural science, applied to practical ends. In the history of tools, this is a very late phenomenon. In history, technology precedes science. Today, the justification for engineering is not only to save human energy but to apply scientific knowledge for the benefit of man, and, at least sometimes, for the benefit of animals and plants: the living planet.

## Growth of Innovations

A typical image of the run-of-the mill inventor is someone who monkeys around until he is lucky to find something new that meets a need. A typical image of the run-of-the mill engineer, who uses an inventor's new technology, is that he spends an inordinate amount of time repairing the interfaces between new and old technologies. For example, when inventors have provided a motor and a pump, engineers tinker with the fan belt that links the motor with the pump. The reality is somewhat different.

In the 1960s, many American managers in corporate and military establishments felt that they needed to know more about technological change. Prodded by the Department of Defense, conferences were called, and a pooling began of experiences of technological forecasting. A few years later, this budding field of study was filled by civilian academics; The Business School of the University of Texas taking the lead (Bright and Schoeman 1973).

When only few technologies exist, only a few combinations are possible, and the process of achieving new technologies is slow. In times and places where many technologies are at hand, many more combinations are achievable, and the possibility of finding new technologies grows exponentially. Technology, thus, has an ability to bootstrap itself and grow. Some technologies have a bigger effect on future technological growth than others. At present, the arrival of nanotechnology and genomics are great boosters.

Technological advances do not usually originate from a new invention but evolves from a series of old inventions forming a novel module. “Novel technologies are created out of building blocks that are themselves technologies, and become potential building blocks for the construction of further new technologies,” says Brian Arthur (2009, 204).

The Arthur thesis implies that there are many potential engineering innovations, having their base in long established discoveries in physics, chemistry, and biology, not in any new research. You do not have to wait for new discoveries by basic research in physics, chemistry, and biology to create innovations in engineering.

Inventiveness may flourish among lay tinkerers with existing technologies and among ingenious youngsters of pre-college age. Inventions may come among employees in industries, soldiers and officers in the military, bureaucrats in an administration, et cetera. Without competing for prizes for discoveries by basic research in physics, chemistry, and medicine, one could separate a Nobel-type Prize in engineering, for combining old innovations into something new. The Millennium Technology Prize is this type of award; it exists in Finland, as we saw in remarking on the invention of the World Wide Web (4: 160). After all, Alfred Nobel was at heart an engineer, a reluctant industrialist, and not an academic. He had over 400 patents to his name.

New technology is a major vehicle for economic growth, as we noted above.[4] Alfred Nobel’s main innovation was a profitable product, dynamite, that was dangerous to transport. He minimized this danger by establishing manufacturing in several countries. Thus, he also created one of the very first multinational businesses, a true social invention. The Nobel brothers had already a very profitable oil business in the Baku region in Russia. About a quarter of the fortune that provided the capital for the most prestigious prize in science stems, not from dynamite, but from Russian oil business.

Brian Arthur’s thesis of an intrinsic, exponential growth of technology is stunning. It is a shock to our thinking, almost comparable to Darwinism. Here we get a glimpse of what looks like a "law of nature," a spontaneous process bringing forth new technologies. And what technologies! They have more proficiency, are more compact, stable, and efficient. Most important, when we have reached the stage of computers, we have technologies with built-in intelligence and with automatically corrected instructions in the way in which they work.

This may give some second thoughts to many of those whose skill is to preach idealistic and moral beliefs about changing the world for the better — be they public intellectuals, politicians, artists, or preachers — who usually play down or dismiss advanced engineering as a blessed agent of change.

Let us review the innovation of the modern computer in the light of Arthur's thesis on innovations.

## Nine Innovations for Early Computers

### 1. Binary Script

It had since long been known in India that numbers can be written with binary markers or characters, such as "yes" and "no," or, ones and zeros. This idea was noted in Europe by Francis Bacon (1561 – 1626) and was developed by Gottfried Leibniz (1646 – 1716), the German philosopher and mathematician. The latter exemplified in his texts the fact that binary script could, not only represent numbers, but could also represent logic: that which is either true or false. Leibniz implied that almost anything that human beings express, which is more than unarticulated outbursts, could actually be rewritten in a binary fashion; this is cumbersome but possible. He saw no practical use for this digitalization. Today, so called analog-digital converters can also code an emotive outburst or, for that matter, a van Gogh painting, or a whole symphony of Beethoven, as digital strings. The digitalization provides very exact copies of everything written, painted, or played.

### 2. Digital technologies and terminologies

In the nineteenth and early twentieth century, digital technologies became generally available in order to record and transmit binary numbers and messages. Paper tape was used for Morse and teletype, and punch cards were used to enter bookkeeping items into accounting machines. Punch cards had actually been invented already in 1732 in France by Basile Bouchon and Jean-Baptiste Falcon.

The current prevailing terminology emerged during and after World War II. The *bit* (short for binary digit) exists only as a zero or as a one. The *byte* is a combination of 8 bits, and the total possible distinct combination of zeros and ones is 256. In all communication and computer practice the total number of bytes multiplies very quickly, and we refer to these units as kilobytes, megabytes, gigabytes, et cetera. The size of a digital memory is expressed in such units. The speed of any transmission is designated, say, by kilobytes/second.

## 3. The Turing Machine

A new mathematical innovation appeared in 1936 in Britain called The Turing Machine. It was not a machine but a theoretical model of one, existing on paper only. The author was Alan Turing, a mathematical genius. The means and the speed of communication in his design were universal, i.e. totally all-purpose, and empirically unspecified. The nearest illustration of communication in such a machine that might have come to mind in the 1930s was the paper tapes with punched code (such as a telegraph using Morse code), an available digital technology. In any Turing machine, however, the communication sent by steam whistles could equally have referred to sound, and its speed in messages between ships entering or leaving a harbor, or by the speed of the sight as colored flags or smoke puffs between watch towers along a coast, or, as what eventually became the reality: the speed of light in the form of electronic communication. The mechanical turns and shifts in Charles Babbage's never completed "difference engine" from the 1820s could also have served for the transmission of communication in a Turing engine. Turing's ambition in the 1936 paper was, thus, purely theoretical. Explicitly, he was addressing the possibility of predicting the end of a running code sequence, at that time discussed using the German word "Entscheidungsproblem".

## 4. Stored-program computers

Digital script can refer to structures and their properties *in space*, as well representing sequences and processes *in time*. In other words, the same stream of binary makers, such as a tape, may contain data as well as instructions on how to orderly, and in sequence, deal with that data. This beats all old-fashioned human tools, which, like the Swiss Army knife,[5] must keep separate from one another their instructions and their actual use. This also beats the first calculator-computer built by the German engineer, Konrad Zuse in 1936 in which an operator inputs the instructions for the calculation of the stored set of binary numbers. During and after the war, Zuse constructed three improved models which have the features of a stored program computer, but most of these programs did not fit in the limited memory he used and were entered separately. His work was unknown outside Germany; some would call him the inventor of the computer.

We know that the idea of a stored computer program with a common digital stream of instructions and data surfaced in the 1940s, but we cannot say with certainty where it first appeared in completed computer construction. Germany is not the only place. As Merton (1961) observed and documented, multiple independent discoveries are a common phenomenon in science. Such events are also entirely in line with Brian Arthur's theory that the main stream of technological development is comprised of emerging combinations of already existing innovations. Nothing prevents such combinations occurring simultaneously in different places.

Perhaps the idea of a common digital stream of instructions and data arose in Cambridge, Massachusetts with Harvard Professor Howard Aiken when he worked to construct the computer MARK 1. This first Harvard computer was financed by IBM, with parts delivered from its factory in Endicott, N.Y., and with full intellectual support from its staff there. Or, perhaps the idea occurred first in New Jersey when a computer called MANIAC (Mathematical and Numerical Integrator and Computer) was built in Princeton on the grounds of the Institute of Advanced Study, a non-governmental and non-university institution of the kind that we nowadays would call a think tank. The Institute housed, among others, Albert Einstein. The MANIAC project was run by the latter's colleague, the mathematician, John von Neumann, and a team of a dozen engineers headed by Julian Bigelow. Most of them had war ties to Los Alamos and the development of the atomic bomb. In fact, the MANIAC project continued with financial and professional ties with Los Alamos; for example, at night the running of this computer was turned over to the Los Alamos staff for use on defense-related projects (Dyson 2012).

## 5. Cathode-Ray Tubes, CRT

The first innovation of a digitalized memory was the segmented CRT-tubes. Stationary digital information could be stored in a memory in the form of a tape or a rotating drum; later spinning disks took over such tasks. Processing digital information required more flexible memory slots where the results of intermediate steps in a calculation remained only momentarily.

Since the advent of TV in the 1930s, cathode-ray tubes (CRTs) were available to show all shades of black and white, and they were in serial production in the 1940s. Such vacuum tubes were improved for use in the radar technology of World War II.

An analog CRT-tube, like any lamp, could, of course, easily be digitalized by being turned on or off by an electric circuit breaker. More economically, engineers, some of whom were trained in radar research, had learned how to reserve different segments of the face of a CRT-tube for different images. Each of these segments could be quickly targeted to be put off or on by an electronic beam, thus turning the analog tube into a digital one. In this way, the invention of cathode ray *picture* tubes developed to become a new invention of digital *memory* tubes that could process data and change with high speed. When need be, the digital pattern of a tube at any given time could be shown in registers on a console, punched into a tape, and/or printed.

## 6. A mathematical frame for computer memories

The Turing engine assumed a one-dimensional array to hold the digital stream of zeros and ones. In working at Los Alamos, John von Neumann had to choose a mathematical expression of the many properties of the heavy plutonium atom. He noted that an array of 32 x 32 x 40 bits provided a convenient frame for the properties of such big atoms. von Neumann's observation was implemented in the MANIAC (Dyson 2012). This particular two-dimensional array became standard in the memory of several generations of computers.

## 7. Transistors

Even with the economy achieved by dividing the surface of a vacuum tube into many separate spaces to hold bits and bytes, the first computers built by IBM in the 1940s at the universities of Harvard and Columbia required a huge supply of tubes and switches. Columbia's SSEC machine contained 21,400 relays and

12,500 vacuum tubes. An alternative circuit breaker appeared with the discovery that the fibers of certain crystals can act as switches and even amplifiers of electricity. The resulting switching product is the *transistor*.

The transistor is the basis of two engineering advances which got off the ground in the last half of the twentieth century. The first was the "the digitalization of everything" — from traffic lights to washing machines. Transistors may build certain intelligence in the form of computerized experience into already existing tools. The second was "the miniaturization of everything" — from radios to computers. Transistors gave portability to these and many other tools. Transistors require much less energy to operate than vacuum tubes, energy economy being one of the ultimate justifications of any engineering task.

In 1954, Texas Instrument began production using silicon as the active crystal in transistors. They bundled transistors into integrated circuits or "chips." This production turned out to be quite inexpensive, and the uses of transistors could multiply. Chips with numerous integrated circuits built the *microprocessor* that housed all of a computer's functions on a single chip. What used to fill an entire room in the 1950s could, in a microprocessor from Intel in the 1970s, fit in a match box. By the turn of the century, chips and transistors had reached the top in terms of volume in the world's engineering products.

There are records of a simple Canadian transistor patented in 1925 and a German one in 1934, but they were not commercialized or even publicized. In the winter of 1947 – 1948 these were reborn and combined with newly discovered complex switching at Bell Laboratories in New Jersey, a facility owned by AT&T, the giant US telephone company. John Bardeen, Walter Brattain, and William Shockley of the Bell Laboratories were awarded the 1956 Nobel Prize in Physics. This prize was one of the first significant signals that institutions other than universities were in the front line of scientific research.

## 8. Simplifying man-machine relations: compilers

The first generation of computer programmers worked directly with the digital code of zeros and ones that their machines could act upon. The invention of the *compiler program* made their work faster and easier. The first one was created in 1953 for the US Navy by Grace Hopper; a later, commercial version of it became known as COBOL. Compilers convert numbers written as ordinary Arabic digits into binary numbers, and each letter in the ordinary alphabet converts into its binary expression. Most important, Hopper's compiler included a new short vocabulary, easily learned by a programmer, in which signs, letters, or single words stood for all common instructions. A special code was designated to signal when data, not instructions, is written. The items in this vocabulary for programmers were also converted by the compiler to the binary code understandable by the computer. Ms Hopper's various contributions to the Navy became much appreciated and she was promoted to Rear Admiral.

John Backus, was trained at the Watson Laboratory at Columbia University where he also pioneered in trying out compilers. He went to work for IBM, where he led the development of FORTRAN in 1954 – 57, another much used commercially available compiler, also well adapted for use in scientific research.

### 9. Simplifying man-machine relations: graphic interfaces

A console with a screen and a hand-held mouse marked the paraphernalia of a computer operator. By the end of the Twentieth century, additional man-machine relations: a graphical interface for users and a touch-screen-based interface. In 1983, at Xerox Parc in Palo Alto, California, Alan Kay and Douglas Engelbart made the computer screen come alive in a novel way with windows, menus, and icons that a user could point at with a hand-driven device, the mouse. No longer did you have to remember and enter strings of words to start and run a computer process.

In the 2010s, the physical keyboard accompanying a computer could be exchanged for a picture of a keyboard on the screen on which you type inputs to a computer with the touch of your fingertips. Furthermore, the mouse could be exchanged for the fingertips. Two fingers working together on the display could squeeze or enlarge or rotate the words and images on the screen, something the mouse could never do.

## Predicting a Super-Handy

If Brian Arthur is correct in his thesis that the lion's share of new technologies is combinations of old technologies, it should be possible to anticipate new innovations without writing science fiction.

In a study like ours that looks at social reality, i.e. society through the window of language, the most relevant technologies concern the transmission of symbols. The development at the turn of the century of handheld communicators, combining cellular phones (oral) with input by hand, such as SMS messaging (written) and email (printable), voice mail (audible) and cameras (pictorial) gave a person of the new century an easily used device with almost all symbol-carrying modes in one handy tool. In some countries, Germany among them, cell phones were often called my ”Handy.” This designation applied even better when smart phones entered the scene with apps that personalize the use.

At the same time so-called ”cloud computing” made the Web rather than local disks a depository for programs and databases. The latter are available in your device only when you need them, thus cutting down the size and, perhaps, the market price of the handy devices. The old advertising slogan ”the network is the computer” become a reality when networks approached the speed of ordinary computers.

The handy devices grown out of phones include a computer with a memory more exact than the human one. Here you can download, store, and access your archive of writings, your catalogue of relatives, friends, and contacts, your calendar, your favorite music, your photos and films, your bank accounts, your library books, to be read to you by an artificial voice, if your eyes are weak or too tired to read them. The applications may include the downloading of your newspaper, and live radio and television. The device may also include a compass and a GPS so that you know where you are and can find where you want to go. You may also use such a device as a remote control to open your doors and to run your electronic home theater, et cetera. You can use it instead of a credit card for purchases or bank transactions. The device may replace your credit cards. It may monitor your blood pressure and other vital functions and record your amount of exercises.

The choice of numerous “apps” allows any user to personalize the device for individual needs. Such a super-handy helper in mass production in the 2010s may change everyday life to make it seem almost magical by earlier standards. The amazing fact is that the devices are small, cheap, easy to use, widely available, not yet prohibited by dictators, but used in efforts to topple them. It has become ever more possible to use an old adage in a new way: “tell me your aps and I will tell you who you are.”

Big issues for the planet such as population growth or use of nuclear energy may be solved by mass use of apps in a future super-handy. (I should add that neither is yet generally available at this writing in 2013.)

Women of fertile age may use apps in which the display of the handy pinpoints fertile days and safer days of sexual intercourse. These apps could use computer programs that draw individual conclusions from analysis of body temperature shifts in many more menstrual cycles and with better accuracy than conventional ovulation predictor kits. Easy to operate; may not need literacy of users.

In studies in the 1970s of the acceptance of nuclear energy in Sweden by myself, Ingrid Berg, Karin Busch, and Greta Frankel, the fear of invisible radioactivity destroying your health and body loomed large, particularly among women (1980, Table 5 & 6). In the future, by adding a Geiger-type nano-meter to a mobile phone that you always carry around, anyone may detect the level of radioactivity. This may help a majority of humans to come to terms with nuclear power; radiation would no longer be something invisible that unnoticed enters your body and destroys organs and life. Just as sight and smell of flames and smoke, tell you that a fire is around, your future super-handy can warn you of radioactivity and tell you to move from the location, or to protect yourself with special clothing. Other phenomena may also get apps detecting poison in the air, or the level of pollen or other allergic agents that humans do not easily or immediately notice by their senses.

The present limitation of the smart cellphones to transmit only sound, pictures, text, and data may be overcome by future transmissions of the smell of the coffee that a caller happens to drink, and the touch of his or her hand in a handshake from remote, and yes, why not the touch of a kiss overcoming the distance.

The once unsurpassable gap between the small world of private encounters and the global world is would continue to shrink dramatically by such Internet encounters.

Microelectronic translators in super-handies may also overcome the need in the global cacophony of local tongues to learn a lingua franca, at present English. In tomorrow's world, we may not need a lingua franca. You speak the local language in your super-handy, and out comes the local languages of your companions in their super-handies. When asked, which language will succeed English as the lingua franca, the right answer may be "None."

Microelectronic translators may put a final touch on university education using them in Massive Open On-line Courses (MOOCS) from the best universities in the world. The would give a new meaning to Humboldt's *Lehrnfreiheit* (the freedom of students to learn), and that on a scale beyond the wildest dreams of Britain's venerable Open University.

## Value Change and Changing Acceptance of Technology

Brian Arthur's theory of progressive technological advancement must be amended. The potential of technological development is not automatically realized. It is welcomed only when the general value climate in a society is dominated by an emphasis on becoming modern, i.e. looking for the new rather than looking toward being traditional or the old. Among the eight mentalities we have surveyed,[6] we have located two different such mentalities.

One is the 'challenging' mentality of becoming (i.e. of modernism), pragmatism, and materialism.[7] It emerged, for example, in China when it had overcome Mongolian threats from its west. Manufacturing and trade bloomed.[8] The accompanying urbanization modernized old China. Even oceanic possibilities in the east and south were now open with new shipbuilding know-how. With its new technologies adopted, Chinas GNP was probably higher than all the rest of the world combined. As always, engineers from special parts of science are the biggest Providers to the businesspersons in the realm of the economy. As Joel Mokyr puts it in his historical review on technological creativity and economic progress; they are "the lever of riches" (Mokyr 1990). More on this in *The Pursuit of Wealth and Order* in volume 6 in the series *The Many-Splendored Society*.

A second type of value climate that moves technological development forward is the one we have called the 'advocacy' mode of becoming, faithfulness, and materialism.[9] It differs from the 'challenging' value climate in its preference for firm rather than pragmatic values. Its adherents advocate a modern comfortable life, but they accept only new technologies that are faithful to nature as it is given. In today's world, this approach calls for a sustainable level of the extraction of natural resources and other minimum conditions for the survival of human societies. The individuals or groups of people who hold advocacy values are materialists and modern. They should be distinguished both from those who are hijacked by doomsday science,[10] and from those whose values and life-styles are those of flagellants.

## China in 1433, Sweden in 1986, and Germany in 2011

A pivotal change in China took place in 1433 when the Ming government moored its fleet of advanced sea-faring ships forever, and let it burn or rot. The fleet's period of forays into the Indian Ocean had not lasted very long, and it had brought home more prestige than profit to the Imperial Court. However, a shift in the value climate was probably more decisive for the 1433 naval iconoclasm than the strain in the economy from the initial expeditions by sea to India.

Leaders at the Imperial Court apparently lost their nerve. Supported by magic rites vested in the Emperor, they resisted both the development of external trade and the development of naval technology. They turned attention inward. China should preserve its good life. Values were thus shifting from what at that time had been modernity to what was old-fashioned and "tried and true." Confucianism had also taken a traditional turn. This official ideology had slowly, almost unnoticeably, undergone a modification, erasing liberal elements from the founder's heritage and accepting more orthodoxy. This meant less pragmatism in the administration of the provinces and more authority to the Emperor. A most ominous sign in 1433 of the future of a great technological nation was the imposition by emperor Zheng of the death penalty on any shipbuilder producing a ship with more than two masts.

> Proposition 28:1. *Technological Growth and Changes in Cultural Mentality:* (a) Out of building blocks that are themselves technologies, novel technologies are created at an exponentially growing pace, becoming potential building blocks for the construction of further new technologies. (b) The pace of creation of new technologies accelerates by the prevalence of a challenging and/or advocacy mentality in the value climate, and slows down by a mingling and/or soul-searching mentality.

This type of drastic political interference with technological advances is not unique. In 1986, my native country of Sweden signaled a similar turning point in the forthcoming demise of certain leading-edge technological advances. The Energy Minister, Birgitta Dahl, obtained a Parliamentary majority of her own party, the Social Democrats, plus the Communists and Agrarians, to approve legislation stipulating that ”none is to execute construction designs, calculate costs, order equipment, or take other such preparatory measures aimed at building a nuclear reactor within the country.” At that time, Sweden had 11 nuclear reactors located on four sites accounting for up to 40 per cent of all electricity produced.

The ”green movement” of environmentalists all over the world cheers any compulsory phase-out of nuclear power, as well as a phase out of electricity produced by coal and oil. Our electricity should, instead, preferably come from wind and solar power. This policy, embodied in the Dahl prohibition, is a telling parallel to Emperor Zheng, using punitive legislation to phase out all great Chinese ships with three, four, and five masts in favor of ships with only one or two masts. Both violate a basic justification of applied science: to develop and use the technologies that are most energy efficient, for example, to produce electricity with the most efficient of possible technologies. It was a mistake of the old Chinese to believe that the big blue oceans would succumb to a one or two-masted technology that is much less efficient than the one with three or four or five masts. And it is an equal mistake of the contemporary Western world to believe that the less than one-tenth-efficient green technologies will be able to replace the most efficient one so far known to humanity.[11]

Did Sweden, like China after Zheng’s intervention, see a technological decline? It is perhaps a little early to tell, but the signs are telling. After Dahl’s intervention, training in nuclear engineering stopped to a trickle or less. The maintenance industry for nuclear energy was sold to the US company Westinghouse.

More important, in the new century, fewer young Swedes choose any engineering career whatsoever. What seems to be most acceptable to them are small-scale technologies such as solar panels, computer games, and cellphone apps. Also, old and simple technologies are very resilient: earphones rather than loudspeakers, sailing boats rater then motor cruisers, street cars rather than busses, trains rather than airplanes, bicycles rather than cars.

Add to this demise of concern with advanced technology the fact that the Swedish politicians, unlike the German, were greedy enough to decide that the existing nuclear plants should not be closed immediately. They are too dangerous to operate in the long run, but they shall nevertheless operate and earn revenue during the subsequent decades constituting their “technical life-time.”

These politicians believed that the nuclear industry could be turned off like a switch. They have not realized that this field of industry, like many others, involves a whole social system, not just a technological one.

The corporate headquarters of the plants in the Swedish nuclear energy sector were run by financial and market-oriented executives. Some of them (and their board members) have long dreamt of creating Nordic-based continental-scale energy empires. In passing, it may be noted that maintenance has not always been their top concern. The engineers who best understand nuclear processes and plant maintenance are found, not in the top leadership, but in the lower echelons of these organizations.

In the new century, the Dahl prohibition of any planning for new nuclear facilities has been revoked by a center-right government. Some modernization of existing reactors has been undertaken. Only one of the four Swedish nuclear sites has actually been closed. The remaining nuclear plants are run by an elderly staff, certainly faithful, but sometimes forgetful and slow. Do new recruits have a relevant education? Do they come from the top of their engineering class? What do their girl- or boyfriends think of the fact that their impending spouses will work in a nuclear plant? Can they stand a career in a plant about which most of the mass media exercises maximum suspicion? Is journalism fair to them, when, for every expert who publicly appreciates nuclear electricity, the editors have to have to present some well-known intellectual who will speak of his or her aversion to nuclear power? Do new recruits to the nuclear plants work well also during election campaigns when some parties have celebrated candidates who denounce their trade?

International signals underline the consequences of such hesitations. Fears created by the Fukushima accident in Japan in 2011 put the 134 reactors  of the European Union in focus. A long-time political effort by *die Grünen* in Germany reached its goal a few months (sic) after the Fukushima disaster of getting a decision to close all nuclear power plants in that country.

There is a resurgence of one-masted windmills to provide alternative electric power in Germany. German politicians, willy-nilly, and not only as a last resort, will apparently also rely on Russian natural gas for the future of their, so far, very effective industrial economy. It will be interesting to see whether Germany will experience the same popular disinterest in technological education as hit Sweden after its decision to phase out nuclear energy.

The staff of the governmental regulatory bureaucracies set up to control nuclear radiation has reason to shake their heads, not only in worries for their own future careers. On average, the Swedish-owned nuclear reactors in Sweden and Germany have had more and longer emergency stops in recent years than the average in Europe. We may seriously question whether the prophets of nuclear doom in the previous century — the likes of the well-meaning Mrs. Dahl — have created a self-fulfilling prophecy.

My general impression is that nuclear power is one of those issues, like Big Science and patents, which are better settled by the central zone of society than by the commons.

## Lags in the Acceptance of Technology

Humans have been greeting technological advances with enthusiasm during only relatively brief periods of history. The contemporary detractors of automobiles, computers, off-shore or shale gas and oil may seem like minorities, but in history, their counterparts appear as majorities.

Looking back, however, to the beginning two decades of the twentieth century, a very visible period of exponential growth in technology occurred in the United States. All over the modern world, there was talk of the "Yankee ingenuity." William F Ogburn, a pioneering America sociologist, studied the inventions, accumulations, diffusions of new technologies, and the adjustments they brought to the social structure. He found that technological change was faster than changes in social structure, and that it was particularly faster than changes in culture (Ogburn 1922). He was responsible for research in President Hover's Committee on Social Change and produced a landmark text of his days, *Recent Social Trends* (Ogburn 1933).

We know that both social structure and culture are language-dependent phenomena. We have described the slow progress of the language-dependent development of humanity, in our Proposition 3: 4 reproduced above[12] as "a slow but increasing expanse of language-based activities, both in absolute and relative terms, in comparison with humanity's pre-language activities." This slowness contrasts with the exponential growth "by an inherent and rapid development" when a sufficiently large bundle of technologies that Brian Arthur rightly presumes produces a continuing exponential development. This opens a way to revive Ogburn's theory of cultural lags without relying on any naïve ideas of technological determinism.

> Proposition 28:2. *Mutual Stimulation and Lags between Societal and Technological Developments:* (a) Societal and technological changes promote each other as societal differentiation provides opportunities for new technology, and new technologies open up opportunities for new societal differentiation. (b) Lags are created by the discrepancy between the speedier technological development and the slower societal development.

The discrepancy between technological differentiation and the societal differentiation creates lags in a technologically dominant society. These lags create frustrations. In many cases they spill over into alienation and loud calls to go back, not necessarily to nature, but to an earlier world. This leads to a preference for the old over the new, for tradition over modernity. We have already noted this important dialectic in the study of shifting climates of human values.[13]

Sorokin (1937-41) tried to show that technological advances are most welcome when a new "sensate culture" is approaching culmination.[14] Sensate culture, as he presents it, corresponds roughly to the phase of 'materialism' (as opposed to 'humanism') in the fluctuations of climates of human values described in our Proposition 4:2 reproduced here.* At times of sensate and materialistic values, attitudes toward technology are positive, technological inquisitiveness is intense, and the number of inventions increases. As we noted, China and India had such periods at the time of the European high Middle Ages (1000 – 1200 CE). Europe and parts of North America had such a period beginning with the Industrial Revolution in the eighteenth century and still lasting. Major advances in engineering came forth at an amazing rate and diversity: steamboats, railroads, and automobiles, bulldozers, air-

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* Proposition 4:2 recalled. *The Zeitgeist:* In the history of symbolic environments in societies that have many activities beyond those of needs and lusts, there is a tendency to develop a dialectic with a *thesis*, for example, of being traditional, or having fidelity, or accepting materialism, and then a corresponding *antithesis*, for example, of becoming modern, or admitting pragmatism, or acknowledge humanism, but rarely a *synthesis*; apparently the first thesis returns and the process starts all over (1: 164).

planes, oil, nuclear power, computers, cell phones, satellites, the Internet, et cetera. Exclude the contribution of European-American engineering, and you have left mostly the Chinese and Indian innovations and some old tools for weaving, cooking, hunting, fishing, warfare, and agriculture. The rising European-American engineering has outperformed the engineering of all other civilizations combined.

In recent centuries, the European-American engineering disciplines have changed societies much more than any impact from the social sciences. Engineering has thrown open the restricted "ceiling of action" in human biology,[15] so that the sky becomes our limits. Engineering has enhanced our senses so that we can see and hear over time and space. If you need to be convinced of the enormous impact on society of European-American technology, read, for example, David Bodanis' (2005) odyssey *Electric Universe. How Electricity Switched on the Modern World*. The Internet is an engineering feat that begins to reshape, not just humankind's physical and biological reality, but its social reality.

One manifestation of lags is the anti-technology movements, started by the Luddites in industrializing England in the 1810s. At that time, textile artisans, who found their jobs changed by new technology, threw their wooden shoes and other destructive items into the mechanical looms to stop them. In the history of industrialization, these protesters have had many followers who were rebels against a technological present and future. In yesteryears, the anti-technology movements have been anti-trains because trains run too fast, anti-automobiles, and anti-airplanes. Recently, they have been anti-computers, anti-internet, anti-nuclear power, anti-genetic modification. Psychiatrists and psychologists find that some people suffer from "techno-stress," thus assuming that we are dealing with a disease, rather than with normal human feebleness or foolishness.

How long is a typical lag? The original Luddites lasted a couple of decades. The belief that speedy transportation is alien to natural human living has been largely overcome in an equally short period. However, the thought that nuclear energy or gene-modified food is an enemy of all human life is with many Europeans at the time of this writing.

We can be sure that when the invention of fire for human use took place many thousand years ago, there were people who said that fire is incompatible with life. We have since discovered and developed more and more satisfying methods of separating fire from everything alive; we have learned how to transport it and have also learned to keep it under constant watch and control.

In many religions, fire was seen as a messenger between man and the gods. In practical life, fire became the servant of humanity in cooking, in clearing land for agriculture, in heating, in lighting caves and huts, in pottery making, in metal production, in transportation. Of course, fire also destroyed: in 64 AD Rome burned for eight days, and 70 percent of the city was destroyed. In 1106, London burned in "the Great Fire," in 1751, Stockholm burned, and in 1906 San Francisco burned after an earthquake. Nearly all places man has inhabited can record devastating fires. Consequently, all places have fire protection, and legislation on fire has become very detailed. In the wake of the fires of London a system of fire insurance has also developed.

It took a very long period of lag before humans' use of fire became non-problematic. Nuclear power will certainly have a shorter lag. However, its residual lag can linger on and become dangerous. Some seven decades old, nuclear power is getting more dangerous by the day in Europe due to a Luddite public opinion that has discouraged entire generations of engineers from specializing in nuclear technology. The government agencies set up to be nuclear watchdogs face a nightmare. The situation is not helped when the management of energy companies defines their duty as having a greater focus on exciting financial arrangements and expansion than on the dull maintenance of their nuclear plants.

At the time of this writing, Europeans lag Americans in accepting gene operations on food, but the gap seems to be closing. After all, plant breeding has been practiced since 10 000 years when some parts of humanity first shifted to supply its main livelihood from agriculture rather than from hunting and gathering. In addition, at that turn of events, some people must have protested against this "unnatural way" of getting food. It even required that you gave up your normal life as a nomad, and stay in the same place year after year! Plant breeding became normal in the new situation. Moreover, so became animal breeding. Hens, cows, horses were refined, and dogs, after generations of breeding, became man's best friend. Agricultural technologies nowadays grow fast, and lags of public acceptance become shorter. In 1970, Professor Norman Borlaug won the Nobel Price Prize for his innovations in plant breeding that saved much of the growing third world population from starvation. Faster gene management has now succeeded his research methods.

Technology serves special needs in society. While a few technologies may have been born simply out of idle curiosity, the rule is that technologies emerge and stay in place to serve our handling of physical, biological, and social reality. This point was made at the beginning of our text, and it can be seen by any layman.[16]

## A Note on Medicine [BIO]

Our bodily spontaneities can be suppressed by Freudian Unbehagen norms.[17] They can also be enhanced and controlled by different social designs affecting the health of the human body. A most remarkable such design is the system of modern medicine, which modifies the most fundamental spontaneous bodily sequence of birth, growth, decays, and death.

The societal realm of religion has generally incorporated a standing concern for birth, growth, decay, and, particularly, for death. Medical advice and practice, not only prayers for health, could then be delivered by priests. China, however, developed an advanced practice of medicine. Its physicians generally carried stable traditions of treatment from generation to generation that were not based on magic, nor on religion. Other old civilizations have had organized medical practice - ancient Egypt, Persia, India, Arabia, Inca — with stronger relations to magic and religion; “medicine men” were cousins of magicians and priests.

Hippocrates of Kos (ca. 460 BCE – ca. 370 BCE) is celebrated for creating a practice of medicine more unrelated to religion and void of magic for the ancient Greeks, and with a special code of ethics distinguishing medical decisions from political, religious, and economic concerns. The famous Hippocratic Oath of medical practice belongs in secular morality, and is a good example of the tradition in Greek antiquity to separate religion and morality.

Modern medicine originated as an applied science and developed in recent centuries in Europe. For example, the germ theory of disease developed by Louis Pasteur (1822 – 1895), French chemist and biologist, determined that a number of illnesses depend on micro-organisms entering the body. This discovery led to treatment by pasteurization and, eventually, by antibiotics, and to prevention by regimes of hygiene and vaccination.

Medical treatment became increasingly based on new, proven empirical evidence. Medicine took the same rapid pace as that of other scientific progress. This meant that medical practice was no longer stable from generation to generation, but changed as "the present standpoint of science" changed.

## Organizing Applied Knowledge in Medicine

As professions based on applied science develop, there emerges a need to organize knowledge into manuals, which differ from both the analytic and the systemic paradigms. The engineer's handbook differs from a textbook in physics. A manual for teaching is different from a text on psychological theory. Manuals for ecologists are still rare, and may look much like an old-fashioned flora of botany. This may be due to the fact that ecology has only recently developed into a major profession. In medicine, the last hundred years have seen a drastic reorganization of its knowledge to better serve physicians at work.

"Definition," "History of Knowledge," "Incidence," "Etiology," "Symptoms," "Prognosis," "Diagnosis," "Treatment," and "Prevention" are the subheads used by Sir William Osler in his classical work *Principles and Practice of Medicine* (1892) to organize medical knowledge for fingertip use by physicians. This format proved superior to both the analytical and systemic presentations in anatomy, histology, physiology, et cetera. The format is very different from the usual propositional or systemic presentations of science practiced, for example, in the book you are now reading, and is, rather, centered on the requirements of the situation in which a physician examines a patient.

In a standardized fashion, Osler tells the physician where to look, what to look for, and, depending on what he finds, how to treat the patient. At the same time, the author reminds the physician of the relevant knowledge acquired in the systematic study of anatomy, histology, physiology, et cetera, and also points out where knowledge is missing. He often provides a summary of the history of knowledge about a disease. For half a century, new medical knowledge could easily be fitted into this schema, and Osler's textbook enjoyed numerous editions.

Of course, post-Osler versions of medical handbooks have modifications. In an era when the patients have both knowledge and interest in self-improvement and in healthy lifestyles, textbook sections in medical texts on what the patient, rather than the doctor, can do to improve treatment and prognosis have become common.

There are also more openings in contemporary handbooks for sections going beyond a mere locating of symptoms to organs. A recent medical manual may tell that, say, a cancer is of a special generic type, not just a location, such as a colon, breast, prostate, or skin cancer. In addition, the textbook presentation of cancer diagnoses is changing, so that not every appearance of a cancer requires the full arsenal of treatment; initially, mere watching may sometimes be enough. The timeworn image of a life with cancer as short and hopeless has apparently triggered over-diagnosis and over-treatments of some more benign cancers, causing unnecessary distress to patients.

The hands-on approach by Osler has successively been supplemented by new technologies to assist diagnosis and treatment. For example, a total body scan can find a very large variety of current and coming health problems. A simple blood sample can not only identify many medical problem areas, and at the time of this writing we can foresee that such tests also can identify genetic obstacles to treatment before patients take a single dose of medication.

One main task of physicians remains the same as in old times: to relieve sick people from work and other demanding obligations. The excused are expected, in return, to follow their doctor's orders. *The Many-Splendored Society* deals with social science, not medical science. However, in Volume 5, we have something to say about the writing of sick certificates. In doing so, the doctors have to interact with insurance agents and their rule systems as well as patients and their needs and desires, a junction full of problems for social science and welfare politics.

# Notes to Chapter 28, Applied Natural Science

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[1] Ch 4 (Vol 1) Vibrations in Symbolic Environments: A Great Rush of New Symbols: The Sung Period, p 131ff

[2] Ch 28 (Vol 4) On Applied Natural Science: China in 1433, Sweden in 1986, and Germany in 2011, p 251

[3] Ch 3 (Vol 1) Language and Its Distortions: Communicating in a New Binary Mode, p 81ff

[4] Ch 28 (Vol 4) On Applied Natural Science: Industrial Revolutions, p 237

[5] Ch 3 (Vol 1) Language and Its Distortions: An Image of the Human Brain p 54ff

[6] Ch 4 (Vol 1) Vibrations in Symbolic Environments: Eight Mentalities, p 151ff

[7] Ch 4 (Vol 1) Vibrations in Symbolic Environments: Challenging Mentalities, p 151

[8] Ch 4 (Vol 1) Vibrations in Symbolic Environments: A Great Rush of New Symbols: The Sung Period, p 131ff

[9] Ch 4 (Vol 1) Vibrations in Symbolic Environments: Advocacy Mentalities, p 152

[10] Ch 19 (Vol 4) Finding a Modus Vivendi and Ethos of Science: European Doomsday Science and Its International Bent, p 65

[11] Ch 28 (Vol 4) On Applied Natural Science: One kilogram of coal produces energy amounting to 3kWh, while one kilo of uranium provides 50 000 kWh, that is 16 700 times as much. p237

[12] Ch 3 (Vol 1) Language and Its Distortions: Proposition 3:4 *The Spuma Rule and The Civil Rule*, p 107

[13] Ch 4 (Vol 1) Vibrations in Symbolic Environments: Three Useful Dialectical Priorities, p 144ff

[14] Ch 4 (Vol 1) Vibrations in Symbolic Environments: Sorokin's Mentalities, p 140ff

[15] Ch 8 (Vol 2) From Gemeinschaft to Gesellschaft: Mobilization of Actions, p 186ff

[16] Introduction: Layman's Society and Social Reality (Vol 1) Table 1.0, What goes into a Human society? p 2

[17] Ch 18 (Vol 3) Vocabularies of Justification: The Scope of Justifications, Unbehagen, p 19

# 29. Science in Deep Collaboration with Other Societal Realms

Here we shall present two illustrations of the pattern of research in the context of application across societal realms. The first involves a "dual helix" of science and polity, and the second a "triple helix" of science, economy, and polity. The word "helix" was used by Etzkowitz (2008) to convey a process of absolute mutual interdependence between science and other societal realms, such as the economy and the body politic[1].

## A Collaborative Merger of Science and the Body Politic

The Intergovernmental Panel on Climate Change (IPCC) is the largest case so far, at least in terms of publicity and impact, of collaboration between the societal realms of science and polity. The United Nations authorized this panel in 1988. In 2008, it was honored (together with US Vice President Al Gore) with Nobel´s Peace Prize.

Human activity, ever since the transition from hunting and fishing to agriculture, affects our climate. The major reports of the UN-endorsed volunteer scientists and government reviewers in IPCC focus deeply on the increasing and presumably indestructible $CO_2$ (carbon dioxide) emitted from humankind's use of fossil fuels in the industrial era. The predictions of these reports are that $CO_2$ accumulates in the atmosphere, warming our planet, eventually to become uninhabitable in an increasing number of locations.

The prospect of an uninhabitable planet has motivated many large and small counteractions on all continents, some very expensive, some also requiring changes in lifestyles. More are in the making, although still too few and too small, according to IPCC. Since the IPCC Second Assessment Report of 1995, the global emission of $CO_2$ has, nevertheless, grown practically unabated. However, an amazing scientific fact in the twenty-first century (so far) is that the temperature of the earth has not, in fact, continued to increase at the same pace as in the twentieth century. Something (not someone) has pressed a "Pause" or "Stop" button.

The IPCC panel, itself, does not undertake research. "Hundreds of experts are involved on a voluntary basis in the preparation of

IPCC reports," states its Internet home page. “Voluntary basis” is a way of saying that they may be self-presented and, as such, these scientists are not always nominated as experts by learned societies. Also startling is this arrangement described on the web page: "Governments participate in the review process and the plenary Sessions, where main decisions about the IPCC work programme are taken and reports are accepted, adopted and approved." This is not the regular way of arriving at what we know as the ever-improving “current standpoint of science.”[2]

IPCC texts and conferences combine, in various proportions, scientific and political statements. The entire enterprise has made it increasingly uncomfortable for both politicians and scientists with deviant conclusions to come forth. Scientists who are to present the latest measures and revisions of our planet’s temperature curve, might feel as Galilei or Bruno did, with bans from the Catholic Church hanging over their heads when presenting their latest astronomical data[3] and with public opinion solidly on the side of the Church. For contemporary politicians in campaigning for their election, it might well feel safer to endorse expensive measures aimed at reducing global emissions of carbon dioxide, rather, than to oppose them.

More important is that IPCC’s mixture of scientific and political discourses will eventually destroy both. Science and polity have separate columns in our Periodic Table of Societal Realms.[4] Any attempt to merge any parts of them, leads to wobbly or unstable outcomes; this is the message of Proposition 10:14, Merged Societal Realms, recalled above.[5]

A wobbly and short future is what we predict for the IPCC. The surviving components of this much-publicized structure may well be political and moral, not scientific.

The intergovernmental organizational structure of the IPCC preempts the self-correcting process of handling errors in science, and corrupts the democratic process of finding the popular will in the body politic. In the IPCC case, the scientific messages, in effect, have become a sideshow to the political messages. There is a special quality of political pronouncements of environmentalism anchored not only in party ideologies but also in legislation and government agencies. Such political vocabularies are both more widely entrenched and more sluggish in terms of change than are scientific statements and findings.

In the case of global climate, the initial victory of politics over science comes from the circumstance that democratically established political practices are more difficult to revise than scientific errors. If a scientific model no longer fits the data, scientists hurry to make changes in the model, and report the results in a note or paper in the next issue of their journals; such is the modus vivendi of science. To change a political practice is more tedious. Unless you live in a dictatorship, changing policy and legislation may involve party ideology and party congresses, committee work, votes in parliament, the closing of government agencies, even the revision of international treaties. For politicians on the IPCC panel, legislation and its implementing bureaucracies based on old, unrevised scientific findings of rapid global warming during the Twentieth century are very hard to change. This is much more difficult than the acceptance of the same revision by the scientific community. In due time, however, the data on a pause or stop of global warming will force a revision of their model.

It complicates matter that politicians might have geopolitical goals favoring the unrevised climate findings of IPCC, for example, to reduce the international power of the foremost oil- and/or gas-producing countries in the world, Saudi Arabia or Russia. The Saudis use their oil money to finance the spread of a particularly radical Muslimism to the rest of the world. Russia uses its gas and oil income to spread Putinism, a nationalistic (actually fascistic) creed of Slavic moral superiority with rights to incorporate Russia's Slavic neighbors by military force. Neither is welcome in the West that dominates IPCC.

In the international environmental movement, the branch we call Environ-Cleaners continues the local work to achieve clean air and water and non-contaminated food, et cetera. Their work remains unaffected by the failure of IPCC's arguments about global warming with $CO_2$-arguments. In short, their work do not need the dogma of the branch of environmental he movement we call Environ-Saviors.[6] Likewise, the wing of the international environmental movement we called Environ-Diversity Preservers can continue its work of coping with the spread of biological monocultures. Their work is not dependent on any necessary political measures of $CO_2$-reduction to a saving of the next generations from a presumed overheating the globe to make it uninhabitable.

The narrow-minded $CO_2$-scare of global warming promoted by Environ-Saviors might well turn out to be a Quixote focus on windmills. In another aspect of creating a better world, the increase in $CO_2$ has apparently contributed to bumper crops and a speedier growth of trees and plants, a blessing to an increased world population. The loss of the exceptionally good $CO_2$ absorption in the tropical rainforests, which in recent decades have faced too rapid exploitation, may also be considered here.

## A Collaborative Merger of Science, Economy, and the Body Politic.

Henry Etzkowitz (2008) at Newcastle University has made a bold presentation of the new mode of research applied by, originally for the Swedish Innovation System Agency (SINOVA) working jointly with a private Swedish organization, the Center for Business and Policy Studies (SNS).

Imagine a burro hired to serve the application of science. Its mission is to deliver to humanity a new form of energy, or a new medicine, or a gadget of a new technology.

Three persons load the burro. One is a scientist who has made, or is, very close to finishing the presentation of a discovery that promises to be helpful to some people in the larger society. This loader has trained as a developer of new knowledge. The second loader is a businessperson interested in providing a new product for the market. This loader has an eye to new wealth, particularly in the balance sheet of his business. The third loader is a government official in charge of the development of a region by means of new laws and/or more tax money. This loader has a commitment to promote an improved social order of his country.

We can put the above situation in the language of our theory: The first loader wants science to be the main show and the economy and polity the sideshows. The second one wants the economy to be the main show and science and polity sideshows, the third one wants the polity to be the main show and the science and economy to be sideshows.

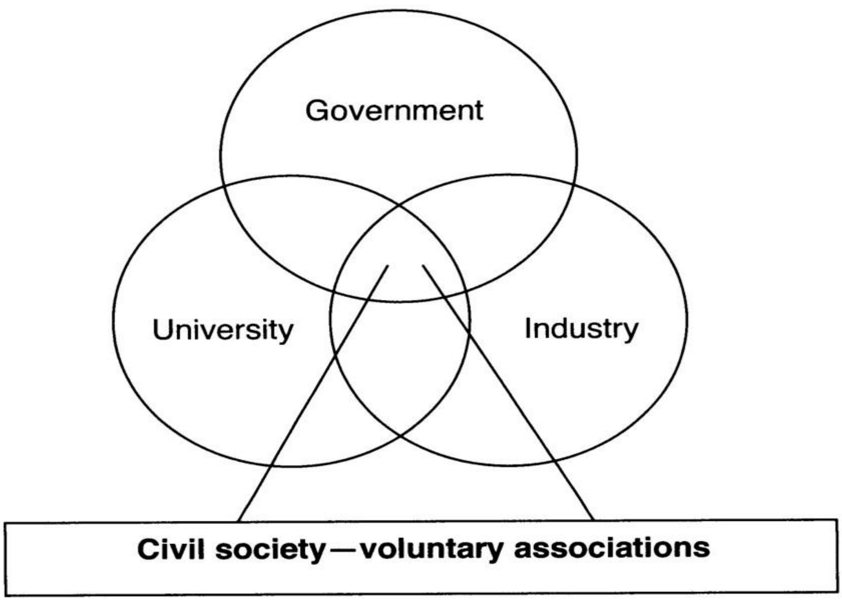
Everyone who knows something about the donkey trade tells the three loaders of the donkey to cooperate. They have to heap the goods around in a way that will not overburden the burro so it cannot carry out its mission at all. Nor must the loads unbalance the burro, so that it loses the trail leading towards the delivery of the application of science.

This is not an easy task: a joint operation of science, economy, and the body politic. This involvement is nowadays discussed under the heading "the triple helix," or, less pretentiously, "the triangle of knowledge."

Etzkowitz (2008) presented The Triple Helix as a new special compound of society where government, university, and industry overlap. It no longer belongs in the pure polity, pure science, or pure economy, but is located in civil society. Thus, the Triple Helix is more than the dual mode of an American type of capitalist incubator in which venture capital prepares a firm with a novel product for independence on the market. It is also more than the dual mode of a communist type of Academy of Science and Engineering that prepares new production for a planned economy.

You may ask why Etzkowitz uses the term "helix," which designates a spiral with special mathematical properties. (We used a conic helix to illustrate the secular trend of humanity's symbol usage in Figure 4.1).[7] In recent years, a helix is mostly known as a DNA-molecule; a double helix structure with one and the same axis. It holds very stable programs for the reproduction of cells, organs, and bodies. The image of helix conveys a sense of results achieved by absolute mutual interdependence.

*Figure 29.1. The Triple Helix According to Etzkowitz (2008, 16).*



In a civil society are usually voluntary and very often idealistic (non-profit). The association of the three loaders of the burro may, of course, be voluntary, but in reality, they are probably bound by ordinary business and employment contracts. It is uncertain whether a Triple Helix in reality ends up in the civil society.

Their mission may be idealistic, for example, when the product they want to deliver is a new medicine, but it could be any new marketable product. A Triple Helix is usually not a "republic of virtue" which many — including the present author (in Volume 5 of The Many-Splendored Society) — see as the jewels of a civil society. The organizational units in a Triple Helix are far from always being the favorite ones of civil society, i.e. "the coop" of shared profits. In fact, Triple Helix organizations may look very much like ordinary profit making limited companies found in the science parks, which, for decades, have also populated the back yard of many university campuses.

Etzkowitz, like Nowotny, Scott and Gibbons (2001) and many others promoting the new mode of scientific research, document in their pleadings that scientists and science teachers are now common types of people in our society, and that all kinds of people are accustomed to talk and deal with them. However, the promoters do not take into full account two basic issues in the dynamics of societal realms.

The first forgotten issue in the designing of a Triple Helix is that various societal realms have different attractions to one another, a fact we spelled out in our Table of Valences.[8] Here we recall denotations such as "Science ≠≠≠ Economy," and "Science ≠≠≠ Polity," and "Economy ≠≠≠ Polity." A sign with three (≠) signals our highest level of difficulty for these realms to reach a mutual consensus. Few mergers of realms in society have such large obstacle to overcome. For one thing, the reward systems of the realms involved are in considerable measure incompatible. One of our loaders wants the eternal honor of a scientific publication, another wants a big bank account, the third wants a promotion in a government bureaucracy.

A second problem is flagged in the previous Volume in the series *The Many-Splendored Society*.[9] Arguments (justifications) with reference to a cardinal value and its related priorities in one particular societal realm cannot effectively be used in alien realms. Everyone can observe that businesspersons and politicians often have different priorities. There is a daily battle between Wall

Street and Washington. Moreover, what sounds good from an economic or from a political point of view may seem irrelevant or even counterproductive from the point of view of science. Our Proposition 11:4 on Consequences of Inappropriate Justifications, reproduced here, lists various outcomes of such conflicts.*

The third often forgotten design problem is that our historical records indicate that any long run of full-fledged mergers of societal realms generally seems to result in increasingly unstable structures. This holds, even when general elation and optimism have marked the initial attempts. We summarized this restriction in Proposition 10:14 on Merged Societal Realms.† There is little reason to believe that the Helix mergers have more chance of survival than the merger of religion and science attempted by Aquino.

Let's look critically at a the health of firms created by triple mergers. How long will they flourish? I believe that statistics would tell that these mergers last long, provided the support from the body politic stays intact. However, what is the shape of modernization where such triple firms have remained? Ordinary business firms, with capitalist financing of production and marketing, may have had better incentives to be quicker at employing smarter and cheaper means than have partially state-owned firms. For example, if a state once has embraced a "green energy policy," it

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* Proposition 11:4. *Consequences of Inappropriate Justifications*: When a justification from one realm is used in other realms, (a) it appears inappropriate to the participants in the other realms, and (b) loses motivational force in the new realms, and/or (c) is actively resisted there, and/or, (d) is pressured to change itself to come in line with appropriate justifications of the new realms (3: 32-33).

† Proposition 10:14. *Merged Societal Realms:* (a) Initially, the proponents of mergers between societal realms tend to become approvingly evaluated in a society, particularly by the Takers in the realms involved. However, (b) any mergers of full societal realms (including their cardinal values, stratifications, organizations, networks, media, etc.) tend to create instable structures that deteriorate over time. (c) The depth and the speed of this deterioration are inversely related to the position of the merging parties on the Scale of Valence of Societal Realms (2: 333).

also has adopted difficulties embracing future possibilities, such as saving clean carbon dioxide in the atmosphere to promote more green vegetation and better harvests.

Triple Helix and similar programs are relatively new phenomena, and we may postpone any final judgments of their effectiveness. We have no full empirical evaluation, only informed impressions, for example, from Newcastle upon Tyne in England and Lund in Sweden; these may simply be comprised of administrative concordat, fair contracts between the societal realms of science, economy, and polity. So far, only our theories raise the fear of a less than solid outcome of this version of research in the context of application. We forecast that the triple-helix start-ups will eventually deteriorate into single-helixes, dominated by the government in societies with socialist tradition, and by the economy in societies with a capitalist tradition.

Unfortunately, it is not certain that existing try-outs with the Triple Helix will ever be subject to proper evaluation. As is typical in all of Europe, the science policies of, say, the United Kingdom and Sweden are full of approaches that the next generations of politicians and professors will support without prior scrutiny. In fact, the science policy of the entire European Union shows a sequence of new "pillars" introduced without having been through any complete evaluation of the previous pillars.

An exception to our predicted outcome of Tripple Helex projects is found in those having new instrumentation, i.e. specific new research-technologies.

## The Hidden but Rare Benefit: Research-Technology

There is at least one area, identified by Terry Shinn as "Research-Technology," in which science, *and* industry, *and* government remain benefitting and long-term partners. This is a specific field in which all stand much to gain by contributing to research-technology in the form of novel *instrumentation.* Shin holds "that research-technology generates broad fundamental impulses that drive scientific research, industrial production and technology-related state activities along their respective paths." (Shinn 2008, 4)

The development of the laser, invented in 1960 in physics, has since then stimulated instrumentation in other pursuits. The use of lasers in medicine in so-called bloodless surgery (e.g. crushing kidney stones) has added to the knowledge of its light. Laser found use in industry and commerce by scanning bar codes in warehouses and at cash counters in stores. The information age through laser disks and laser printers, has created great riches, but has also added to the scientific knowledge of laser properties. The use of lasers by the police in reading and identifying finger prints is a service to the body politic but has probably not had any impact on the physics' of lasers, rather perhaps on the study of skin anatomy. At any rate, the varied instrumentation of laser as a research-technology, sets an example of an important exception to what, otherwise, are the pessimistic prospects of the Tripple Helex model.

Certain instrumentations in the social sciences have had similar effects. The invention of the sampling of interview respondents, questionnaire construction, and statistical analyses is a case in point. Certain demographers in prewar Netherlands used this innovation to expand their field of study of populations to studies of community life, calling this extension of demography "sociography." In the 1930s, psychologists associated with Karl and Charlotte Bühler in Vienna approached sociography community studies with new dimensions of interviewing and analysis. They studied, among many other things, the village of Marienthal with 1500 people outside of Vienna, whose textile factory went out of business in the Great Depression and pushed the majority of the inhabitants into unemployment (Lazarsfeld-Jahoda and Zeisel 1933). The young Paul Lazarsfeld was one of the Bühler assistants who conducted and codified the principles of sociography; see his early papers in a posthumous collection (Lazarsfeld 2011).

At the same time in Princeton, NJ, and independent of the European sociography, George Gallup and Elmo Roper each developed opinion research (polling) based on interviews. Their original instrumentation was nationwide interviewing and publication in the mass media, but their fieldwork was also used for market research. Lazarsfeld, who had moved to the United States, continued his sociography work. In 1940 when he joined Columbia University, he began to call his work "sociology," which fitted the established university organization. The Sociology Department at Columbia housed Professor Robert S Lynd, famous for a community study, *Middletown,* with his wife Helen Lynd (1929).

The instrumentation of interview studies has benefitted all social sciences, particularly sociology, political science, media research, market studies, value research, and cultural studies. In the life sciences, it is used in epidemiology and drug research. Private research houses have been as active as universities and government agencies in the implementation and, thus, users from several societal realms have added to the sophistication of the interviewing instrument.

The success stories of the Shinn-type of applied research receive a great deal of publicity. While I am writing this (Spring 2014), my academy spreads the word that "Lab-On-A-Chip technology is rapidly paving its way as an enabling platform for advanced studies in life science research and as diagnostic or analytical tools in areas ranging from clinical medicine to environmental control." The failing attempts of collaboration of science and other societal realm receive less publicity. They appear more numerous. Reliable numbers are missing.

## Some Notes for a Future Coda

In this book, we have seen the societal realm of science emerge by using old structures such as monasteries and guilds and then breaking with them, eventually forming new structures such as academies, universities and think tanks, and adding an exclusive devotion to knowledge that is different from the devotion to sacredness and riches. We have also noted how the new realm of science, at least in the United States, obtained freedom, so that free universities were founded that could locate, organize, and operate without political control and supervision. Science became thus fit for the *organic cooperation* with other realms. In such cooperation, science maintains its identity and relative independence (*Eigengesetzlichkeit*).

The relation between science and the other realms in society is straightforward. Scientists ask us to make no mistake. It is science that you shall follow when incompatibility occurs between, on one side, traditional religious, political, artistic, business, or gender *descriptions* of the world and of consequences of events and actions, and, on the other side, the present standpoints of physics, biology, psychology, sociology, and other sciences. This does not rule out that sideshows[10] from other realms are welcome and helpful to science. Scientists use money from the economy, legal protection from the polity, styles, and performance from art, virtues of honesty and fairness from the realm of morality, and a sense of meaning and purpose, of course stripped of magic and superstition, that might well be called religious.

*Table 29.1. Organic Cooperation of Societal Realms, (as earlier presented as Figure 10.3 on page 2: 209)*

In a many-splendored society, a realm of knowledge that is governed by politicians is as much an anathema as is politically dictated art, religion, or ethics. Or, for that matter, as obnoxious as business and industry owned and directed by the body politic, i.e. socialism.

Organic cooperation — to incorporate sideshows from other realms — is a welcome and common cooperation between societal realms. With organic cooperation, the Procurers and Providers from science can maintain academic freedoms, as enumerated in Table 23.1.[11] Note clause 2d and 2e in the bundle of academic freedoms that set restrictions, due to a university's mission of teaching and research. Outside financing and assignments, serving other realms than science itself, are issues that the faculty professors, not industrialists, politicians, not even an established university administration, shall dictate. Remember the model rule implementing this restriction at the University of Chicago.[12]

In this book, we have focused on the realm of science, and its godfathers, i.e. religion, economy, and polity. The relation between science and religion has been inflamed. By offering alternative descriptions to the religious practice of sanctifying old stories about the universe, earth, and creation, science defines many current religions as uninformed and pretentious. As we will spell out in Volume 5 of *The Many-Splendored Society,* this does not disqualify religion to be and remain an established realm of society, just as science has more recently been inaugurated as one such realm.

Science does not, cannot, and should not remove emotive evaluations from our language and life. Such parts of language include religious and secular versions of the joy of living, love, compassion, and grief. The latter remain what they always have been in social life, just as when science describes them in terms of glands, neurons, and genes. Such a description is nowadays possible, and is very interesting, as David Brooks (2011) has shown to the educated public. However, the new scientific accounts do not change the effects, known for ages, of our joy of living, love, compassion, grief and other emotively engaging aspects of communicating and living.

Science *describes* the world and the life in the world; it can also tell us something about health, energy efficiency, and environmental sustainability. However, it leaves to other societal realms, particularly economy and religion, to *evaluate* what is worthwhile, and to still other realms, to polity and morality, to *prescribe* and justify actions. This division of labor between the categories of language, as well as between the realms of society, is central to our entire social theory.[13]

With the Dual and Triple Helix and similar designs, many problems and dangers of outright mergers of societal realms reappear. Then, science loses its bounded autonomy (*Eigengesetzlichkeit*), and becomes a mere handmaiden of a capitalist economy and/or of governance driven by national or regional planning. From the point of view of a many-splendored society, such loss of academic freedom would be unplanned and tragic outcomes of planned actions.

## A Task for the Central Zone

Similar to the prospect of many other issues, research activities in the context of applications call for an active role of a central zone within their societies, where the elites of the various societal realms meet as equals and exercises their soft power.

In the dynamics of societal realms, we notice a repeated pattern. Science loses to economy, and economy loses to the body politic. We will soon explore (in volume 5) to what extent the realms of art, religion, and morality follow other paths. At present, all societal realms seem to provide more self-congratulatory clamor, than responsibility for society as a whole. Advanced societies need a fully developed central zone of realm elites mediating the different ambitions of the societal realms.

## Notes to Chapter 29, Science in Deep Collaboration with Other Societal Realms

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[1]In recent years, a helix is mostly known as a DNA-molecule; a double helix structure with one and the same axis. It holds very stable programs for the reproduction of cells, organs, and bodies. Helix is a spiral with special mathematical properties. We used a conic helix to illustrate the secular trend of humanity's symbol usage in Figure 4.1 on page 1: 142

[2] Ch 19 (Vol 4) Finding a Modus Vivendi and Ethos of Science: The Current Standpoint of Science, p 57ff

[3] Ch 18 (Vol 4) The Emergence of Science
in Europe: The Deterioration of the Aquino-Aristotle Synthesis, p 22ff

[4] Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: A Periodic Table of Societal Realms, Table 9.10, p 301-302

[5] (Vol 2) Proposition 10:14, Merged Societal Realms, recalled p 267

[6] Ch 7 (Vol 2) Leadership and Collectivities: The Shifting and Expanded Foci of the Environmentalists, p 159ff

[7] Ch 4 (Vol 1) Vibrations in Symbolic Environments: Figure 4.1 Communication Technologies and Value Climates in the Expanding Symbolic Environment, p 142

[8] Ch 10 (Vol 2) Societal Realms and Their Relations: The Valence of Societal Realms, Table 10.1, p 320

[9] Ch 10 (Vol 2) Societal Realms and Their Relations: The Valence of Societal Realms, Table 10.1, p 320

[10] Ch 9 (Vol 2) Cardinal Values and Their Societal Realms: Sideshows Embedding Alien Cardinal Values, p 255ff

[11] Ch 23 (Vol 4) Universities Then and Now: Table 23.1. The Complex of Academic Freedoms at the Time of Karl Jaspers (1883 – 1969). p 137

[12] Ch 22 (Vol 4) Stratification
and Rewards in Science, criteria for university appointments and acceptance of outside research grants, p 125

[13] Ch 5 (Vol 1) Linguistic Forms and Usages: Discourses, p 185

# Propositions

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## The Author

Hans L. Zetterberg, born 1927 in Stockholm, Sweden, came to the University of Minnesota in 1949 and did maintain The United States as his main base for 20 years. He taught sociology at the Graduate School of Columbia University and at Ohio State University, where he was Chairman of the Sociology Department.

He was also the head of publishing at Bedminster Press, which had the motto: "Books by scholars for scholars." A highlight of this position was the publication in 1968 of the full translation of Max Weber, *Economy and Society*, later available also as a paperback from University of California Press. The members of American Sociological Association voted in 1997 this work as the 20th century's most influential book in sociology.

In his native country, Zetterberg was the first Chief Executive and organizer of The Tri-Centennial Fund of the Bank of Sweden, one of Europe's larger foundations supporting social science. He turned to the private sector and became a long-established professional pollster, Managing Director and owner of Sifo AB, a company for market and social research. He became Editor-in-Chief of the national daily newspaper, *Svenska Dagbladet*, and further developed his writing to reach an inquisitive general public.

Zetterberg is a past President of The World Association for Public Opinion Research. He is a member of The Royal Swedish Academy of Engineering Sciences.

In a multi-volume work in progress, *The Many-Splendored Society*, Zetterberg sums up essential knowledge of social science. His key to social reality is simple and optimistic: if humanity has the capacity to cook previously unheard-of sentences, it also has the capacity to cook and serve social structures and cultures never before seen. However, only a minority of our sentences is new from generation to generation, and it takes effort to create sets of new ones. Societies and their institutions, likewise, can count on both long traditions and on manageable changes. *The Many-Splendored Society* is a great story about this achievement.