SSTC Report 4/2013

“Economization” of Science

Recommendations and Proceedings of the Seminar Held in Bern by the Swiss Science and Technology Council on April 23, 2013

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Schweizerischer Wissenschafts- und Technologierat
Conseil Suisse de la Science et de la Technologie
Consiglio Svizzero della Scienza e della Tecnologia
Swiss Science and Technology Council

The Swiss Science and Technology Council

The Swiss Science and Technology Council SSTC is the advisory body to the Federal Council for issues related to science, higher education, research and innovation policy. The goal of the SSTC, in line with its role as an independent consultative body, is to promote a framework for the successful long term development of Swiss higher education, research and innovation policy.

Le Conseil suisse de la science et de la technologie

Le Conseil suisse de la science et de la technologie CSST est l'organe consultatif du Conseil fédéral pour les questions relevant de la politique de la science, des hautes écoles, de la recherche et de l'innovation. Le but de son travail est l'amélioration constante des conditions-cadre de l'espace suisse de la formation, de la recherche et de l'innovation en vue de son développement optimal. En tant qu'organe consultatif indépendant, le CSST prend position dans une perspective à long terme sur le système suisse de formation, de recherche et d'innovation.

Der Schweizerische Wissenschafts- und Technologierat

Der Schweizerische Wissenschafts- und Technologierat SWTR berät den Bund in allen Fragen der Wissenschafts-, Hochschul-, Forschungs- und Innovationspolitik. Ziel seiner Arbeit ist die kontinuierliche Optimierung der Rahmenbedingungen für die gedeihliche Entwicklung der Schweizer Bildungs-, Forschungs- und Innovationslandschaft. Als unabhängiges Beratungsorgan des Bundesrates nimmt der SWTR eine Langzeitperspektive auf das gesamte BFI-System ein.

Il Consiglio svizzero della scienza e della tecnologia

Il Consiglio svizzero della scienza e della tecnologia CSST è l'organo consultivo del Consiglio federale per le questioni riguardanti la politica in materia di scienza, scuole universitarie, ricerca e innovazione. L'obiettivo del suo lavoro è migliorare le condizioni quadro per lo spazio svizzero della formazione, della ricerca e dell'innovazione affinché possa svilupparsi in modo armonioso. In qualità di organo consultivo indipendente del Consiglio federale il CSST guarda al sistema svizzero della formazione, della ricerca e dell'innovazione in una prospettiva globale e a lungo termine.

SSTC Report 4/2013

“Economization” of Science

Recommendations and Proceedings of the Seminar Held in Bern
by the Swiss Science and Technology Council on April 23, 2013

Contents
Table des matières
Inhalt

Summary
Résumé
Zusammenfassung

E

Far-reaching changes have taken place in industrialized countries since the 1980s in how science and innovation are thought of and practiced. Science policy studies often conceive these as effects of an emergent “knowledge economy”. To better understand these developments, the Swiss Science and Technology Council (SSTC) held a seminar in April 2013 focused on the “economization” of science.[1] Its aim was to learn what forms such “economization” takes, the effects it has had and the opportunities and risks these changes entail for the science system funded by the state.

Dominique Pestre (Ecole des hautes études en sciences sociales, Paris), Peter Weingart (University of Bielefeld) and Gerd Folkers (SSTC member) contributed their insights; thereafter, the SSTC discussed their presentations. These presentations and discussions are the subject of the following publication, and they form the basis for statements and recommendations by the SSTC published in the first section of the present document.

“Economization” provides welcome opportunities for the development of higher education and scientific research. For these opportunities to be realized, lawmakers, research funders, trustees and boards of directors, but university administrations as well, should maintain the conditions for original work, conducted over a longer term, that permits fundamentally new knowledge to be generated. Adequate, public, basic funding serves this purpose. In reports on the performance of the universities (accountability) a balanced selection of indicators should make the entire spectrum of the disciplines and their achievements visible. A monetary “return on investment” should not count as the measure of good public science. The reporting should show that a university, in a sensible balance, fulfills its three fundamental functions: research, teaching and educating, as well as benefitting society and economy as a whole. Universities should establish explicit guidelines for the relationship between universities (or institutes and professorial chairs) and private funders as well as private partners in scientific collaborations. These should be nationally uniform and apply to all institutions equally.

1 In this publication, the notion of “economization” always appears in quotes to emphasize that we here refer to transformations in science and knowledge and in the public arena during the last decades that can be understood as having been driven, at least in part, by “the economy”.

F

Depuis les années 1980, dans les pays industrialisés, les conceptions et les pratiques de la science et de l’innovation connaissent une profonde transformation que les études sur les sciences associent aux effets de l’émergence d’une «économie de la connaissance». Afin de mieux comprendre ces développements, le Conseil suisse de la science et de la technologie (CSST) a tenu en avril 2014 un séminaire consacré à «l’économisation» de la science[2]. Le but de ce séminaire était de comprendre les formes de ce processus, ses effets, les chances qu’il offre ainsi que les risques qu’il comporte pour le système scientifique financé par les pouvoirs publics.

Suite aux exposés de Dominique Pestre (Ecole des hautes études en sciences sociales, Paris), Peter Weingart (Université de Bielefeld) et Gerd Folkers (membre du CSST), le Conseil a mené une discussion approfondie. Ces présentations et discussions font l’objet de la présente publication; elles constituent la base sur laquelle le CSST a formulé ses thèses et recommandations qui sont reproduites au début de ce document.

«L’économisation» ouvre des perspectives bienvenues pour le développement de l’enseignement supérieur et de la recherche scientifique. Afin de tirer le meilleur parti de ces chances, le législateur, les organismes d’encouragement de la recherche, les entités de tutelle et les directions des Hautes écoles doivent préserver les conditions-cadre nécessaires à la conduite de travaux originaux et à long terme, lesquels favorisent le développement de nouvelles connaissances fondamentales. Un tel but nécessite de disposer d’un financement public de base suffisant. Les rapports à soumettre aux autorités de tutelle sur les activités des Hautes écoles au titre de la redevabilité *(accountability)* doivent offrir une sélection judicieuse des indicateurs pour rendre visible la totalité du spectre des disciplines et de leurs accomplissements. Le retour purement financier sur l’investissement ne saurait devenir l’aune à laquelle se mesurerait la qualité de la science publique. Ces rapports doivent montrer si l’établissement remplit ses trois missions fondamentales selon un juste équilibre: la recherche, l’enseignement et la

2 Dans les pages de la présente publication, nous mettons le terme «économisation» toujours entre guillemets afin de souligner que nous interprétons des transformations intervenues dans les domaines de la science, du savoir et de l’opinion publique pendant les dernières années comme causées, au moins partiellement, par «l’économie».

formation, ainsi que le service à la société et à l'économie. Les Hautes écoles doivent établir des directives explicites pour les coopérations scientifiques entre Hautes écoles, instituts et chaires professorales ainsi que leurs bailleurs de fonds et partenaires privés qui s'appliquent sans distinction à toutes les institutions de Suisse.

D

Begriff und Praxis von Wissenschaft und Innovation haben seit den 1980er Jahren in den industrialisierten Ländern weitreichende Veränderungen erfahren. Die Wissenschaftsforschung interpretiert diese meist als Auswirkungen der sich entfaltenden „Wissensökonomie". Um diese Entwicklungen besser zu verstehen, hat der Schweizerische Wissenschafts- und Technologierat (SWTR) im April 2013 eine Veranstaltung über die „Ökonomisierung" der Wissenschaft durchgeführt.[3] Der Rat verfolgte das Ziel, sich mit den Formen dieser „Ökonomisierung", deren Auswirkungen sowie den sich daraus ergebenden Chancen und Risiken für das öffentlich finanzierte Wissenschaftssystem auseinanderzusetzen.

Im Anschluss an Referate von Dominique Pestre (Ecole des hautes études en sciences sociales, Paris), Peter Weingart (Universität Bielefeld) und Gerd Folkers (Mitglied des SWTR) hat der Rat eine weiterführende Diskussion veranstaltet. Die vorliegende Veröffentlichung enthält die Referate und Diskussionsbeiträge. Auf ihrer Grundlage hat der SWTR seine Thesen und Empfehlungen ausgearbeitet, die dem Dokument vorangestellt sind.

Die „Ökonomisierung" bietet willkommene Chancen für die Entwicklung des Hochschulwesens und der wissenschaftlichen Forschung. Damit diese Chancen realisiert werden können, sollen Gesetzgeber, Forschungsförderer, Trägerschaften, aber auch die Hochschulleitungen die Rahmenbedingungen für längerfristige originäre Arbeiten, die grundsätzliche neue Erkenntnisse ermöglichen, erhalten. Dazu dient eine ausreichende öffentliche Grundfinanzierung. Die Berichterstattung über die Leistungen der Hochschulen an die Trägerschaften *(Accountability)* soll durch eine ausgewogene Wahl der Indikatoren das gesamte Spektrum der Disziplinen und deren Leistungen sichtbar machen. Dabei soll ein monetärer „Return on investment" allein nicht als Massstab für gute öffentliche Wissenschaft gelten. Das Berichtswesen soll zeigen, dass eine Hochschule alle drei Aufgaben in einem sinnvollen Verhältnis zueinander erfüllt: forschen, lehren und bilden sowie Nutzen für Gesellschaft und Wirtschaft stiften. Für die Beziehungen zwischen Hochschulen oder Instituten/Lehrstühlen und privaten Geldgebern sowie privaten wissenschaftlichen Kooperationspartnern sollen die Hochschulen explizite Richtlinien aufstellen, die innerhalb der Schweiz für alle Institutionen gleichermassen gelten.

3 Der Begriff „Ökonomisierung" wird in dieser Veröffentlichung stets in Anführungszeichen gesetzt. Wir möchten damit unterstreichen, dass wir damit Veränderungen der letzten Jahre in Wissenschaft, Wissen und im diesbezüglichen öffentlichen Diskurs bezeichnen, die wenigstens teilweise als Wirkungen eines Einflusses „der Wirtschaft" aufgefasst werden.

Part One

Statements and Recommendations by the Swiss Science and Technology Council

1. Defining the "economization" of science

We define the "economization" of science as the application of economic principles to the structures of science. This includes treating knowledge as a good whose production and marketing is competitive, and the (monetary) price of the good is determined. In this context, scientists and researchers act increasingly as *homines economici* in their roles as producers, providers, consumers or investors, while academic research institutions take on the role of firms. The differentiation of a scientific research field from an economic field, and the corresponding distinction between capital that is specifically scientific from capital that is economic, blurs. The term "academic capitalism" has been used to characterize this development.[4]

The Swiss Science and Technology Council (SSTC) would like to use the notion of "economization" in a more differentiated manner, so as to distinguish between what promotes and supports science and what has dangerous effects. The SSTC would like to make recommendations how the positive effects, including creating spinoffs, can be utilized, and the negative effects mitigated.

The "economization" of science is manifested in two dimensions. These have existed for some time, but have increased in importance in the last decades. In the first dimension, "economization" is part of, as well as a consequence of, creating a knowledge economy. The second dimension is seen in various phenomena lying at the intersection between science, politics and the public, as well as within research endeavors: it is connected to a particular type of "governance" or "management" of publicly financed research. Such phenomena can be understood as the effects or consequences of creating a knowledge economy (the first dimension).

4 Hasselberg 2012.

A broader understanding of the "economization" of science

The "economization" of science, understood more broadly, is a process that changes the conditions for engaging in research and teaching at publicly financed universities. It results from the fact that knowledge—the result of research freely engaged in and publicly disseminated—has an economic value, or can have such a value. Knowledge can be a good for which there is a market and which has a monetary value. In the course of establishing a knowledge economy and a knowledge society, this commodity characteristic of knowledge has become increasingly evident. In specific fields, public universities thereby become firms which produce and market knowledge, and through their sponsorship or investment, private firms are also present at these public knowledge production sites. This has changed the conditions under which scientists and researchers work and are evaluated. The distinction between knowledge acquired in public university settings, which in consequence is knowledge that belongs to the public, and proprietary knowledge (shielded from competitors) that is acquired in private market settings, is put in question. The customary, successful cooperation between academic/public and entrepreneurial/private cooperation, which had been based on the complementarity (or asymmetry) of their different working conditions and goals, now appears in a new light.

A narrower understanding of the "economization" of science

In a narrower sense, the "economization" of science refers to a process by which the basic elements of direction and administration (governance or management, for example) used in the world of private companies (and which was tailored to the administration of businesses) is transferred to public universities. This usually takes place in the expectation that public funders will thereby be disburdened from their institutional guidance roles yet will at the same time receive a higher return for outlays for higher education (New Public Management).

On the one hand, this tendency is manifested externally in the relationship of universities to public funders and trustees (an obligation to provide accountability in return for granting institutional autonomy, under the condition that the independent university act in an entrepreneurial manner, as well as performance-dependent funding, understood as investments that are profitable or worthwhile). On the other hand, it is manifested within the universities through changes to academic structures, the manner in which they act, and in their leadership style (strategic on the part of trustees or boards; management by university administrations; internal resource allocation based on performance; corresponding personnel policies). Characteristic here are performance mandates or goals tied to the use of quantitative performance indicators (including success at winning third-party funding, as well as indicators of the quantity and effects research products have had), a focus on results rather than process, monetary incentive schemes, routinized quality assurance measures, and the use of benchmarking and rankings.

2. Effects of the "economization" of science

Research at public universities is increasingly linked to the use of this knowledge by private firms. This process has gone furthest in the molecular sciences. Entrepreneurial thinking among researchers is supported, and university administrations promote such tendencies by providing guidelines for patenting, licensing, and knowledge or technology transfer. They also do so by making contacts with companies or by making success at obtaining third-party funding into a criterion for selecting university instructors and researchers. The esteem in which specialized fields are held becomes dependent on their opportunities and abilities to create economically exploitable knowledge. It is against this background that research efforts are restructured or redistributed between institutions.

Material incentives and competition that follows rules formulated from outside of the scientific community (oriented to productivity rather than to knowledge gained, for example), as well as the obligation to provide accountability at intervals and in formats determined from without, affect the behavior of researchers and instructors. Having to orient research activity to accord with relatively short-term projects, and to pay increased attention to the potential economic and social effects the knowledge produced has (outside of science), changes the research culture in the affected disciplines. Steering by the university administration, employing the strategic emphases, profile development, and orientation to setting objectives that private market firms use, and that awards or withdraws resources based on quantifiable successes, competes with or supplants the self-steering that exists in scientific research. Instead of a logic generated from the reward system that exists in science (academic prestige serving as a form of "capital" that is specific to academic research), one finds a logic generated from the marketplace.

3. The opportunities "economization" provides

"Economization" expands the scope of action in individual research areas by creating direct relationships to private funders and to circles interested in using the knowledge to stimulate their own research. To complement their public funding, such research areas can tap into private sources, and can acquire new knowledge through cooperating with private sector research efforts. In doing so, knowledge transfer possibilities improve, the effectiveness of scientific activities increases, and innovation is made easier.

"Economization" is currently the political precondition for granting greater (institutional) autonomy to public universities. The use of key numbers as indicators makes a formalized and transparent accountability possible. In given circumstances, this may allow trustees, boards of directors, and public funders to develop the needed confidence and trust to finance the operations of a university. The emphasis placed on competitive elements and systematic comparisons are regarded by such overseers as quality assurance mechanisms, making direct or top-down intrusions and closely supervised controlling measures superfluous.

Market mechanisms are only partially compatible with the science system. But also in science and research, there is a market for ideas. This will especially be the case when the adequate decisions are taken at the decentralized level of faculties, institutes and professorial chairs, instead of at the top of the university. This conception of market and concurrence structures can help academics to take scientific decisions on their own ("bottom-up") within the given strategic orientation of their institution.

4. Risks associated with "economization"

"Economization" carries with it the risk of privately acquiring knowledge using public resources, of research efforts oriented in a one-sided manner toward results that can be readily economically exploited, and of science itself becoming dependent on the expectations of private funders. The exclusive use of knowledge by private interests also carries the danger it will inhibit open communication between researchers currently carried out through the rapid dissemination of results in specialized journals. The expectation that resources made available to universities can only be justified by the monetary profit they realize obscures seeing the non-monetary goals of scientific work, namely the methodical search, guided by curiosity and corrected by critique, for truth.

The use of unsuited elements of New Public Management, such as the monetary calculation of costs and yields, or using reporting formats developed for private companies to steer public universities, can devalue the intrinsic motivations of researchers and instructors in favor of a materialist profit optimization.

If incentives are applied without taking the particular logic of competition within scientific research into account, then the number and formal 'impact' of publications, along with success in obtaining third-party funding, may come to be rewarded as ends in themselves. Academic "production" would then be limited to small-scale, short-term, low-risk projects. The long-term search for unexpected and fundamentally new insight and knowledge would be relegated to the margins.

A strong emphasis on competition within a university turns it into a loose association of profit-making centers and weakens the institution's inner cohesion.

5. Recommendations

As noted above at 3., “economization” provides welcome opportunities for the development of higher education and scientific research. For these opportunities to be realized, the SSTC recommends taking the following measures.

5.1

Lawmakers, research funders, trustees and boards of directors, but university administrations as well, should maintain, and where necessary improve, the framework and conditions for original work, conducted over a longer term, that permits fundamentally new insights and knowledge to be generated. Adequate, public, basic funding serves this purpose. Those who teach and do research at universities should be able to plan for the longer term and work under conditions of relative material security so as to be able to take the risks that are associated with good scholarship and science. Magnitude or quantity alone should not be rewarded.

5.2

Reporting on the performance of the universities to trustees or boards of directors (accountability) should be structured in such a manner so as to adequately inform public funders in accordance with their needs but not so as to excessively burden researchers. A balanced selection of quantitative and qualitative indicators should make the entire spectrum of the disciplines and their achievements visible. The reporting should show that a university, in a sensible balance, fulfills its three fundamentals functions: research, teaching and educating, as well as benefitting society and economy as a whole.

5.3

The variety of disciplines should be guaranteed in such a manner that university administrations, in resource allocation as well as in publicly reporting the achievements at the institution, take all disciplines duly into account. Research areas in which knowledge can more readily find direct economic use should not just for that reason be favored.

5.4

Market mechanisms in higher education should serve to shift decisions from the university administration to faculties, institutes, and professorial chairs, thereby expanding their self-empowerment. A monetary “return on investment” should not count as the measure of good public science.

5.5

Universities should establish explicit guidelines for the relationship between universities (or institutes and professorial chairs) and private funders as well as private partners in scientific collaborations. These should be nationally uniform and apply to all institutions equally. These guidelines should adhere to the following basic principles:

- Agreements between universities (or their units) and private funders or private collaborators should be set up in a transparent manner. The conditions laid out in the respective agreements should be publicly available; aspects that are commercially competitive would remain confidential.
- The financing should be ensured for the longer term.
- The freedom to teach and conduct research should be explicitly guaranteed.
- The freedom to choose the methods to be used should be guaranteed.
- Personnel decisions should be made according to the usual academic practices and rules.
- Knowledge generated in the context of a collaboration between a public university and a private enterprise should be available for use in non-commercial basic research.
- The free communication of scientific results should be guaranteed. This should also be true of negative results or of results which are not in the interests of the private sector partner.

Première partie

Thèses et recommandations du Conseil suisse de la science et de la technologie

1. «L'économisation» de la science: définitions

«L'économisation» de la science désigne l'application des principes de l'économie de marché aux structures scientifiques: le savoir est conçu en tant que marchandise, sa production et sa vente s'inscrivent dans un contexte de concurrence qui en détermine la valeur marchande. Le scientifique, ainsi transformé en *homo economicus*, endosse de plus en plus le rôle de producteur, de fournisseur, de consommateur ou d'investisseur; quant aux centres scientifiques, ils deviennent des entreprises. La ligne de démarcation s'estompe entre le domaine économique et scientifique, entre le capital économique et spécifiquement scientifique. On a ainsi parlé à ce propos de «capitalisme académique»[5].
Le Conseil suisse de la science et de la technologie (CSST) adopte une approche nuancée de «l'économisation», en distinguant bien ses aspects positifs pour la science et ses retombées indésirables; il souhaite, par ses recommandations, nourrir la réflexion sur les façons de tirer parti des apports de cette évolution (p. ex. la création de *spin-offs*) et de pallier ses effets négatifs.
«L'économisation» de la science possède deux dimensions, qui ne sont pas nouvelles, mais qui ont gagné en importance ces dernières décennies. La première est celle de l'avènement d'une économie du savoir, dont «l'économisation» est à la fois une composante et une conséquence. La seconde se manifeste dans un ensemble de phénomènes apparus au sein de la science et à ses interfaces avec la classe politique et le grand public; liés à une certaine forme de gouvernance resp. de gestion de la science à financement public, ils sont en partie l'expression de l'économie du savoir observée dans la première dimension.

5 Hasselberg 2012.

«L'économisation» de la science au sens large

Au sens large, «l'économisation» de la science est un processus qui influe sur les conditions de l'enseignement et de la recherche dans les établissements d'enseignement supérieur à financement public. Un tel processus s'explique en raison du fait que le savoir, même issu de la recherche libre et diffusé par l'enseignement public, possède ou peut acquérir une nature économique et devenir une marchandise, avec son propre marché et sa valeur monétaire. L'émergence de l'économie resp. de la société du savoir confirme toujours davantage ce caractère marchand, au point que dans certains domaines disciplinaires, des Hautes écoles publiques se muent en entreprises de production et de commercialisation de savoirs, tandis que le secteur privé intervient dans ces lieux de production par le biais du sponsoring et de l'investissement direct. Ces transformations influent sur les modes d'évaluation des scientifiques ainsi que sur leurs conditions de travail. Elles remettent également en question la séparation entre le savoir généré par la Haute école publique, qui appartient de fait à la collectivité, et le savoir généré par le secteur privé, lequel doit être protégé de la concurrence des autres acteurs privés. Dès lors, la coopération traditionnelle et performante entre la recherche universitaire publique et la recherche industrielle privée, fondée sur la complémentarité entre des conditions et objectifs «asymétriques», apparaît sous un jour nouveau.

«L'économisation» de la science au sens restreint

Au sens restreint, «l'économisation» de la science désigne un processus par lequel les principes de la direction *(governance)* et de la gestion *(management)*, en vigueur dans le secteur des entreprises privées ou portés par l'économie d'entreprise qui s'en réclame, sont appliqués aux Hautes écoles publiques. Les bailleurs de fonds publics en attendent le plus souvent un allégement de leur fonction de pilotage, et une meilleure efficience des moyens qu'ils affectent aux établissements (cf. Nouvelle gestion publique).
Ce phénomène s'observe d'une part à l'extérieur de la Haute école, c'est-à-dire dans ses rapports avec ses bailleurs de fonds publics et ses collectivités de tutelle (devoir de redevabilité ou *accountability* en contrepartie de l'octroi de l'autonomie institutionnelle,

accordée à la condition que la Haute école désormais indépendante agisse comme une entreprise; financement aux résultats, conçu comme un investissement qui doit être rentable). Et d'autre part, il apparaît à l'intérieur de la Haute école, dans la transformation des structures académiques, des fonctionnements et des modes de direction (direction stratégique assurée par le conseil de la Haute école, direction opérationnelle confiée à l'équipe de direction, allocation interne des ressources selon les résultats obtenus, politique du personnel définie en conséquence). Citons également, à titre de mots-clés, la conclusion de contrats de prestations et le recours aux indicateurs quantitatifs de performance (parmi lesquels la capacité à capter des financements de tiers, ainsi que le volume des produits du travail scientifique et leurs effets), l'accent mis sur les résultats plutôt que sur les processus, les systèmes d'incitations financières, les dispositifs intégrés d'assurance de la qualité, ainsi que le recours à l'étalonnage *(benchmarking)* et aux classements *(rankings)*.

2. Les effets de «l'économisation» de la science

La recherche dans les Hautes écoles publiques est toujours davantage liée à l'utilisation du savoir par les entreprises privées. Ce rapprochement est le plus avancé dans le domaine des sciences moléculaires, où l'entrepreneuriat des chercheurs est fortement encouragé. Les directions des établissements soutiennent ces tendances en édictant des directives relatives aux demandes de brevet, d'octroi de licences et de transfert de savoirs et de technologie, mais parfois aussi en prenant pour critères de sélection de leurs chercheurs et enseignants l'insertion dans des réseaux scientifiques et le potentiel de captage de financements de tiers. Les disciplines sont appréciées en fonction de leur capacité à produire des savoirs qui peuvent être valorisés sur le plan économique, ce qui peut déboucher sur des restructurations internes de disciplines ou des redistributions entre établissements.

Dans les domaines scientifiques les plus concernés par ce phénomène, le comportement des enseignants et chercheurs subit l'influence des incitations matérielles et de la concurrence fondée sur des règles externes à la science (productivité plutôt que découverte de nouvelles connaissances), ainsi que l'obligation de rendre des comptes selon une fréquence et des modalités formelles définies hors du contexte scientifique. Une nouvelle culture émerge parmi les chercheurs des disciplines concernées: la recherche se fait au rythme de projets à relativement court terme et se centre davantage sur les retombées économiques et sociales (non scientifiques) que le savoir est censé générer. L'autonomie décisionnelle de la science entre en concurrence avec le pilotage interne émanant de la hiérarchie institutionnelle, laquelle s'appuie sur la définition de priorités stratégiques, de profils et d'objectifs inspirés de la gestion d'entreprise, et accorde ou retire les ressources en fonction de succès quantifiables. A la logique de la récompense scientifique, où le prestige académique est conçu comme un capital propre à la science, s'ajoute ainsi une logique économique.

3. Les chances de «l'économisation»

«L'économisation» de la science élargit la marge de manœuvre dans certains domaines scientifiques, en créant des liens directs avec des bailleurs de fonds privés et des entités intéressées par la valorisation du savoir, ce qui peut stimuler la recherche. Ainsi, ces domaines parviennent à capter des ressources privées, en plus de leurs financements publics, et, par la coopération avec la recherche privée, à faire avancer les connaissances. Cela accroît les possibilités de transfert de savoir, améliore l'efficacité du travail scientifique et facilite l'innovation.

«L'économisation» est la condition politique de l'autonomisation institutionnelle des Hautes écoles. L'utilisation de chiffres-clés en tant qu'indicateurs favorise le formatage et la transparence de l'information. Dans les circonstances actuelles, les collectivités de tutelle et bailleurs de fonds publics trouvent dans une telle forme de redevabilité la confiance nécessaire à la légitimation du financement de l'établissement. De même, l'accent mis sur les principes de concurrence et sur les comparaisons systématiques permet de garantir l'assurance de la qualité, et rend superflus le contrôle étroit des activités ainsi que l'intervention directe *(top-down)* par les collectivités de tutelle et bailleurs de fonds publics.

Les mécanismes du marché ne sont que partiellement compatibles avec la science. Mais il existe aussi un marché des idées dans le cas de la science et de la recherche. Celui-ci ne peut toutefois fonctionner que lorsque les décisions correspondantes émanent non pas de la direction des Hautes écoles, mais de manière décentralisée, au niveau des facultés, des instituts et des chaires professorales. Une telle compréhension des structures du marché et de la concurrence doit faciliter la prise de décisions par les acteurs de la Haute école selon un processus *bottom-up,* mais dans le respect des axes stratégiques de leur établissement.

4. Les risques de «l'économisation»

«L'économisation» comporte le risque d'une appropriation par le privé du savoir obtenu à l'aide de ressources publiques, celui de l'orientation unilatérale de l'activité de recherche vers les résultats scientifiques valorisables à court terme, ainsi que le risque d'une dépendance de la science à l'égard des attentes des bailleurs de fonds privés. L'exploitation exclusive du savoir par des intérêts privés risque d'entraver la libre communication entre les chercheurs, laquelle nécessite de publier rapidement les résultats dans des revues spécialisées. L'idée selon laquelle les ressources fournies à une université ne se justifieraient que par le bénéfice monétaire à en retirer tend à faire oublier l'importance des objectifs non commerciaux du travail scientifique, notamment la recherche méthodique de la vérité, guidée par la curiosité et l'esprit critique.

La motivation intrinsèque des chercheurs et des enseignants peut être dévalorisée au profit de l'optimisation du gain matériel par l'application de procédures inadaptées issues de la Nouvelle gestion publique, comme l'appréciation purement financière des coûts et des bénéfices, ou l'adoption par les Hautes écoles, à des fins de pilotage, de dispositifs de reporting spécifiquement conçus pour le secteur privé. Si les incitations ne tiennent pas compte de la logique spécifique de la concurrence scientifique, elles risquent de ne récompenser plus que le nombre des publications, leur «impact» purement formel et le captage de financements extérieurs, qui deviendront des buts en soi. La «production» scientifique se concentrerait alors sur des projets saucissonnés en plusieurs sous-projets, de courte durée, et aux risques minimaux. La recherche de longue durée débouchant sur des connaissances imprévisibles et fondamentalement nouvelles pourrait s'en trouver rejetée à l'arrière-plan.

Donner une place excessive à la concurrence interne dans une Haute école la transforme en un assemblage composite de centres de profit, au détriment de la coopération en son sein.

5. Recommandations

«L’économisation», on l’a vu à la section 3, ouvre des perspectives bienvenues pour le développement de l’enseignement supérieur et de la recherche scientifique. Afin de tirer le meilleur parti de ces chances, le CSST recommande de prendre les mesures suivantes:

5.1
Le législateur, les organismes d’encouragement de la recherche, les entités de tutelle et les directions des Hautes écoles doivent préserver, et le cas échéant améliorer, les conditions-cadre nécessaires à la conduite de travaux originaux et à long terme, lesquels favorisent le développement de nouvelles connaissances fondamentales. Un tel but nécessite de disposer d’un financement public de base suffisant. Les enseignants et chercheurs dans les Hautes écoles doivent pouvoir travailler sur le long terme et dans une sécurité matérielle relative, afin d’être en mesure de prendre les risques indispensables à la production d’une science de qualité. On se gardera de faire du volume de production un but en soi en se bornant à des indicateurs purement quantitatifs.

5.2
Les rapports à soumettre aux autorités de tutelle sur les activités des Hautes écoles au titre de la redevabilité *(accountability)* doivent être formatés de façon à répondre aux besoins d’information des bailleurs de fonds publics sans que cela n’occasionne un surplus démesuré de travail pour les scientifiques. La sélection judicieuse des indicateurs quantitatifs et qualitatifs doit rendre visible la totalité du spectre des disciplines et de leurs accomplissements. Les rapports doivent montrer si l’établissement remplit ses trois missions fondamentales selon un juste équilibre: la recherche, l’enseignement et la formation, ainsi que le service à la société et à l’économie.

5.3
Lors de l’allocation des ressources et de la présentation de leurs activités au public, les directions des Hautes écoles doivent tenir compte de l’ensemble des disciplines afin d’en préserver la diversité. Les disciplines dont les savoirs sont plus aisément exploitables au sein de l’économie ne doivent pas être privilégiées.

5.4
L’adoption de mécanismes du marché dans le domaine des Hautes écoles doit viser à transférer le pouvoir décisionnel de la direction aux facultés, instituts et chaires, et élargir ainsi leur marge d’autodétermination. Le retour purement financier sur l’investissement ne saurait devenir l’aune à laquelle se mesurerait la qualité de la science publique.

5.5
Les rapports dans le cadre de coopérations scientifiques entre Hautes écoles, instituts et chaires professorales, ainsi que leurs bailleurs de fonds et partenaires privés doivent reposer sur des directives explicites qui s’appliquent sans distinction à toutes les institutions de Suisse, et qui s’accordent avec les principes suivants:

- Les conventions conclues entre les Hautes écoles ou leurs unités et les bailleurs de fonds ou partenaires de coopération privés doivent être transparentes, et leurs conditions publiquement accessibles; par contre, les contenus relevant des enjeux relatifs à la concurrence sont confidentiels.
- Le financement doit être garanti sur le long terme.
- La liberté de l’enseignement et de la recherche doit être expressément garantie.
- La liberté de choix des méthodes doit être garantie.
- Les décisions en matière de personnel doivent se conformer aux règles académiques d’usage.
- Le savoir élaboré à l’occasion d’une coopération entre un établissement public et une entreprise privée doit pouvoir être exploité dans des travaux de recherche fondamentale à caractère non commercial.
- La liberté de la communication scientifique des résultats doit être garantie, même lorsque ces derniers sont négatifs ou non conformes à l’intérêt du partenaire économique.

Erster Teil

Thesen und Empfehlungen des Schweizerischen Wissenschafts- und Technologierats

1. Begriffe der „Ökonomisierung" der Wissenschaft

„Ökonomisierung" der Wissenschaft bedeutet die Anwendung von marktwirtschaftlichen Grundsätzen auf die Strukturen der Wissenschaft. Dazu gehört die Behandlung von Wissen als einer Ware, deren Produktion und Absatz im Wettbewerb erfolgt, wobei der (monetäre) Preis der Ware ermittelt wird. WissenschaftlerInnen handeln dabei zunehmend als *homines oeconomici* in den Rollen von Produzenten, Anbietern, Konsumenten oder Investoren; wissenschaftliche Institutionen in der Rolle von Unternehmen. Die Unterscheidung eines wissenschaftlichen von einem ökonomischen Feld und die entsprechende Differenzierung zwischen einem spezifisch wissenschaftlichen und einem wirtschaftlichen Kapital werden unscharf. Man hat in diesem Sinne auch von „akademischem Kapitalismus" gesprochen.[6]

Der Schweizerische Wissenschafts- und Technologierat (SWTR) möchte das Konzept der „Ökonomisierung" differenziert verwenden, zwischen der Wissenschaft förderlichen und ihr gefährlichen Folgen unterscheiden und Empfehlungen zur Diskussion stellen, wie die positiven Effekte (darunter Ausgründungen/Spin-offs) genutzt und die negativen Wirkungen gemildert werden könnten.

Die „Ökonomisierung" der Wissenschaft manifestiert sich in zwei Dimensionen. Diese bestehen seit Längerem, haben aber in den letzten Jahrzehnten an Bedeutung zugenommen. In der ersten Dimension ist die „Ökonomisierung" Teil und Folge der Herausbildung einer Wissensökonomie. In der zweiten Dimension handelt es sich um ein Bündel von Erscheinungen, die sich innerhalb der Wissenschaft und an den Schnittstellen zwischen Wissenschaft, Politik und Öffentlichkeit manifestieren und mit einer bestimmten Art der „Governance" oder des „Management" von öffentlich finanzierter Wissenschaft zusammenhängen. Solche Erscheinungen können als Effekte der Herausbildung der Wissensökonomie in der ersten Dimension verstanden werden.

6 Hasselberg 2012.

Weiter gefasstes Konzept der „Ökonomisierung" der Wissenschaft

In einem breiten Verständnis ist „Ökonomisierung" der Wissenschaft ein Prozess, der die Bedingungen für Forschung und Lehre an den öffentlich finanzierten Hochschulen verändert. Er folgt aus dem Umstand, dass Wissen – auch als Ergebnis von freier Forschung und verbreitet durch öffentliche Lehre – einen wirtschaftlichen Wert hat oder erhalten kann. Wissen kann eine Ware sein, für die es einen Markt gibt und die einen monetären Wert hat. Im Zuge der Etablierung einer Wissensökonomie und einer Wissensgesellschaft tritt dieser Warencharakter zunehmend in Erscheinung. In bestimmten Fachgebieten werden dadurch öffentliche Hochschulen zu Unternehmen, die Wissen produzieren und vermarkten, während privatwirtschaftliche Unternehmen durch Sponsoring und Investitionen an diesen Orten der Wissensproduktion präsent sind. Dadurch verändern sich die Bedingungen, unter denen die WissenschaftlerInnen arbeiten und bewertet werden. Die Trennung zwischen universitär-öffentlich erarbeitetem Wissen, das demzufolge der Allgemeinheit gehört, und einem privatwirtschaftlich angeeigneten und vor der Konkurrenz geschützten Wissen wird in Frage gestellt. Die herkömmliche und erfolgreiche Kooperation zwischen öffentlich-akademischer und privatwirtschaftlich-unternehmerischer Forschung, die auf der Komplementarität ihrer unterschiedlichen Bedingungen und Ziele beruht („Asymmetrie"), erscheint in einem neuen Licht.

Enger gefasstes Konzept der „Ökonomisierung" der Wissenschaft

In einem engeren Sinne bezeichnet „Ökonomisierung" der Wissenschaft einen Prozess, in dessen Verlauf Grundsätze der Führung und Verwaltung *(Governance* oder *Management)* aus der Welt der privaten Unternehmen und der auf sie zugeschnittenen Betriebswirtschaft auf die öffentlichen Hochschulen übertragen werden. Dies geschieht meist in der Erwartung, dass die öffentlichen Geldgeber dadurch von der Führung der Institutionen entlastet werden und zugleich für ihre finanziellen Aufwendungen einen höheren Ertrag erzielen (New Public Management).

Diese Tendenz manifestiert sich einerseits extern im Verhältnis der Hochschulen zu öffentlichen Geldgebern und Trägerschaften (Pflicht zur Rechenschaftslegung: *Accountability* im Gegenzug zur Gewährung von institutioneller „Autonomie“ unter der Voraussetzung, dass die selbständige Hochschule unternehmerisch handle, sowie leistungsabhängige Finanzierung, verstanden als Investition, die sich lohnen soll). Andererseits zeigt sie sich auch hochschulintern durch eine Veränderung der akademischen Strukturen, der Art ihres Handelns und des Führungsstils (strategische Führung durch Hochschulräte, Management durch Hochschulleitungen, interne Ressourcenzuteilung nach Leistung, entsprechende Personalpolitik). Als Stichworte seien Leistungsaufträge mit Verwendung quantitativer Leistungsindikatoren (darunter der Erfolg bei der Einwerbung von Drittmitteln sowie Volumen und Effekte der Produkte wissenschaftlicher Tätigkeit), die Ausrichtung auf Ergebnisse statt auf Prozesse, monetäre Anreizsysteme und routinisierte Qualitätssicherungsmassnahmen sowie die Nutzung von Benchmarking und Rankings genannt.

2. Wirkungen der „Ökonomisierung“ der Wissenschaft

Die Forschung an öffentlichen Hochschulen ist zunehmend mit der Nutzung des Wissens durch private Unternehmen vernetzt. Am weitesten fortgeschritten ist dieser Prozess im Bereich der molekularen Wissenschaften. Unternehmerisches Denken bei Forschenden wird gefördert. Die Hochschulleitungen unterstützen diese Tendenzen durch Vorgaben für die Patentierung, Lizenzierung und den Wissens- und Technologietransfer, aber zum Teil auch dadurch, dass Wirtschaftskontakte und Drittmittelerfolge Kriterien für die Auswahl der Lehrenden und Forschenden werden. Die Wertschätzung, die den Fachbereichen entgegengebracht wird, wird von deren Chancen abhängig, wirtschaftlich verwertbares Wissen zu schaffen. In diesem Zusammenhang werden Fachbereiche auch restrukturiert oder zwischen Institutionen neu verteilt.
Materielle Anreize und Wettbewerb nach ausserwissenschaftlichen Regeln (Produktivität statt Erkenntnisgewinn) sowie die Verpflichtung zur Rechenschaftsablegung in fremdbestimmten Intervallen und Formaten beeinflussen in den davon am meisten betroffenen Bereichen das Verhalten der Forschenden und Lehrenden. Die Orientierung der Forschungstätigkeit am Takt der relativ kurzfristigen Projekte und die vermehrte Ausrichtung auf die potenzielle wirtschaftliche und gesellschaftliche (ausserwissenschaftliche) Wirkung des Wissens verändern in den betroffenen Disziplinen die Forschungskultur. Eine Steuerung durch die Hierarchie innerhalb der Hochschule, die mit strategischer Schwerpunktsetzung, Profilierung und Zielvorgaben nach dem Modell von privatwirtschaftlichen Unternehmen arbeitet und aufgrund quantifizierbarer Erfolge Ressourcen zuspricht oder entzieht, konkurrenziert oder verdrängt die wissenschaftliche Selbststeuerung. Neben die Logik des innerwissenschaftlichen Belohnungssystems (akademisches Prestige als spezifisch wissenschaftliches „Kapital“) tritt eine wirtschaftliche Logik.

3. Chancen der „Ökonomisierung“

Die „Ökonomisierung“ erweitert den Handlungsspielraum in einzelnen Fachbereichen, indem direkte Beziehungen zu privaten Geldgebern und zu Kreisen, die an der Verwertung des Wissens interessiert sind, deren Forschung stimulieren können. Diese Fachbereiche können komplementär zur öffentlichen Finanzierung private Ressourcen für sich erschliessen und durch die Kooperation mit der Forschung in der Privatwirtschaft zusätzliche Erkenntnisse gewinnen. Zugleich wird dadurch die Möglichkeit zum Wissenstransfer verbessert, die Effektivität wissenschaftlicher Tätigkeit verstärkt und die Innovation erleichtert.

Die „Ökonomisierung“ ist die politische Voraussetzung für die Autonomisierung der Hochschulen im heutigen Sinne (institutionelle Autonomie). Die Verwendung von Kennzahlen als Indikatoren ermöglicht eine formalisierte und transparente Rechenschaftsablegung, die unter den gegebenen Umständen dafür sorgt, dass die Trägerschaften und öffentlichen Geldgeber das nötige Vertrauen aufbringen, um den Hochschulbetrieb zu finanzieren. Die Betonung von wettbewerblichen Elementen und systematischen Vergleichen gilt ihnen als qualitätssichernde Massnahme und macht direkte *(top down)* Eingriffe und ein eng geführtes Controlling überflüssig.

Marktmechanismen und Wissenschaft sind nur zum Teil kompatibel. Auch in Wissenschaft und Forschung gibt es jedoch einen Markt für Ideen. Dieser kommt vor allem dann zur Geltung, wenn die entsprechenden Entscheide nicht an der Spitze der Hochschulen gefällt werden, sondern dezentral auf der Ebene der Fakultäten, Institute und Lehrstühle. So verstandene Markt- und Wettbewerbsstrukturen erleichtern es den Universitätsangehörigen, innerhalb der vorgegebenen strategischen Ausrichtung der Institution die wissenschaftlichen Entscheide selbst zu fällen *(bottom up)*.

4. Risiken der „Ökonomisierung“

Die „Ökonomisierung“ birgt das Risiko einer privaten Aneignung von Wissen, das mit öffentlichen Ressourcen erarbeitet worden ist, der einseitigen Ausrichtung von Forschungsanstrengungen auf kurzfristig wirtschaftlich verwertbare Ergebnisse sowie der Abhängigkeit der Wissenschaft von Erwartungen der privaten Geldgeber. Die exklusive Nutzung von Wissen durch private Interessierte enthält die Gefahr, dass die freie Kommunikation unter Forschenden, die das rasche Publizieren in Fachzeitschriften erfordert, beeinträchtigt wird. Die Erwartung, dass den Universitäten zur Verfügung gestellte Ressourcen nur durch einen damit erzielten monetären Gewinn zu rechtfertigen seien, verstellt den Blick auf die nichtmonetären Ziele wissenschaftlicher Tätigkeiten, namentlich der durch Neugier und Kritik geleiteten methodischen Suche nach Wahrheit.

Die Verwendung ungeeigneter Elemente des New Public Management wie z.B. der monetären Berechnung von Kosten und Ertrag oder eines für die Privatwirtschaft entwickelten Berichtswesens zur Steuerung von Hochschulen kann die intrinsische Motivation der Forschenden und Lehrenden abwerten zugunsten einer materiellen Gewinnoptimierung. Werden Anreize ohne Berücksichtigung der spezifischen Logik des innerwissenschaftlichen Wettbewerbs gesetzt, könnten vor allem die Zahl und der formale „Impact“ von Veröffentlichungen sowie der Erfolg bei der Akquisition von Drittmitteln als Selbstzwecke belohnt werden. Die „Produktion“ würde sich auf kleinteilige, kurzfristige und risikoarme Projekte konzentrieren. Die langfristig angelegte Suche nach unvorhersehbaren, grundsätzlich neuen Erkenntnissen könnte ins Hintertreffen geraten.

Eine starke Betonung des Wettbewerbs innerhalb einer Hochschule macht diese zu einem lockeren Verbund von Profitzentren und schwächt den inneren Zusammenhalt.

5. Empfehlungen

Die „Ökonomisierung" bietet, wie oben in Abschnitt 3 ausgeführt, willkommene Chancen für die Entwicklung des Hochschulwesens und der wissenschaftlichen Forschung. Damit diese Chancen realisiert werden können, empfiehlt der SWTR, die folgenden Massnahmen zu ergreifen.

5.1

Gesetzgeber, Forschungsförderer, Trägerschaften, aber auch die Hochschulleitungen sollen die Rahmenbedingungen für längerfristige originäre Arbeiten, die grundsätzliche neue Erkenntnisse ermöglichen, erhalten und wo nötig verbessern. Dazu dient eine ausreichende öffentliche Grundfinanzierung. An Hochschulen forschende und lehrende Personen sollen auf längere Sicht und in relativer materieller Sicherheit arbeiten und die mit guter Wissenschaft verbundenen Risiken eingehen können. Dabei soll davon abgesehen werden, Grösse als solche zu belohnen.

5.2

Die Berichterstattung über die Leistungen der Hochschulen an die Trägerschaften *(Accountability)* soll so gestaltet werden, dass sie zwar die öffentlichen Geldgeber deren Bedürfnissen entsprechend informiert, aber die WissenschaftlerInnen nicht über Gebühr belastet. Eine ausgewogene Wahl der quantitativen und qualitativen Indikatoren soll das gesamte Spektrum der Disziplinen und deren Leistungen sichtbar machen. Das Berichtswesen soll zeigen, dass eine Hochschule alle drei Aufgaben in einem sinnvollen Verhältnis zueinander erfüllt: forschen, lehren und bilden sowie Nutzen für Gesellschaft und Wirtschaft stiften.

5.3

Die Vielfalt der Disziplinen soll dadurch gewährleistet werden, dass die Hochschulleitungen bei Mittelzuweisungen und bei der Darstellung ihrer Leistungen gegenüber der Öffentlichkeit alle Fachbereiche angemessen berücksichtigen. Fachbereiche, deren Wissen einer wirtschaftlichen Nutzung leichter zugänglich ist, sollen nicht allein deswegen bevorzugt werden.

5.4

Marktmechanismen im Hochschulbereich sollen der Verlagerung von Entscheiden von der Hochschulleitung hin zu Fakultäten, Instituten und Lehrstühlen dienen und damit deren Selbstbestimmung erweitern. Ein monetärer „Return on investment" soll nicht als Massstab für gute öffentliche Wissenschaft gelten.

5.5

Für die Beziehungen zwischen Hochschulen oder Instituten/Lehrstühlen und privaten Geldgebern sowie privaten wissenschaftlichen Kooperationspartnern sollen die Hochschulen explizite Richtlinien aufstellen, die innerhalb der Schweiz für alle Institutionen gleichermassen gelten. Diese Richtlinien sollen an folgenden Grundsätzen ausgerichtet sein:

- Vereinbarungen zwischen Hochschulen oder deren Einheiten und privaten Geldgebern oder Kooperationspartnern sollen transparent gestaltet werden. Die Konditionen in den entsprechenden Vereinbarungen sollen öffentlich zugänglich sein, während kompetitive Inhalte vertraulich sind.
- Die Finanzierung soll langfristig abgesichert sein.
- Die Freiheit der Lehre und Forschung soll ausdrücklich gewährleistet sein.
- Die Freiheit der Wahl von Methoden soll garantiert sein.
- Personalentscheide sollen nach den üblichen akademischen Regeln gefällt werden.
- Wissen, das im Rahmen einer Kooperation zwischen einer öffentlichen Hochschule und einem Unternehmen der privaten Wirtschaft erarbeitet worden ist, soll in nichtkommerziellen Grundlagenarbeiten verwendet werden können.
- Die freie wissenschaftliche Kommunikation von Ergebnissen soll garantiert sein. Dies soll auch für negative oder den Interessen des Wirtschaftspartners nicht entsprechende Befunde gelten.

Part Two

SSTC Seminar on “Economization” of Science

A Introduction

The Swiss Science and Technology Council (SSTC) is the independent advisory body to the Swiss Federal Council on issues related to science, higher education, research, and technology policy. The SSTC's goal is to provide long-term advice about, as well as a framework for, the further development of Swiss higher education. The SSTC also advises the Federal Council on research and innovation policy matters. As part of its interpretation of its mandate, the SSTC—as in this publication on "economization"—keeps abreast of the larger frameworks in which scientific research takes place.

Since the beginning of the 21st century, industrial societies have experienced profound changes in both the conception and the practice of science and technology. The central role that knowledge and scientific research have come to play in innovation and in creating added value, whether in the economy or in society, has led to the emergence of what has been called a "knowledge economy". The central role that knowledge plays in economic growth in Switzerland, as in other countries, fosters a tendency to adopt a more utilitarian notion of education and research than in the past. Examples include the call for more graduates in MINT professions (i.e. mathematics, informatics, natural sciences, and technology), or parliamentary debates about the employability of graduates of Swiss higher education institutions.

The SSTC decided to devote a seminar to the general question of the "economization" of science in the public sector. This seminar was held in Bern on April 23, 2013. Its goals were to understand what the "economization" of academic science might mean, what forms it takes, what the possible consequences of such "economization" are, and what opportunities or risks it now presents for research and teaching in a public context. The SSTC has decided to publish the proceedings of this seminar as a contribution to a more general discussion of the policy challenges both Swiss universities and the Federal Council face. This publication also serves as a background for statements and recommendations issued by the SSTC.

The SSTC uses the term "economization" in quotes to emphasize that we mean the recent transformations of science and knowledge that have been driven by "the economy". We do not use the term in its standard sense of avoiding waste or reducing expenditures.

As various scholars have emphasized,[7] and as noted in the seminar, the "knowledge economy" has radically transformed the "production" of public science. Two main aspects characterize this process:

First, a neo-liberal global economy reinforces the role knowledge and science-based innovation play in economic growth and competitiveness. This is particularly important in fields such as biomedicine or communications technology. The fact that the EU based its Lisbon Strategy on the concept of a knowledge economy itself underscores how important this process has become.

This new knowledge economy expects academic researchers to think and act more like entrepreneurs than they previously have. As a result, patents and intellectual property rights have come to play an increasing role in the commercialization of scientific output, especially in the life sciences. The strategic importance of the knowledge economy puts pressure on governments to reassess their investment, both material and abstract, in the university. One of the main functions of universities, at least as some understand it, should be to transform scientific information, processes, and outputs into economic results.

Second, the introduction of New Public Management methods in public administration has led to a major shift in management culture and research policy in academia. As in other public institutions, universities and research institutes have reoriented their management practices towards outputs, outcomes, and impact. Monitoring practices and a continuous quality assurance of processes have become increasingly widespread. Universities, formerly much under the tutelage of government, have now gained greater financial and procedural autonomy. However, managing with a performance mandate involves setting binding targets

7 See, for example, Funtowicz and Ravetz 1993; Gibbons et al. 1994; Etzkowitz and Leydesdorff 1998; Slaughter and Rhoades 2004. For a general assessment, see Hessels and Lente 2008.

that need frequent evaluation, which in turn calls for establishing indicators of performance. This shift in the management of science and universities compels researchers to adapt to a new culture of accountability, and to focus on quantitative measures as the main method of evaluation.

In the first part of the seminar, three experts presented their views on the "economization" process. Dominique Pestre (Ecole des hautes études en sciences sociales, Paris) provided an overview and contextualization of the main transformations that have taken place in science and technical production. Peter Weingart (University of Bielefeld) focused on the specific forms that "economization" takes in universities, while Gerd Folkers (SSTC member) gave an inside view of this process. In the second part of the seminar, the participants held a general discussion, which was complemented by a final synthesis provided by Walter Stoffel (SSTC member).

In his presentation, Dominique Pestre outlined the key elements in the upheavals affecting scientific and technological knowledge during the last thirty years. The emergence of a "knowledge economy" has transformed the regulatory framework of science and technology in both private and public sectors. Economic (and financial) power is increasingly global, and increasingly influenced and steered by short-term interests and product-based innovation. Technological innovation, the key factor in growth and leadership in Pestre's view, means the number of interested parties and stakeholders involved have increased. Scientific research itself is no longer the exclusive domain of universities and private laboratories. Instead, scientific research itself has become privatized, and its outputs are now the driving forces behind industrial and commercial development. Academics must become entrepreneurs who actively facilitate translating their intellectual output into economic goods. One of the most powerful factors in this new commercialization of knowledge has been the change to patent rules in the United States which began in the 1980s (i.e. through the Bayh-Dole Act). Today, property rights are granted on more and more basic knowledge, and this has had a significant impact on academic freedom.

For his part, Peter Weingart pointed out that "economization" has displaced the ideal of knowledge for its own sake, at least in Europe. Knowledge production is increasingly oriented to its marketability. He also identified two main types of interaction between academia and the private sector. In the first, "economization" means universities are directly involved in commercial interests, through sponsoring, patenting, licensing, copyright, or intellectual property rights. The second is an indirect "economization" linked to how policymakers intervene in universities to increase performance. They create artificial markets through the application of new management tools (rankings, bibliometrics, and performance indicators). As a result, an "economization" driven by monetary incentives replaces the "traditional" incentives in academia that were mainly based on reputation. The university itself increasingly appears as a self-interested actor, and thereby loses its status as a neutral moral authority. Moreover, the intellectual property rights involved in the first type of "economization" may affect the ability of an academic scientist to publish the results of his or her research freely. Weingart suggests universities should carefully monitor their relationships to biotechnology companies to ensure that the right to publish research results is protected. Universities should also police their relationship with industrial sponsors.

Gerd Folkers's main argument turns on the problems associated with "massification". Folkers defined this as the increase in the number of researchers worldwide and in annual global research output. The difficulty, to him, is that higher education systems and the knowledge they produce create public goods. Yet while competition may work for private goods, it is not suited to public goods. Nevertheless, the "machine of science" today has to justify itself in economic, competitive terms. Academics are now asked to produce private rather than public goods. Folkers suggests the scientific community has lost its long-term perspective.

In the general discussion, participants agreed the "economization of science" does not affect all disciplines equally, but takes place primarily in biotechnology, biomedical science, and in information and communication sciences. These disciplines provide a dual output that both contributes to basic knowledge and has immediate industrial applications. Moreover, intellectual property rights play an important role in these disciplines. Most discussants held that the public university system has an increasing need for legitimacy, since science has expanded to an unprecedented degree in the last years. However, the "economization" of science often has been advantageous for Switzerland, especially in the biomedical sciences. In conclusion, SSTC members and the invited experts agreed that the main question is to learn which form "economization" should take in order to allow for a positive development of the university and the functions it performs.

Walter Stoffel, who spoke in his capacity as a market specialist, provided a closing synthesis. On the one hand, the common denominator among the three presentations is that the "economization" of science has gone too far. On the other hand, one has to admit that academia has not been generally opposed to the government opening the marketplace to scientists. He suggested that academia should remain open and globalized, and refrain from asking for protective measures. In turn, academics must accept accountability as a necessary element in their relationship to the public. He also suggested that the SSTC should adopt, when discussing the relationship between science and the market, a market notion that implies decentralized decision-making. In this perspective, introducing market elements into academia means approaching the ideal of "bottom-up" instead of installing a "top-down" measure.

This seminar has provided useful input to the SSTC in considering the "economization" of science. The Council hopes that these proceedings, complemented by the SSTC's statements and recommendations derived from its insights, spark a larger debate about the "economization" phenomenon.

The SSTC warmly thanks all participants and speakers for their contributions and attendance.

B Presentations

1 On Science and Technical Production in the Last Thirty Years: Chronicle of a Mutation

Dominique Pestre

Scientific and technical knowledge has gone through a series of deep upheavals since the 1980s. The objects, working methods, and tools of scientific and technical knowledge—indeed, the entire universe associated with such knowledge—have fundamentally changed. So also has the relationship of such knowledge to individuals and society, as well as to the marketplace and to politics. The changes have taken various forms and have a variety of origins. They also have had major consequences. In what follows, I would like to give some idea of the complexity of this transformation as well as outline key elements that, in my opinion, emerge clearly from it.

My approach is quite simple. I first consider the economic and productive order, and identify the changes that have taken place in it. I then consider the order of science and technology, particularly the practices and tools that define it. I am particularly interested in the changes that have taken place in its working methods, as well as in the very nature of science and technology. Third, I consider transformations that have taken place in the social order, in order to determine how this has reconfigured the position that science and technology occupy in society. I close my considerations by describing two central aspects of the changes that have taken place in the last three decades.

1.1 On the new political economy of knowledge

It is commonly accepted that the last few decades have seen profound transformations in production, in the economic system, and in financial mechanisms. Scientific knowledge has played a role here—one can think of mathematical tools invented to help develop financial markets, or of bio- and information and communication technologies that are at the core of the "new economy".

The transformation in economic regulation

The transformation in economic regulation and in the global political order is a multifaceted process that can be first summarized in four brief observations.

First, over the last three decades, technoscientific productions have developed extremely rapidly and have achieved an unprecedented spatial expansion, with product replacement now exceptionally quick, and a mass consumption that is now globalized.

One can also see this transformation in terms of the diversity of political mechanisms created to govern the new global society that our planet has apparently become. In earlier times, geopolitics involved a Westphalia balance of power among nations. That has yielded to more global systems that are regulated by market rules and to new forms of "governance". However, one should keep in mind that the major nation-states (most obviously, the United States) still play pivotal roles.

Thirdly, economic power has shifted from managers to shareholders and financial agents. This has led to a new relationship to time and a shift from long-term corporate technological and industrial planning to the short-term interests reflected in stock markets. The driving force today is less production and the pairing of manager to product than it is the more versatile pairing of shareholder to customer. Economic demand has certainly always played a central role in liberal economies. But industry, as site of innovation and production, was central during the post-WWII boom years and played a key role in defining the direction of technical and scientific research.

Today, finally, the ongoing changes mean that there are no longer any stable reference points. Unlike in the far simpler and more stable Cold War world, there are no "safe positions" anymore, whether for corporations, countries, individuals, or populations. This also applies to long-established scientific fields.

Concomitantly with these broad changes, there has also been a transformation in the production, design, appropriation, distribution, and regulation of research (as well as in new technologies). One can see this in the following five realms.

The multiplication of interests in research[8]

As economic and political actors often regard investment in "new technologies" as the key factor in growth, as well as in achieving competitive advantage, interest in research has grown immensely. Since the 1980s, this has led to various legislative changes and to a proliferation of new players. Venture capitalists, pension funds, NASDAQ,[9] startup companies, and business lawyers, along with the military, governments, and scientists, have become key decision-makers in setting directions for research and the forms it should take; as well as in determining which subjects will be studied and which will be ignored. This has also led to a redefinition of the university, making it more dependent on the logic of the marketplace. New rules (as seen in changes to intellectual property rights, for example) and practices (which are shaped by the financing by project), for example) have emerged in the process.

Academics are now encouraged to become entrepreneurs. They must seek outside funding, engage in contractual agreements (notably with private companies), and must "mobilize" for the sake of the nation's economic future. This is particularly true for younger academics and for those who work under contract (contract work is an increasingly prevalent form of academic employment; in France, for example, one out of four academics is a contract worker). In the process, academics have lost some of the autonomy and self-motivation that used to be an important characteristic, as well as a privilege, associated with academic work.

The nature of private company innovation

The nature of research and innovation has also changed in private companies. Until the 1960s, at least for laboratory-based research, innovation came from three distinct sources: academic, industrial, and national laboratories. These different types of institutions had well-established modes of interaction. To remain simplistic, the academic laboratories were responsible for basic research, the industrial laboratories were in charge of R&D, and the national laboratories were in charge of standardization. Some of the largest industrial research and innovation sites, however, such as Bell Labs, covered the entire spectrum in order to maintain full control over the innovative process.

Under the influence of financial markets, which value short-term returns, this order has given way to a new division of labor. In certain industrial sectors, such as pharmaceuticals, traditional forms of research have partly been maintained. But in many others, laboratory research, with its long-term objectives and its in-built inertia, has been significantly reduced. Research and development has been supplanted by the design of generic products and series, which now form the core of industrial innovation.[10]

Research thereby becomes defined as an input to be bought on an *ad hoc* basis. Research work is often contracted out to specialized firms or networks that sell services on demand. Some of this work is also sent to major universities that receive corporate sponsorship. The university remains an institution which provides education and offers space and freedom to its researchers, but in many places it has also become a research business that is in competition with other dedicated research centers.

Industrial research and territory

While universities (and populations) are territorially anchored, industrial research has become emancipated from such earthly ties. Large corporations now locate their research activities worldwide and respond to technical possibilities, as well as wage opportunities, in a process that removes them from the political, economic, or social control of any given place or people. This logic of work is not new but has changed in its scale and nature.

Nevertheless, it has its limitations. Most companies still maintain a national center of gravity, and call upon the state when difficulties occur, as the recent economic crisis demonstrated. Likewise, states themselves remain major players in research and innovation through investment, financial support, and the

8 For this and the three following sections, see Pestre 2003.

9 National Association of Securities Dealers Automated Quotations (American stock exchange).

10 Le Masson et al. 2006.

design of global plans; they also defend the universities and companies located on their territory. This is the case for the United States, as well as for France or Switzerland.[11]

The locations where strategic decisions are made are no longer fixed, and may be moved from a city to a regional level, or from the national to the European or global levels. Major players in research are now active at all levels, from the local to the global, making the issue of attractiveness (for universities as well as for the siting of corporate laboratories) crucial. Indeed, the capacity to attract students, top researchers, competitive research funding, etc., defines a new benchmark for institutions of higher education and research that want to maintain their position among the best. One may illustrate this point by noting the important role that the Shanghai academic rating of world universities plays in France's restructuring and management of its universities.

The shift in patent rules toward the early stages of discovery

Another key change at the heart of the new political economy of knowledge is the shift in intellectual property rules, which directly affects the "hard sciences". The rules for granting patents underwent significant changes during the 1980s, first in the United States and then in the rest of the world. This was due to the emergence of new practices, including the ability to manipulate genes (which raises difficult legal issues), as well as to efforts on the part of the United States to improve its long-term strategic position in research and production. The objective was to modify the definition and scope of patents so as to reserve entire fields of technological research in the future. That was done by protecting "fundamental" discoveries made in the country's university laboratories and in the startup companies that worked in molecular biotechnology and information technology—fields in which the United States had, and still has, an important edge over the rest of the world.[12]

Property rights today are granted more and more on items of basic knowledge. Traditionally, an invention that was to be patented had to be useful, had to provide an identifiable benefit, and had to be capable of use. These constraints on utility have been loosened in patent law, which explains why it is now possible to patent a gene, a business method, or a computer mouse click—as well as why patent lawyers have come to play such an important role in American universities. These new forms of intellectual property also explain the new division that characterizes research, the emergence of monopolies based on patent ownership, and the growing number of lawsuits in scientific work. Indeed, even in academic settings, research planning often requires that agreements be formulated about the future utilization of entities under property rights, as well as on the distribution of expected profits.

The new position of the university in the knowledge economy

In concluding this first section, I would argue that in the current state of the knowledge economy, the university and publicly funded research, as well as the values on which both have historically rested, have lost their position and no longer serve as reference points. Knowledge production has taken on a new, more pragmatic function directed at shorter-term utility. The result is that the identity of the university has been redefined.

Four elements can be given to precise the picture. First, the earlier balance that existed between public, open, freely circulating knowledge on the one hand, and on the other hand private knowledge, the use of which depended on how it was valued by economic actors, has shifted in favor of the latter. Disinterestedness, curiosity, and non-monetary activity, to mention old notions, are categories today demonized among those who finance research. This remains far less true among scientists themselves, though one should not idealize the realities of the earlier era. Second, cooperation between different professional fields has gained ground in research based on generic objects and series. Universities, which by definition focus on education and are guided by their own research logic(s), have difficulty understanding these developments, or gaining any control over them. Third, politicians, primarily interested in economic development and by what they call streamlining (applied here to universities), try to reduce the role and autonomy of professions, in particular academic professions, by develop-

11 For a perfect illustration, see Benner and Löfgren 2007.

12 Posner 2002.

ing research under contract or by modifying assessment methods. Fourth, on a wider scale, the availability of information and knowledge on the Internet undermines the perceived legitimacy of academic (or more generally school-based) knowledge.

1.2 On the redefinition of scientific practices and disciplines

Scientific disciplines, practices, and working tools have also changed significantly over the last thirty years. There are five main points I would like to make about these changes.

Biotechnologies and the new order of the laboratory

In the 19th and most of the 20th centuries, but especially during the Cold War, physical science and the engineering associated with it made their mark on society and played a key role in guiding technological and political choices. In particular, basic physical science laid out the standards of good science and lent it its major representations. In terms of the history and philosophy of science, consider Bachelard, Popper, or Kuhn, who thought about science primarily in terms of physics, most notably relativity and quantum mechanics. This is a rather narrow scope for thinking about technoscience now!

Since the 1980s, the central position physical sciences held in the collective imagination (and, to a lesser degree, in industrial realities) has been taken over by other laboratory sciences or technosciences, most notably the life sciences, biotechnology, and nanoscience. In the collective imagination, the science and technology that enable us to recombine and optimize biological matter and thus to remake life, humans and nature, have become central.[13]

Today, scientific working methods are more pragmatic, or at least more pragmatic than they were in the physical sciences in earlier decades. They are more clearly and explicitly guided by and towards technological outcomes, and they prioritize know-how and efficiency. Such sciences (or techniques) are primarily ways of doing and manipulating, and are only secondarily bodies of knowledge.[14] They do not play as central a role in war as do physics or mathematics, for example. However, as Rabinow and Rose have shown, such technosciences have led to historically new forms of biopolitics, since they are as much in the hands of individuals as they are under the control of states.[15]

New data-processing tools

Changes in recent decades have not been limited to the shift in the center of gravity from technophysics to technobiology, with its associated alterations in symbolic, scientific and product-oriented representations. Scientific practices have also been redesigned as a result of new mathematical and data-processing tools, as well as the availability of increased computing power and the resulting opportunities for modeling and simulation. Science and research have been profoundly transformed by direct reading devices (such as DNA chips in biology that automatically record and process large volumes of interactions online), by data storage (with huge data banks used in biotechnologies and environmental science), and by data-processing capacities (with a great variety of widely available software).

The exponential development of data-processing capacities has had an impact in all fields. Synthetic biology, which has been widely discussed in the media, is only the most recent example. Modeling tools have become the core means by which to analyze large "natural" systems (in the study of climate change, for example)—having already played a central role in the development of military systems (computer-based digital simulations were first used for designing hydrogen bombs in the 1940s).[16]

The return of observation-based science

New fields have also emerged in recent decades, and they have drastically modified the scientific landscape. While the history of science in the last 150 years might be seen as the inexorable rise of the reductionist approach and of laboratory-based science—a process that is still underway—the last three decades have seen the return of "observation-based" science and of global or holistic approaches. Today, the sciences deal

13 Pestre 2007.
14 Forman 2007.
15 Rose 2007; Rabinow and Rose 2003.
16 Galison 1997; Dahan and Pestre 2004.

broadly with the study of ecosystems of all sizes. Such systems involve human activity, the effects of which we try to understand and limit as a matter of ecological engineering. Tens of thousands of scientists and engineers study the Earth as a system, examine planetary equilibria, consider biodiversity and how to manage it, analyze pollutants of all kinds, and engage in "global risk management". One consequence is certainly the end of a vision—one Auguste Comte shared—of the unity of all the sciences. It also spells the end of a common epistemological standard.

There are many reasons for the return of observation-based science. The emergence of new computer tools is a first reason, since it is the condition that makes possible the integration of a mass of diverse observations and data in a unique cognitive space. It is also the condition for the acceptance of the alert, since it is the works of scientists that, starting in the 1980's, enabled to make global warming and loss of biodiversity tangible and "real". More generally, it is the failures of "unfettered progress" and its associated load of environmental cases and negative impacts—and of course the shape they have been given by the environmentalist movement since the 1960's—that brought these issues in the public space, and led science to also explore these new directions.[17]

Knowledge that is equally descriptive and prescriptive

In these new fields, moral and political considerations, management issues, and *ad hoc* studies and assessments are mingled together.[18] Analyses are at once descriptive and prescriptive, and focus equally on natural and on human activities. The issues addressed include conservation and sustainability, the management of nature and the future of the species, the direction that technological choices should take. For example, studies of global warming involve meshing the quality of satellite-driven measurements or software with the mobilization of other disciplines such as oceanography and paleochronology. There is a question about how the costs attendant on taking action should be assigned geopolitically, political questions about which regulations should be implemented, and which indicators (CO_2 measurements, for example) should be chosen to guide action (such as to reduce global warming) through various economic and political tools (such as creating a market for carbon emissions). These are very complex, potentially conflict-laden, political issues, and the solutions chosen may have numerous negative side effects as well—such as the question whether measured CO_2 levels are a good indicator of the equilibrium of the planet as a whole, and what bias is introduced if that becomes the sole indicator driving policy choices. These complexities are one reason why these new fields also call upon the social sciences.

The new fields addressing the Earth as a system, simulation and modeling practices, as well as bio- and nanotechnologies have significant social and political effects. Some of the issues they raise are entirely novel; to take an extreme example, human cloning will trigger fierce debates that will polarize societies to an extent that research in the physical sciences never did. They involve judgments and criteria that are difficult to assess: think about the concept of precaution, or the difficulty in assessing the effect over the next fifty years of measures taken today to adapt to global warming. Simulations and high-volume data processing provide scenarios that laypeople cannot wholly grasp. The democratic debate thus takes on a peculiar cast, since most "facts" under debate rely on simulations. Scientists themselves argue over many points and no independent means are available for judgment. The question of trust in the work of scientists, like the question of how trust in science is managed both publicly and in the media, thus become an important issue.[19]

The definition of what constitutes "good knowledge"

The question of what constitutes "good" knowledge has again arisen, particularly in the humanities and social sciences. The modern university developed as an autonomous institution during the second half of the 19th century. It had its own modes of judgment, and as a politically protected and independent authority, it operated as a "neutral" *alter ego* of the state. This po-

17 Agar 2008.

18 Demeritt 2001.

19 This is what is at stake with the attacks against the Intergovernmental Panel on Climate Change (IPCC) since November 2009, undermining the public's trust in the provided data that show significant warming of the atmosphere.

sition is no longer tenable today, since the advice that universities provide is now recognized as strategic and critical to major political issues. Since the 1970s, moreover, other institutions have emerged that produce their own knowledge and expertise, challenging the university's vision of what is true and pertinent.

The first group of institutions one should mention includes neoliberal and conservative think tanks, such as the "Heritage Foundation" or "Enterprise", think tanks and research institutes that were created by the business world and by Republican Party networks in the United States. Since the 1970s, they have challenged the Keynesian and social ideals that held sway in the universities at the time, with the objective of using the public arena as a means to legitimate claims to economic freedom or to the necessity of liberalizing government policies. In the 1990s, after the fall of the Berlin Wall, they also began advocating the ideas of necessary war, preventive war, and the clash of civilizations.

Parallel to this, large international NGOs also began in the early 1970s to address the preservation of nature as well as environmental and/or economic development issues. Like think tanks, they started to use research teams to back their claims. Strictly speaking, the field of environmental science as we know it today was initiated, in collaboration with academics, by these NGOs. In subsequent years, this phenomenon has been seen in other fields; patient organizations now play a major role in the field of public health, for example.

One should also mention the transformation of the major international institutions such as the OECD and the World Bank (which now calls itself the "bank of knowledge"), which, like the think tanks, produce numerous reports, analyses, and standardization criteria. They, too, try to influence what knowledge should be and what the "right issues" are. Finally, one should also take note of the fast-growing number of managers who, having changed corporate and governmental practice, are now invited to streamline universities and to redefine useful knowledge using the same techniques of benchmarking and rankings.

The standards defined by these many institutions influence the university, compelling it—compelling us—to formulate and to justify what legitimates our assumptions, methods and categories. This orientation has created a relatively new situation, one that is not necessarily negative in the demands it places on academics. However, over the last decade or so, it has also resulted in direct attacks on how they work. More specifically, it has led (in the United States, for example) to the rejection of knowledge that did not fit with the development of business, or was even regarded as hindering it. This has been particularly true in health and environmental issues (as in the link between obesity and the consumption of soft drinks), and in the organization of public science expertise, which was often reorganized under the Bush administration.[20]

1.3 On social issues, individuals and the technoscientific order

So far, I have addressed some of the economic, political, scientific, and cognitive elements in the new regime of technoscience production and regulation. In brief, the contemporary world can be characterized by the existence of two parallel phenomena. On one hand, people are confronted with a very diverse array of techno-industrial developments, with a rapid rate of change and renewal due to the role played by innovation and by the deregulation of global markets. This has a significant impact on society, since this research often deals with "life itself" and its manipulation. On the other hand, people are also confronted with diverse and often contradictory expert discourses. Grand narratives are provided, each with different proportions of technological promise and catastrophic outcomes, rendering judgment difficult.

Individuals and societies are thus under the constant influence of a rapidly changing techno-scientific environment, which leads to uncertainties. There are other reasons for the changes in social issues, however.

The transformations of social worlds

Social worlds have first been transformed by structural changes, such as the massive de-industrialization of the North, the rise to prominence of highly educated groups, or the fast-growing middle classes in India and China. Subjectivities have also been transformed, most notably after 1968, such as in the in-

20 Details in Pestre 2008.

dividual's relationship to authority. These changes have been accompanied by the development of a more open public space. This has engendered fierce debates about technoscience and its powers, and has led to thinking about concepts, such as governance or sustainability, that were unknown thirty years ago.

One might say that as societies have become less hierarchical and more heterogeneous we face a dual phenomenon. First, careers and lives tend to be more individualized, with various forms of self-fulfillment becoming prominent. As a result of the new possibilities offered by the life sciences, personal modifications ("cyborgization", for example) have also become legitimate projects in many segments of the population. Secondly, the hierarchy of what the key issues are is now challenged, as the "social issues" that long dominated the political agenda have been replaced in large part by issues of race, identity, and the environment.

There are therefore three possible interpretations of the evolution of the world and the role that technoscience plays in it. One is positive, and includes the possibility of a new personal biopolitics and the realization of the democratic project through extended individual choice. Less lyrically, but just as important, we can talk about the decrease in the value accorded to equal rights, the increased gap between rich and poor, suffering in the workplace, and executive or scientist burnout (to mention only a few of the titles of best-selling books from recent years). We can also talk about a Janus-like situation that on the one hand promotes individual fulfillment and the development of the self, while on the other hand those lives are becoming invasively controlled in the name of avoiding risk or promoting security.[21]

The transformations of public space

The nature of the public sphere, and with it the definition of political issues, has also changed. The public sphere has been privatized, though in two opposite directions. Issues once considered private, such as gender, reproduction, and end-of-life issues, have entered the public sphere, while issues that once belonged to the public or political sphere are now considered personal or a matter of private choice.

In this process, the capacity to mobilize resources—in particular expertise—has become essential. Large, environmentally-oriented NGOs now publish reports—on the state of forests in the southern hemisphere, on biodiversity, or about global warming. Patient organizations, too, have become recognized experts on rare diseases, as they provide invaluable knowledge that cannot be obtained in clinical settings. The pharmaceutical industry in particular has given much attention to the knowledge produced by patient organizations. Other examples of this new dynamic include the emergence in the 1980s of biodiversity and issues surrounding indigenous peoples and their knowledge.[22]

Modes of action in the public sphere have also changed. The formerly dominant mode consisted of making claims and calling upon the state to act as a guarantor of neutrality (one can think here of labor unions). Modes of action today (for example, by Greenpeace) rely both on scientific expertise and on a do-it-yourself approach. They target a variety of audiences—states, international organizations, public opinion—and use various means, such as the publication of reports, direct action, and boycotts. This has had an impact on the nature of knowledge, and in particular on "official" science.

The transformations of modes of government

The ways in which humans, things and nature are governed have also undergone a profound change.[23] Power relations, to cite Michel Foucault, are now pervaded by a new, liberal, form of governing that aims at steering the conduct of autonomous individuals. This mode combines a call for universal self-government, a call for "rationalization" (including the reorganization of the medical profession and the universities in order to improve their performance), but also active methods of "reformatting" individuals. The objective is to "re-set" people after the disastrous interlude of the welfare state and the "dependencies" it created, to reprogram them and have them constantly optimize their lives.

This is not a simple task, however, since individual and social life is more than the constant optimization of advantages, and cannot be reduced to a Hobbesian war of all against all. Thus, individuals need to be

21 See Castel 2008; Dejours 1998; Dupuy 2005; Ehrenberg 2000; Sennett 2006.

22 Boisvert 2005. On the role of ethics committees in organizing the market for biotechnological products, see Tallacchini 2009.

23 Brown 2005; Pestre 2009.

“stimulated” and guided so they can transform themselves in the right direction—hence the use of benchmarks and the permanent competition over rankings.[24]

“Governance” is a key word in that transformation. It appears as a type of management that promotes the “participation” of all in the “decision-making”, and promises openness, dialogue, and deliberation.[25] Governance has its own institutions, such as the French National Commission for Public Debate, whose goal is to address public opinion about essential issues. It has its own language—responsibility, openness, public access, ethics—and its own tools like participatory forums or, at European level, the Open Method of Coordination. Governance is thus a new top-down mode of managing populations.

Ideally at least, such “governance” appears to complement the liberal mode of government, as it advocates dialogue and responsible collective choice. The liberal mode, by contrast, thinks of the individual essentially as a prisoner facing the Prisoner’s Dilemma, as someone who is isolated, wary, and not cooperative.[26]

The transformations of social certainties

A consequence of these transformations is a change in attitude towards the institutions of science. The belief in progress, and in particular in unlimited technical progress that is always positive and under control, has declined, even if it never was fully realized in the first place.[27] Two factors have contributed to this move. One was the rise in concern with environmental issues during the 1960s. This shifted the discourse from a debate among experts to a discussion in the public arena. This change in attitude towards science was completed by the end of the 1960s, with the publication of the report by the Club of Rome on “The Limits to Growth”—despite the fact that its argument was soon challenged by other experts, most notably from the OECD.[28]

Since that time, the decisions that experts arrive at have been systematically challenged when they are not made openly or do not involve public debate. It is essential to underscore the fact that what is at play here is less a general or *a priori* rejection of innovation or progress than a desire to be able to make one’s own judgment about issues and solutions. Of course, there is mistrust towards systems that colonize the lifeworld (as Habermas would say), but what is important is the desire to evaluate the course of events independently. As an example, NGOs question the accuracy of decisions and the relevance of regulations—which shows that knowledge has become the central value.[29]

In France, the process was also triggered by issues related to nuclear power. Mistrust of official statements and of the media coverage of the Chernobyl accident, as well as what representatives of the nuclear safety industry had to say, led people to create organizations, with the help of scientists, to carry out surveys, to exert more control, and to publish their own findings and results.[30] In addition, complaints are now more systematically registered by justice than in the past.

These changes have been brought about by technoindustrial practices and repeated crises and environmental disasters. They are also the result of a deeper transformation—the emergence of the World Wide Web and its associated capacity for fostering exchange. Just as the rapid multiplication of printed volumes and the end of state-supported monopolies were key factors in the rise of intellectual skepticism and the feeling of liberation during the second half of the 18th century, so the spread of the Internet is essential today. The Internet produces new ways of judging available knowledge, alternative ways to generate, appreciate, and consume information, and new ways of managing one’s relationship to authorities and experts. It also gives youth new ways to learn, less hierarchical ways of tackling problems, and less sequential modes of action. It encourages a capacity to be always on the lookout and always ready to move. Radically polycentric and infinite in its openness, the World Wide Web also marginalizes the hierarchical channels that have been used until now to distribute knowledge, and thus undermines science as a natural form of authority.[31]

---

24 Bruno 2008.

25 Moreau-Defarges 2001.

26 The analogy was suggested by Pierru 2007.

27 Schaffer 2005; Fressoz 2012.

28 Balogh 1991; Agar 2008

29 Winner 2002 [1986].

30 Topçu 2013.

31 Mallein 2008.

The ordinary short–sightedness of the elites

In scholarly environments (including the social sciences), the tendency has long been not to take these new realities seriously. The developments have been regarded as incidental, or are treated as an expression of irrationality that should be opposed, a disease in the social body to be cured through education and a "scientific and technological culture". A similar opinion exists in economic and political circles. Following the controversy over genetically modified organisms, elites, especially in Europe, are terrified by the idea of being undermined once again by what they consider to be an unfounded technophobia among the population.

But this is simply a way of ignoring massive realities that involve large, well-educated segments of the population. All studies refute the accusation of irrationality, as it is not knowledge which is primarily targeted; rather, it is the regulation of technological products, the predominance of certain types of knowledge to the detriment of others, the systematically technophile attitudes of those who wish for the advent of everything that technoscience could make possible—in short, people are challenging the relevance of the technological pathways our societies have taken. Moreover, the growing demand for participation and the increasing critique of official knowledge go hand in hand with an increased valuation of expertise in all fields.

It is thus not enough to talk of a general distrust of science, knowledge or experts. In fact, the recurrent issues in the public arena focus on attitudes towards industrial technoscience, and two trends could be identified. On the one hand, there are demands that precautions be taken with respect to the long-term effects of industrial practices. These concerns tend to be about collective goods such as public health (as in the Vioxx case), environmental goods (as with global warming), religious and ethical convictions (about cloning or stem cells, for example), or in conjunction with perceived threats to science itself (when it is perceived as a common good) or to the future of new collective goods such as open source software.

On the other hand, progress is embraced without reservation when it concerns the treatment of certain diseases or when it enables individuals to enhance their capacities (for example, through notions of transhumanism). This attitude arises when everyone can understand and evaluate the risks and when the proposed solutions allow for individual choice. In such cases, acceptance of and belief in progress are often enthusiastic.

My opinion is that this diversity of attitudes, alert to what we should do with technological development, is positive. This kind of attention is what gave birth to the concept of precaution. In fact, it is through public mobilizations against the negative effects of technoindustrial innovation that producers, administrators, and regulators have historically taken action and defined stricter norms.

I suggest as a conclusion that it has become less and less possible to reduce the dynamics of our societies to the ideal technological trajectory that experts dream of. The best solution for social or environmental justice, for precaution, as for mere profitability, consists in relying on the diversity of approaches and knowledge, and to use it as lever for both innovation and precaution. This is the necessary condition for a more socially and environmentally friendly development that can be technological, market-driven and democratic at the same time.

1.4 On the specificity of the last thirty years

In this paper, I have argued that our societies have undergone many major transformations over the last three or four decades, and that we are confronted with a profound shift in the position of science and technology in society. One can perhaps ask whether this shift has been overstated. After all, progress in science and technology has faced opposition before—just consider the Luddites, who were far more radical than opponents of technological innovation are today. There have also always been arguments about the consequences of technoscientific and industrial innovation. Put differently, one might argue that it is primarily in contemporary *discourse* that the past is portrayed as conflict-free when it comes to progress. This remark is most right and I would like, in conclusion, to come back more precisely to the differences.

From the local problem to global political issues

In my opinion, a key novelty is that issues are now raised at a global level. They have become both universal (they are said to concern all of humanity) and common to all (Gaia is unique).

To point out the difference, one can take the chemical works established near Marseilles in the early 19th century that manufactured mineral acids and soda. The scientists and industrialists who promoted them faced strong opposition from the local population, with peasants and landowners protesting the destruction of their environment and property (notably olive tree plantations). At that time, as now, the new facilities were supported by a state eager to develop its national economy. In this effort to reform the country, industry, and academics worked with the state—the same people (such as the chemist and industrialist Jean-Antoine Chaptal, who was a member of the Academy and later Interior Minister) playing several roles.[32]

The opposition took on most of the forms we still see today: public demonstrations, press campaigns, reports, information provided in the form of agricultural or epidemiological expertise (from both proponents and opponents), and the filing of complaints for damage. The main conflict, at least with respect to regulation, was (as it is still today) between commissions of experts established by executive authorities, which frequently concluded that development was beneficial (emissions from the chemical works near Marseilles were judged beneficial on the argument that they purified the atmosphere of miasma), and judicial authorities who, in cases about damage to goods, often ruled in favor of the plaintiffs. Their decisions led to industrialists being enjoined to reduce emissions, for example, and the fines and constraints imposed produced actual precautionary effects (such as companies rapidly developing filters to reduce air pollution). As Jean-Baptiste Fressoz emphasizes, it is also from this context that there emerged the idea of a “natural” environment distinct from humanity. This “natural” world, though of course it is affected by human activity, was (and is still considered as) one with its own logic. The present, in other words, shows continuities with the past, even with the ancient past.

There is nevertheless an obvious difference. Though battles against pollution are still fiercely fought today, though they continue to be fought as they were in earlier centuries, and though administrations and experts continue to pass laws in response to complaints, action today tends to also consider the environment in global terms and environmental protection as a battle for the survival of the species and the planet. It is also *the* issue that has replaced social issues in the hierarchy of values and political concerns. If we argue that social and political debates are structured around three poles—namely, economics, social justice, and the environment—then one can say that the weight and priority given respectively to the latter two were inverted between 1860-1960 and 1970-2010.[33]

The climate is the issue where the increase in generalization is the clearest. Intergovernmental Panel on Climate Change scientists “demonstrated” that the global climate is *the* problem, a problem that concerns all humanity. They did so using the large models noted above, and asked for multilateral solutions. Of course, fierce debates continue about the precise political architecture that ought to be implemented to address the problem (the Kyoto protocol, which had been the dominant political scenario, was nearly killed by the 2009 Copenhagen conference, where constraining policies were rejected), but the globality of the issue is now commonly accepted.

From technological risk to “risk societies”

A second observation about the specificity of the present time is about the emergence of the expression “risk societies”, which became widely popular in the social sciences at the end of the 1980s, as well as among experts and managers concerned with technoindustrial issues.

The term refers to the renewal of technologies after the Second World War. The expression refers to nuclear power, a risk that is new and for which classic insurance policies are not relevant. It refers to anti-polio vaccines, to growth hormones and to multiple drug-related risks that have often erupted into legal cases. It refers to pesticides, fertilizers, pollutants, and to industrial and environmental risks generally. It finally refers to behavioral risks, to ill-considered risks taken by individuals—for example, by those who smoke.[34]

32 For this and the following paragraphs, see Fressoz 2012.

33 I owe this formulation to Jean Paul Karsenti.

34 Boudia 2007; Jas 2007.

It would be naive, however, to believe that the expression captures only this proliferation of risks to individuals and society. When it emerged in the late 1980s, it connoted more: it announced that reality had changed and that we were living in a new kind of world. The expression told us that our view of political and social issues was outdated, that it was not the small conflicts of our everyday lives that mattered, but broader and more general risks that were important. These larger risks were now an intrinsic part of our lives and expressed the essence of our situation. Techno-industrial risks should prompt humans to rethink how they live, to imagine different ways of living together with Gaia. Global risk requires imagination, it demands that we undergo deep transformations and understand that a "risk society" can only be a "reflexive society".[35]

The expression is thus more than a mere snapshot of what is now the case. Instead, it is a prophecy which tells us about the new world and its ontologies. And if the expression has caught on and makes sense to everyone, it is because the world has indeed become "risky"—more socially risky for example, with economic and social precariousness increasing in the wake of the partial dismantling of the welfare state; but also more politically risky, since in an era of terrorism and lack of security.

The expression "risk society" thus signals a significant transformation of the world, a shift in ways of seeing and defining it, a change or alteration of the rules, categories, ontologies, and values. It is part of a new narrative that is specific to the last few decades and that is linked to scientific and technological developments and what they bring to society.

35 Beck 1986 [1992 transl.]; Giddens 1991.

2 The "Economization" of Science: Consequences for the University

Peter Weingart

The "economization" of science involves two main actors. One is academia, and here the main focus of such "economization" is on the public functions and mission of academia, especially with respect to research. The other is the private sector, understood either as industry or as it is manifested in the economy. Before analyzing in detail what the "economization" of science means, what specific forms it takes, and what its consequences are for universities, it is necessary to clarify some of the basic categories that are at stake.

There are three readily identifiable and traditional distinctions that have been drawn between academic and industrial or commercial research:

First, the defining characteristic of academic research has been its self-referential quality. Academic research has been oriented to particular disciplinary communities; its ideal (or ultimate objective) is the production of knowledge "for its own sake". Academic research therefore mainly consists in fundamental or basic research. Industrial research is different: the objectives of that research, which is mostly applied or strategically-oriented, is determined mainly by the corporation or business that funds it. The ultimate objective in this case is the production and development of knowledge that is marketable.

Second, the pivotal role in academia is played by the scientific community. This is particularly evident in how it addresses the quality of research, which is either through peer review or by the promotion of specific procedural norms, which Robert Merton and his followers called "Communalism, Universalism, Disinterestedness, Originality, Skepticism" (abbreviated as CUDOS).[36] Additionally, it is the disciplinary communities themselves that set priorities in the research agenda. In industrial research, by contrast, priorities are set according to corporate market strategies, and quality control relies instead on norms related to functionality and efficacy.

36 Merton 1973.

Third, academic research remains institutionally anchored in universities. University funding is predominantly public (private universities remain an exception), reinforcing the role of the public in legitimizing the university's mission. In addition, the results of academic research are communicated openly in scientific journals. Industrial research, on the other hand, may be carried out both in corporate settings and in universities as commissioned research. Industrial research is privately funded, and it is justified by its outcomes. The communication of results most often is restricted, or occurs only after proprietary rights have been secured through different means such as patents or copyrights.

As Dominique Pestre has explained, changes to the organization and funding of research since the middle of the twentieth century have blurred these older distinctions between academic and industrial research. New evidence and new contexts today challenge the traditional distinctions and assumptions noted above. For example, the common distinction between basic and applied research, popularized since the 1960s by the OECD's Frascati Manual,[37] is artificial and simplistic. This distinction no longer fits the scientific practices followed in biomedical or translational research, for example. Similarly, studies have shown that a linear model is not the only way to understand the nature of innovation (for an example, see "Pasteur's Quadrant"[38]).

But the main changes concern the university itself. The earlier assumption was that the "freedom to conduct research" implied that basic research would be conducted within an academic context such as a university. This assumption is challenged by the fact that universities have now taken on new missions. In addition to its traditional mission of producing knowledge and disseminating it through research and teaching, the university today must fulfil a "third mission", which includes developing technology transfer mechanisms, engaging in outreach (communicating to the public, for example) and in community service in a broader sense (explaining the social relevance of science, for example). In other words, the university must assume a function in which it legitimizes itself *vis-à-vis* economic and political institutions. This also means that traditional functional aspects of academic science, such as an open and disinterested mode of communication, have been augmented by an orientation to the public good, that is, to political and economic objectives. This "third mission" converges with an affirmation of the "entrepreneurial university" and the research conducted in it as an additional frame of reference.[39] As a result, the contemporary university must act not only according to science-driven strategies but also according to market-driven interests and economic opportunities.

The "economization" of science in particular underscores two types of increasing interaction between academia and the private sector. On the one hand, it can mean that commercial interests directly affect universities. That may take the form of sponsoring, patenting, licensing, copyrights, asserting intellectual property rights, and so on. On the other hand, an indirect "economization" refers to how policy-makers intervene in universities in order to increase performance at institutional and individual levels. This may take the form of creating artificial markets using new management tools like rankings, or bibliometric and performance indicators. These two types of interaction rely on the same basic mechanism: the replacement of an orientation to reputation within a scientific discipline by monetary incentives. Becoming entrepreneurial means first of all becoming oriented towards all kinds of material and monetary incentives.

As Diana Rhoten and David Powell have emphasized, adding a market-driven mission has led to a "shift from a model of science based on the philosophy of the public domain to one leaning towards notions of proprietary ownership and control".[40] At the same time, this shift affects the public nature of the university through an overall reduction in the role that the state plays in the university, in both financial and regulatory terms. The new, entrepreneurial university relies on a diversified funding model, in which public funds are only one source of support (others include private funding, performance-based funding, and so forth). At the level of governance and regulation, an

37 OECD 2002.

38 Stokes 1997.

39 Clark 1998; Etzkowitz et al. 2000; Geuna 2001.

40 Rhoten and Powell 2007.

increase in accountability, institutional autonomy, and the introduction of monitoring and evaluation (through New Public Management tools and methods, for example) have given the university more freedom over its short-term management but have also reinforced the need for it to be responsive and accountable to society at large.

There are numerous indicators of the changes that the "economization" of science has brought about. Various countries have established institutions that operate on the basis of (supposedly) internationally recognized standards.[41] The explicit affirmation of principles of scientific and academic practice is itself an indicator of the effects of the "economization" of science. These principles include adherence to CUDOS norms, honesty in communication, reliability in performing research, impartiality and independence in such research, openness and accessibility, due diligence, fairness in citations and in giving credit, and an explicit responsibility to future scientists and researchers.

Indirect rather than direct "economization" may affect a larger segment of academia, because it affects the culture of academic science itself, but focusing on the latter may be more revealing. A major example of direct "economization" is the shift in patenting and in the regulation of intellectual property rights in the United States after the 1980 passage of the Bayh-Dole Act (formally, the Patent and Trademark Law Amendments Act). This law extends patentability to previously disallowed areas, including non-naturally occurring and non-human multicellular living organisms (such as animals), mathematical algorithms, and methods that underlie even the most basic software programs and Internet applications. Some countries in the EU, including Denmark and Germany, have introduced legislation similar to Bayh-Dole.

At a more scientific level, there has been an increase in "dual knowledge" in biotechnology. That has meant an immediate industrial utility of such research—already evident as the research is being generated—which has led to all kinds of attempts to shield this knowledge from industrial competitors, often by obtaining patents. Such patenting takes place primarily in the life sciences and in biotechnology fields. Although university patenting is growing in Europe, it is far more prevalent in the United States, where already in 1998 41 percent of the academic patents were in just three areas of biomedicine. In terms of revenues, about half the royalties generated by university patents are related to the life sciences, including biotechnology.[42] By contrast, 45 percent of the Higher Education Institutions (HEIs) in the United Kingdom made no new patent applications in 2002, the mean number of patent applications per HEI was 9, and 67 percent of HEIs obtained no patents in 2002.[43]

The effects of direct "economization" on universities and researchers are in fact rather negative. One study of the role of intellectual property rights in scientific knowledge, with a specific focus on the dual knowledge generated in biomedical research, showed that patenting could significantly delay the publication of scientific results.[44] Based on a sample of 340 peer-reviewed scientific articles that appeared in Nature Biotechnology from 1997 to 1999, this study found that in nearly half the cases a US patent covering the knowledge presented in the article had already been granted, and on average, more than three years had passed between the granting of the patent and the scientific publication. The authors of the study further pointed out that while published articles associated with formal intellectual property are more highly cited than those whose authors choose not to file for patents, the article citation rate declines by 10 to 20 percent after a patent is granted. This decline is particularly salient in articles authored by researchers affiliated with the public sector.

This substitution effect between publishing and patenting may be worse for younger researchers than for older ones: "young researchers active in patenting from the start of their careers may prove to be less productive in the long-term", the authors noted.[45]

More generally, commercial involvement in academic research changes the norms in, and principles of, the production of scientific knowledge in academic contexts. For example, after the Bayh-Dole Act was intro-

41 See the European Code of Conduct for Research Integrity, available at www.esf.org/fileadmin/Public_documents/Publications/Code_Conduct_ResearchIntegrity.pdf, accessed on May 25, 2013, as well as the various national codes; See also Singapore Statement on Research Integrity at www.singaporestatement.org/, accessed on May 25, 2013.

42 Geuna and Nesta 2006.

43 Geuna and Muscio 2009.

44 Murray and Stern 2007.

45 Geuna and Nesta 2006.

duced, "universities and individual researchers soon began to respond to the financial incentives by rejecting communalism and increasing efforts to seek patents […] Once a critical mass of norm violators was reached, rapid norm breakdown ensued".[46] The neutral position of the university, traditionally considered as a moral authority, is thus challenged more often, with the institution itself coming to be seen as acting from self-interest.[47]

Other studies have shown that "economization" reduces the ability to communicate results quickly. This is due to delays, the perceived need for secrecy, or the increased costs associated with accessing research materials or tools. Also, it "[diverts] the research resources (researchers' time and equipment) from the exploration of fundamental long-term research questions that tend not to be suited to the development of intellectual property rights".[48]

At the same time, the benefits to universities of "economization" through patenting are not overwhelming: "only a few universities are likely to win it all, while the majority of universities will eventually become poorer through the expensive daily running of their technology transfer and patenting offices."[49] "Most technology licensing offices barely break even, fewer than 20 universities garner significant returns to licensing, and only a handful of licenses on any campus generate more than $1 million."[50]

In conclusion, therefore, there are a number of main characteristics of direct "economization" in universities:

- It has had a much greater impact thus far on the United States than on European universities.
- Its effects are felt most in only a few research fields: biotechnology, biomedical sciences, and information and communications technology. The distinction between basic and applied research no longer applies in these fields, as they tend to produce "dual knowledge".
- The financial resources obtained from patents vary greatly among universities, but few universities are able to profit from them. Most Technology Transfer Offices do not make money.
- The change to the "academic culture" and the perception of universities as "entrepreneurial institutions" must be weighed against each other.

Finally, there are recommendations for how to limit the effects of "economization". Universities should carefully monitor their relationships with biotechnology companies. Universities may want to make clear to faculty and to companies that they oppose the protection of trade secrets that result from industrially supported research, and that the right to publish research results (with modest delays to allow companies to file patents) must be protected. Academics and faculties should be encouraged to police their relationship to industrial sponsors, particularly in order to disclose what financial interests exist in their ties to industry.

46 Rai 1999.

47 Slaughter and Leslie 1997.

48 Geuna and Nesta 2006.

49 Geuna and Nesta 2006.

50 Rhoten and Powell 2007.

3 "Economization" in Science and of Science Itself: Changes to the Game[51]

Gerd Folkers

One can begin with some brief comments about the public life of scientific facts, and note at just how many points the process of producing a scientific paper can be influenced (see Fig. 1).

It is a general observation that the scientific enterprise has become a mass endeavor. According to research done by Arif E. Jinha, the contemporary world of scientific research relies on six million researchers worldwide, with one million new researchers in the developing countries added since 2003.[53] There are one million research papers published each year, and three million papers rejected (by at least two reviewers each). More than half of all published papers are never cited. Since 1665, 50 million papers have been published, and there are 25,000 peer-reviewed journals.

51 The author gratefully acknowledges important suggestions and fruitful discussions with Franz Schultheis, St. Gallen and Manuel Trajtenberg, Jerusalem.

52 Scheme based on the research of Gerd Folkers and Vladimir Pliska, 2006.

53 Jinha 2010.

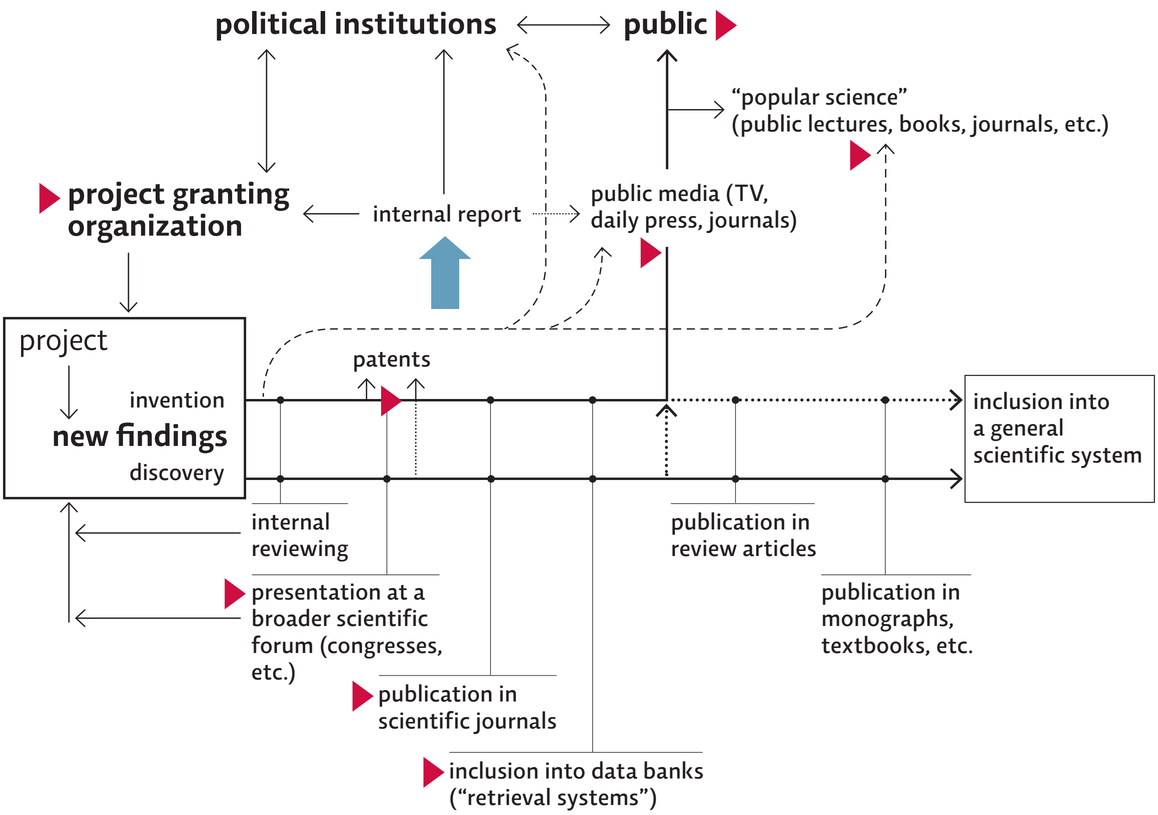

Fig. 1: **The public life of scientific facts**[52]
[The red triangles indicate potential economical drivers.]

Since the 1950s, there has been an exponential increase in annual global research output, as measured by the number of articles published (see Fig. 2). There has been a corresponding increase in the proportion of "toxic papers" as well: a recent study indicated that about one-third of the scientists asked admitted to having used "questionable research practices" at some point (see Fig. 3).[54]

The main question is whether this escalation reflects a real increase of knowledge, or whether the escalating costs of science simply reflect the costs of maintaining an enormously large system of science. This question touches on the problem of limited resources in academia, both in terms of time and in terms of attention that can be given to research. Under the current conditions of mass education, becoming a successful researcher means that a student must compete with fellow students for course credits, for lab space, and for PhD and/or post-doc positions. There is also competition among teachers within individual autonomous disciplines, between institutions to get the "best" students, and between nations to keep the "best" students and to avoid brain drain. Getting and keeping the "best" faculty implies competition among institutions and between nations as well.

The lack of time and attention that can be given to research among researchers themselves creates new survival techniques and targeted behaviors. Ratings and rankings, higher wages for talent, and efficiency thinking (the development of an "economic habitus") are one aspect. Another is acceleration, accountability (quantified evaluation processes whose feedback loops make time and attention even more scarce), and streamlined teaching ("you teach because there is a certain accountability for what you teach, and you don't teach what you really think you should teach"). This fight for resources constrains the emergence of talent (which does not grow at the same rate as the number of peer-reviewed papers, journals, and patents). The development of the fast-growing "machine of science" is taking priority over what should be its main goal. One can therefore ask what purpose this competition serves. In my view, competition is useful for private goods but not for public or common goods. This rests on the notion that knowledge is a public or common good, a contestable notion.

54 Fanelli 2009.

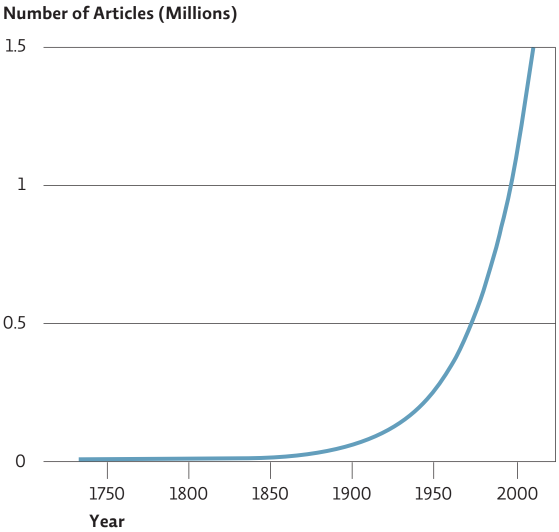

Fig. 2: **The production of scientific articles since 1726**

Source: Jinha 2010.

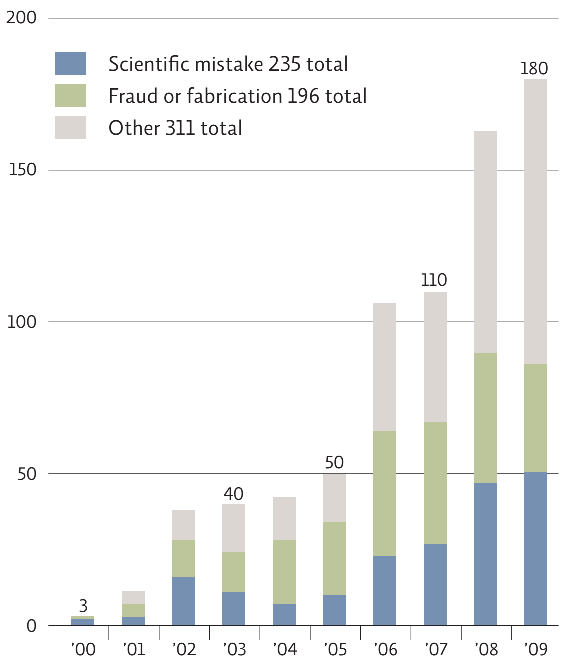

Fig. 3: **Rise in retracted articles**
A study of the PubMed database found that the number of articles retracted from scientific journals increased substantially between 2000 and 2009.

Source: Zimmer 2012.

The game has changed. If we argue that knowledge production is going to shift to the private sector, then the observed "economization" can be explained. The competition for talent among institutions and nations means "moving the food": brains follow the money. Fighting for credits means that students reach for the low-hanging fruit: their behavior is "credit-driven" instead of "interest-driven". Fighting for impact means publishing (preferably together with well-known people) as much as possible in a field that gets a lot of attention: this behavior is "impact-driven" instead of "interest-driven". Fighting for time means not stopping to reflect, but producing and being efficient. This new game affects support and sponsorship within academic institutions: you have to market your field. And we all know the "Matthew effect". As noted before, disciplines are now treated unequally, and the state may even wholly withdraw its support. This can lead to increased flat-rate taxation and may also lead to reduced budgets for education and a reduction in the scope for development.

Such a game does not really fit with the historical view of academia, which gained its huge advantage from being independent of Pope and King, as was true of Bologna, the first university (founded in the early 11th century). The game today is the exact opposite. "More than 60 top-ranked researchers from different scientific disciplines—all on the Institute for Scientific Information's (ISI's) highly cited list—have recently signed part-time employment arrangements with King Abdulaziz University in Jeddah, Saudi Arabia, in which they agree to add KAU as a second affiliation to their names on ISI's list of highly cited researchers. Meanwhile, a bigger, more prominent Saudi institution—King Saud University in Riyadh—has climbed several hundred places in international rankings in the past 4 years largely through initiatives specifically targeted toward attaching KSU's name to research publications, regardless of whether the work involved any meaningful collaboration with KSU researchers."[55] In 2010, KSU moved into the 300-400 bracket of universities in the Shanghai ranking, and a year later into the 200-300 bracket. On the latest Webometrics ranking, KSU is at rank 186, far ahead of rank 2910, where it had been in 2006.

The utilitarian principle legitimizes a shift in how disciplines are valued. Evaluation now means valuing a discipline according to its economic utility. The multiplication of scientific databases like Scopus and the Web of Science not only helps in developing a new market for scientific information, but also leads to a new course of action, and justifies management by rankings.

The effects are well known. Scientists must adopt an "entrepreneur mentality". They must think in terms of productivity and efficiency, and their behavior becomes market-driven. The trend towards flattening problems creates a jargon of efficiency. Interdisciplinarity comes to be seen as a waste of time, and new inventions are less innovative because the proposals that lead to them are streamlined and become both more incremental and more conservative.

In sum, two forces are at stake. The external force we face is an economic tsunami where budget-conscious leaders of academic institutions find themselves in an all-or-nothing game that pushes knowledge to become a private good. The internal force(s) we should promote rely mainly on actively striving for objectivity and on prioritizing publications for the scientific community. The main measure of quality, namely peer review, is aimed at ensuring that the main output of science benefits society, and that it contributes to the overall capacity of society to think in the longer term, as well as critically.

55 Bhattacharjee 2011.

C General Discussion

Walter Stoffel opened the discussion by asking Dominique Pestre what conclusions he would draw about the future of the university.

Dominique Pestre responded by making two observations.

The first was that one needs to keep both the context and the particular disciplines in mind. In terms of the latter, while the social sciences may well survive "economization", the humanities will have a more difficult time. That was certainly the case at his own home institution in literature, anthropology and history disciplines. In terms of the former, the emergence of bio-businesses has created a context, at least in the United States, which has profoundly affected how certain disciplines in the hard sciences are organized.

The second observation was that we tend to see the "economization" of science as the result of the private sector exerting its influence on the public realm. That leads us to believe such influence is the problem, though that is not entirely true historically. Economic ways of thinking already began to influence public policy during World War II, and these evolved, by the late 1950s and the early 1960s, into new management and funding practices. For example, research and development work after the war led to creating the Rand Corporation, a think tank that would redefine the nature of innovation in the postwar era. Research began to be organized around projects, and that affected how money was allocated to research as well as academic disciplines themselves. In the late 1950s, the Defense Department of the United States created a discipline, materials science, which until then had not existed as a separate academic field or area of scientific inquiry. The needs of the military were not for physics, crystallography, or chemistry as such but instead for the study of "materials". Universities were not reconfigured because disciplines set new priorities but instead by introducing new management techniques and project-based funding.

We must keep in mind, Dominique Pestre noted, that "economization" can refer to at least three different ways of combining the private and the public in an institution like the university. The first transforms the university into a market-like institution. The second privatizes parts of the university. The third creates new forms of management such as by project. The principles underlying each are different but all three contribute to changing universities.

In response, Hans-Joachim Böhm wondered why such "economization" takes place largely in disciplines such as biotechnology, biomedical science, or information and communication science. Why not in engineering or law?

Peter Weingart's response was that a field such as engineering is already linked to the economy, or at least to industry. That was not new. However, there were disciplines whose knowledge production is fundamentally dual in nature, where the results of research can as readily be used in industrial applications as it can contribute to basic knowledge. This is particularly true of biotechnology, biomedical sciences, and information and communication sciences. Such dual knowledge production is specific to those disciplines in which basic and applied research are not separated.

Concurring, Gerd Folkers noted that these particular disciplines can benefit from "economization" more because they combine intellectual property with the potential for a high multiplication factor. That potential determines the degree of "economization" of a discipline. Additionally, the products of biotechnology and biomedical research can affect the entire world's population, while the production of intellectual property in law simply does not have the same influence on the (potential) marketplace.

In response, Dominique Pestre drew attention to the United States where an argument has been made since the 1980s that patents are the key element for linking academic research to the marketplace. Granted, patents play a key role in industry, but this is true to an only limited extent for universities, which mainly obtain patents in the biosciences.

Patents are not as central in many other fields, nor are patents significant in how universities respond to the needs of the economy. Knowledge transfer in the physical sciences, for example, mostly does not take place through patents but instead through creating devices and instruments, and by passing on the knowledge necessary to master these devices. That, in turn, means collaborating with specific industries and providing information that cannot be directly transmitted through a patent alone. Hence, knowledge transfer from university to industry or into the economy does not rely on a single system such as patents, raising doubts whether patents play such an exclusive or even central role in this transfer.

Still, the dominance of patents in biotechnology is a fact. Many universities and smaller companies complain that with the multiplication of property rights claims, patents now act more to impede than to encourage innovation. The Myriad Genetics case[56] currently pending before the Supreme Court of the United States, is interesting since it is possible that the Court will rule that certain types of knowledge production simply cannot be patented.

Astrid Epiney raised a question about what other forms “economization” might take.

In answer, Peter Weingart explained why he regards “indirect economization” as much more significant than “direct economization”. The former affects the entire culture of research, redefining the distinction between public and private, and thus the conception of science itself in academia. In the past, accountability meant how science justified itself to society at large. Now it means the control exerted by certain private interests, with “economization” (or an orientation to the marketplace) affecting the attitudes of both institutions and individuals. Because it takes place at this much deeper level of culture and attitudes, in a realm one could call the cultural fabric, it is a quite disturbing development.

Yet what self-regulating capacity does the academic world have, Walter Wahli wanted to know. The speakers had drawn a rather pessimistic picture, though perhaps they were simply being realistic. What can or should the academic community do in the future?

Peter Weingart responded that a major shift has taken place since the early 1990s, brought about by introducing New Public Management tools and methods (i.e. evaluation, performance assessment through indicators, and so forth). Concerns about accountability are expressions of a need for legitimacy, as science has expanded to an unprecedented degree in recent years. The end of the Cold War in 1989 not only ushered in a new era of greater global freedom for science, but it also legitimized the idea that the regulation of science would no longer, or could no longer, only be in the hands of scientists themselves. The rapid development of bibliometrics is just one example.

One should remember, Peter Weingart said, that the scientific community has not always been able to find effective ways to evaluate, using explicit criteria, or to allocate funds to large research projects. The “system” of science, which governed itself using mechanisms such as reputation, peer-review, and self-regulation within disciplines, had gradually slid into a crisis and had to change. Yet the current pressures to be accountable and meet what are called “social expectations” is striking, especially since these expectations often reflect particular interests, are unsystematic and often *ad hoc*.

The question is how we can find a proper balance between the self-regulation of science and what outsiders call the “grand challenges” or expectations of society. New mechanisms have to be found. What we do know is that New Public Management methods have taken us to the other extreme.

In responding, Dominique Pestre agreed with Peter Weingart’s analysis. It is not just the (supposed) self-regulating capacity of academic disciplines that is at issue: academia itself is divided with respect to “economization”. Some disciplines, and some researchers, are quite happy with their own “economization”, as they can then obtain more funds. As Gerd Folkers put it in his presentation, “if the food is offered, some people will run to get it”.

Dominique Pestre therefore suggested one should not speak in generalities but with reference to particular situations. How can we resolve the problem that we encounter in the biosciences, for example, where much knowledge is controlled privately and by many different players? Should we look for solutions from the Supreme Court of the United States or other political institutions?

Another issue, Dominique Pestre went on, is the number of research proposals each professor is asked to review. The number expands exponentially, and a professor can spend all day just reviewing them. Yet because more and more requests for review are made, the reviews are undertaken ever more quickly, leading to more superficiality in the reviews, which is not

56 On June 13, 2013, the Supreme Court of the United States invalidated several of Myriad Genetics’ patents on two human genes associated with many types of breast and ovarian cancer, assimilating the isolation of genes to discovery instead of invention. The Court however retained patentability of complementary DNA (cDNA) molecules, which are synthesized from transcripts of these genes. See www.supremecourt.gov/opinions/12pdf/12-398_1b7d.pdf, accessed on July 16, 2013.

good. These processes have to do with how academic communities manage themselves, and a solution could be to identify where the problems are in the system, and try to slow down or go back to past practices. In commenting on this, Gerd Folkers emphasized that the first University of Bologna, which began as a relatively small entity, remains an ideal. It is simply not possible to scale up from the 11th century University of Bologna to a modern research university. Today, we need to have layers of management and must engage in "economization" simply to make it possible for a modern university to function as it should.

Yet differences within the disciplines remain quite striking. Take the mathematicians: they do not suffer from all the regulations related to New Public Management, at least not in their reviewing and publishing practices. When they publish, authors' names are listed in strict alphabetical order. Mathematicians meet twice a year in small groups, and this size constraint leads to a kind of social control: all who want to contribute to a discussion can do so. The structures and demands made on researchers and administrators in chemistry, for example, as well as how they communicate their findings to one another, are quite different.

We would probably have to go back to smaller units to again have meetings that do not need to be managed and organized. The problem starts with the fact that more money is available if your entire operation is bigger: more students, more doctoral candidates, more degrees, and so on. This creates clear incentives to have departments that are as large as possible.

In response, Wolf Linder asked Gerd Folkers about what should be done. Dominique Pestre had explained that the last thirty years saw not only the privatization of (some areas of) knowledge, but economic globalization and the implementation of a neoliberal project as well. That has meant the emergence of a kind of Social Darwinism where only the largest survive—not necessarily the fittest. This is a structural view, however, while Gerd Folkers had focused on the virtues of individuals. Wolf Linder thought this insufficient, because those scientists who survive are the ones who are the most opportunistic and who chase after the money. How, then, can we change the structure and make it attractive for young researchers? How can we arouse their curiosity?

In response, Gerd Folkers explained why the changes must take place at the level of individual behavior. If a scientist behaves like a capitalist, then he or she can obtain funding to hire young researchers and give them the opportunity to explore areas they are interested in. Those young researchers may discover realms where they can contribute, and more so than if they remain confined to their own field.

Gerd Folkers also strongly believes in a neutral Darwinian evolution that involves mutation, selection, adaptation and chance. If every mutation would immediately change the phenotype of a species, no species would ever persist. This is why he recommends creating a nucleus of researchers and finding the money to hire young researchers—and he hoped his theory of evolution is correct.

Walter Stoffel then asked about a distinction Gerd Folkers made in his presentation between knowledge as a public good and knowledge as a private good. Why is knowledge supposed to be a public good? It can be, but it does not have to be, does it.

Gerd Folkers explained this in linguistic terms. German uses two different terms to refer to knowledge: *Erkenntnis* and *Wissen. Erkenntnis* is knowledge that is publicly available and (should in principle be) accessible to all. *Wissen,* by contrast, is more related to know-how, an example of which might be a method to manipulate DNA. It can be commercially advantageous to have such knowledge, which also means it can be a private good. In its *Wissen* sense, knowledge can be accumulated; this is harder to do for knowledge in its *Erkenntnis* sense.

Dominique Pestre added a note on the value of science *per se.* As Louis de Broglie long ago noted,[57] the value of science is moral, inasmuch as it involves education and personal formation, or because it can be understood as a moral attitude. In short, it has a value that is not purely economic, and it may even be that "knowledge" (in its *connaissance* or *Erkenntnis* sense) has an inherent value that cannot be commercialized.

Astrid Epiney then asked all the participants to address the public mission of universities. Is there a particular role universities are supposed to play?

57 Broglie 1941.

To Gerd Folkers, the main characteristic of knowledge is that it serves as a touchstone. If knowledge is hidden when it becomes privatized, this touchstone is lost.

Peter Weingart, in turn, wanted to emphasize the fundamental relationship between knowledge and the democratic constitution of a society. This should be where a discussion of values begins. Knowledge produced in universities should be accessible to all, since a democratic society cannot tolerate public institutions that produce knowledge that cannot be used. If knowledge is kept secret, it creates a means to exert power that is outside of public control. This is also why freedom of opinion is the basis for the freedom to pursue scientific inquiry in every democratic society. Although not always made explicit in national constitutions, freedom of opinion is used everywhere as a justification for protecting science from political or economic control.[58]

In his answer, Hans-Joachim Böhm argued that global competition requires players to invest constantly in new technologies. Knowledge therefore needs to be useful, for to survive, each country must develop something and commercialize it. If we say everything is in the public domain, we exclude ourselves from the game.

Dominique Pestre wholly agrees with Hans-Joachim Böhm. Since the scientific revolutions of the 17th century, universities have had three major functions. The first is teaching, meaning not merely passing on the technical information necessary to become a good engineer, but also *Bildung*, educating the "whole person" technically, socially, and culturally. The second function is research, which is oriented to developing a better understanding of the world. In the way we now use it, "research" has taken on a quite abstract general meaning. No one ignores the third function today: to be useful to society. One example is the Accademia del Cimento, founded in Florence in 1657, which was conceived of as a place to experiment. Its functions included collecting machines, inventing new ones, making measurements, and (partly) standardizing.

The point is not to choose from among these three functions—training and *Bildung;* research and understanding; usefulness and practical application—but instead to establish how one should organize the relations between them. A kind of unwritten contract always exists that tries to find a balance among the stakeholders in scientific research; it is like the equilibrium that is always being sought between politics, economy, and society. Over the last thirty years, however, more and more people have realized we have gone too far, and the hope is that we will roll things back, at least somewhat. It would be wrong to accept the idea that usefulness means complete privatization, and wrong if this became the absolute priority of any university. The point is to define all the rules precisely, and as always, the devil is in the details.

Gerd Folkers responded that this point brought the discussion right back to the question of patenting. A patent is a contract, the German word for which is *Offenlegungsschrift* [lit. a document of disclosure], meaning that the document is meant to be published. At the same time, a patent is part of a contract that grants security for a certain period of time against copying the discovery that has been made. A patent also preserves the right of the inventor against others who would like to use the discovery for other purposes. If nothing was patented, no new developments would be possible in certain fields. There are types of knowledge that are not patented but are simply secret, such as the formula used for making Coca-Cola. Patent means disclosure, so publication is very important. The social contract is therefore a juridical contract that enables "economization" to proceed in a *regulated* way.

Hans-Joachim Böhm added that the "economization" of science is a reality and must be discussed as such. One cannot just do nothing and look away.

But in demurral, Dominique Pestre said he is quite reluctant to use the expression "economization of science", and prefers to talk instead about the social contract and about the bundle of rights distributed among different stakeholders. Such a social contract existed in the late 19th century in Western Europe in Germany, France and Great Britain, but it has changed considerably. The point is not to say that we do not want any commercialization or "economization", for such changes have always occurred and will continue to occur.

58 In Europe, the constitutions of Austria [Art. 81c (1)], Finland [Sect. 16 (3)], Germany [Art. 5 (3)], Greece [Art. 16 (1)], Italy [Art. 33 (1)], Poland [Art. 73] and Sweden [Art. 18] explicitly guarantee the freedom of science.

Hans-Joachim Böhm then drew attention to the enormous opportunities the "economization" of science has brought to Switzerland, whose excellence in biomedical sciences is internationally recognized. Nowadays, there is a trend for large companies to move closer to famous universities and research sites, for example from New Jersey to Boston, or from Manchester to Cambridge. This could be of great advantage to Switzerland. Sometimes we think about what commercialization or marketization means only in one direction, namely what goes out from the universities and into the marketplace, but we should not forget that it can also mean what is brought from the marketplace into the universities.

Peter Weingart pointed out that one problem lies in overstating the significance of such developments. That big research enterprises are moving closer to major academic research centers is a good thing: the real problem is when public money is devoted to private use.

In reference to this last point, Gerd Folkers noted that the Swiss pharmaceutical industry and Swiss universities already have close ties. Roche, for example, has research facilities close to the universities in both Zurich and Basel. Gerd Folkers remains firmly convinced that academia and industry should complement one another's research, and suggests collaboration could be inspired by the example of how knowledge is generated about AIDS and other infectious diseases.

Such collaboration could rely on a complementarity between high research risk, made possible by the relatively secure positions that researchers have in academia, and low research risks that are dictated by the hard market realities of private industry. This is also a kind of economic model. However, industry should not simply approach the universities in order to take advantage of PhD students whose training is funded from the public purse; there should instead be a fair transfer of knowledge. The challenge to properly using this economic model is how to make the complementarity robust.

Hans-Joachim Böhm agreed, but felt the problem is that one sometimes entirely misjudges the future potential of a discipline, even from a purely commercial point of view. Who could have imagined twenty years ago that Islamic Studies would become so crucial today?

Walter Wahli added that, at least globally speaking, these interactions between universities and industry work quite well. There is a correlation in most countries between the strength of research and the economic strength.

While Dominique Pestre agreed generally, he noted that one should not forget that the main element of economic success is not primarily knowledge, or what comes out of a university, but rather the management practices and business models being used. Mastery of knowledge plays a role, but it is not the central determining factor in economic success. Historians who have compared late 19th century Germany to Britain emphasize that German science was not in itself superior to British science but that the organizational modes and economic models used in Germany were quite different. Knowledge certainly played a role, but the dominant factor in economic success was how it was linked to organization and economics.

In response, Peter Weingart pointed out that there are at least two models of innovation systems. One has strong private industry and strong science, the other has a strong state and strong science. Both systems work, but it is not always clear how they are organized internally.

Frédéric Joye-Cagnard then asked the guest speakers about the possible emergence of a new narrative. The current narrative is characterized by opposition to the "economization" of science and by a degree of resistance to the methods used by New Public Management. Is there anything in the current science studies literature that promotes a positive narrative arguing for a new balance among different stakeholders?

Peter Weingart responded by saying that he believes there is a growing awareness that things may have gone too far in the wrong direction. Most countries in Europe, Switzerland included, have the advantage that they were not legislative innovators, and did not follow the model of the Bayh-Dole Act from the very beginning, though a few countries like Denmark did.[59] But at this point it seems the skeptical voices are growing louder. The realization that a new balance is needed is probably stronger than the desire to avoid

59 This 1980 act gives US universities and non-profit institutions the authority to commercialize inventions even if the research that led to the invention had been publicly funded.

making further mistakes. But this growing awareness was of "direct economization", the general movement toward commercialization. Things are not so clear concerning the need to move beyond New Public Management, because the orientation to an economic way of thinking is much stronger through "indirect economization". There is already some talk about pulling back from using New Public Management practices uncritically.

What needs to be strengthened, specifically in universities, is finding a new balance between being responsive to society on the one hand—in a sense, reinvesting in the old argument about the social relevance of higher education and research—and the need to develop the "entrepreneurial university", the university managed like an enterprise, on the other hand. Scientists need to become responsive and answer to certain expectations from outside their institutions and disciplines, because the model of self-regulating disciplines, an exclusionary model, simply does not work anymore. At the same time, to have the maximum possible number of doctorate candidates, the maximum number of published articles, and so on, is a questionable objective.

This discussion, in Dominique Pestre's eyes, raised questions that might be better answered in the political realm or the public arena. In the 1980s and 1990s, the development of free enterprise was regarded as the only possible future as well as the best one. Some in the political arena, in countering this narrative, saw this tendency as a type of "economization" and criticized it accordingly. This difference of opinion is ultimately a matter of political choice, not of science. In the specific issues raised by the Bayh-Dole Act and the decisions made by patent offices, a new equilibrium was reached between the various functions of universities, namely training, research, and usefulness. Within academia, some complain about the constraints they face in their ordinary work due to new organization and the new ways in which universities have become dependent (although universities are always dependent). All the specific dependencies that we have experienced over the last thirty years prevent universities from doing certain things, and universities want to loosen some of these constraints.

The question is not whether to encourage or oppose "economization". The question instead is: which form of "economization" is good for the university and the functions it performs? One can discuss whether it is appropriate for Myriad Genetics to have property rights on two genes, and whether this impedes innovation. One should also ask to what degree granting property rights interferes with or even prevents research by those who do not have these rights. The movement from 1980 to 2010 has been more and more unidirectional. If the Supreme Court of the United States were now to tell Myriad Genetics: "No, you cannot be granted such extensive rights just because of this one thing you have done: you cannot reserve a whole realm of technical activity solely for your own profit", these discussions of "economization" could also take place at this more specific level. Finally, Dominique Pestre reminded discussants of a graph Gerd Folkers had presented, showing the exponential rise of global research outputs.[60] This is a challenge because the current rate of increase is not infinitely sustainable.

Hans-Joachim Böhm recalled his recent visit to a company in the Chinese city of Wuhan. When he asked why the company had decided to locate its operations there, he was told that there are 100 universities/colleges and one million students in Wuhan alone. That could mean that even if one looked only at specialized journals in chemistry, for example, Wuhan alone might submit five hundred articles each year. The global number of researchers has simply become too large, and this quasi-invisibility of research institutions and scientists in the East is another consequence of the "massification" that was discussed.

Walter Wahli observed that most such diagrams simply reflected the number of people who devote themselves to a problem, and that sooner or later a saturation point is reached. We should distinguish between what is a mass effect and what is harmful for the system.

In response, Peter Weingart added that already in 1961, Derek de Solla Price, one of the first historians of science to use quantitative analysis, predicted that if the number of scientists continued to grow at 1960s rates, every man, woman and dog on earth would be a scientist by the year 2000.[61] Still, the reason the exponential curve is infinite is that new definitions of science keep emerging.

60 Cf. presentation of Gerd Folkers, fig. 2.

61 Price 1961.

In the end, the question is how many scientists can be sustained by a society and how many can contribute to social development. However, the official targets for science funding are not really sustainable. The OECD encourages investing 3 percent of GDP in research, but once this goal is reached, the next recommendation might well be to increase it to 3.5 percent. “Massification” has changed the entire system as well as its foundations. The tradition of self-regulating departments and disciplines, which has been at the core of academia, no longer works.

For Hans-Joachim Böhm, “massification” may not be the main issue. Innovation continues to take place, but it is largely at a very small number of top universities—Stanford, Cal Tech, UC Berkeley, Harvard, Oxford, Cambridge, ETH Zurich, and so on. The vast majority of other institutions do not play a big role. What is key for Switzerland is to maintain its ability to spin off the promising ideas that emerge from what was initially conceived as basic research. If a society were to decide universities should only do applied research, that would be their demise. One must maintain the correct balance.

Gerd Folkers agreed, though in his view, this has nothing to do with the effects of “massification”. The problem is that more and more money is being poured into a machinery that works inefficiently, not that these top twenty universities are in jeopardy. One has to break this cycle and concentrate on research that is genuinely innovative and produces new ideas and findings.

Dominique Pestre disagreed with the suggestion that the main innovations only come from the top twenty universities. This does not fit with the real economic world. Chinese universities do count a lot, as well as all those higher education institutions that do not rank highly in global comparison tables. Any university has an impact on the local economic fabric, and it is not just a matter of making important discoveries and applying them.

Still, Hans-Joachim Böhm pointed out, it is a fact that no major pharmaceutical innovations so far have come out of Asia.

Dominique Pestre in responding emphasized that the power of Indian pharmaceutical companies came about because India decided not to respect Western laws and simply copied Western molecules. Indian and Brazilian pharmaceutical companies engage in reverse engineering, and this works out in economic terms. It is therefore a question of the laws, or the game being played, more than it is a matter of science. Europe was the world’s innovator until the 1920s, when the United States was relatively weak. The Americans did not respect patent rights and copied every European invention, but once the United States became strong, they told the rest of the world, “do not copy us”.

Government policy, in Peter Weingart’s view, has tried to push German science and industry to become innovators and initiators. Some see this as foolish, and suggest instead that Germany should cultivate the advantages that being an adopter bring. Unfortunately, it is nearly irresistible to politicians to pursue the (misconceived) idea that universities have to be among the top twenty globally in order to matter. This goal is set politically so it therefore should also be addressed politically. A negative side effect of “economization” is that it focuses the entire system on high-tech innovation, on first-movers, and on technology. This might well be the wrong approach to take, especially for those who adopt innovations later.

Finally, Dominique Pestre quoted a study by the historian David Edgerton, who emphasizes that economic success in the mass production of chemical products has not always depended on being obsessed by the latest innovation.[62] Brand-new products and processes, being at the frontier, or adopting the latest innovations can be quite dangerous. Switzerland and Germany are economically on top today, but this might not be due to their frontier, radical technical innovations. Big profits are not necessarily made by investing in what is brand-new.

In his synthesis, Walter Stoffel emphasized he spoke as a market specialist and not as a legal scholar. He learned from one of Dominique Pestre’s main findings that academic research now needs to justify itself in the public arena in a manner it did not have to previously. The bundle of rights is not being redistributed in a well-organized way but more by a process called “economization”, though Dominique Pestre would rather not use this concept.

62 Edgerton 2008 [2006].

One can refer to "economization" as applied to a university in three ways: 1) by transforming a university into a more market-like institution; 2) by privatizing it; or 3) by applying new administrative methods such as those drawn from New Public Management. Depending on country, circumstances, traditions, and other factors, many such transformations are to the good, yet the perception overall is that we have gone too far in such "economization".

Peter Weingart notes, as Walter Stoffel understood, that "economization" in Europe has displaced the ideal of knowledge for its own sake. Production of knowledge is more and more oriented to its marketability, and this is a major change. In addition, the older orientation to reputation in scientific disciplines is being replaced by an orientation driven by monetary and material incentives. Research institutions, and academia more generally, have lost their neutral status, and the culture of free academic communication is endangered. Peter Weingart suggests we probably need to turn back from the direction we have taken.

Gerd Folkers' main argument focuses on the problems associated with "massification". Though this may not be evident at a particular or personal level, he shows that this tendency creates problems for and in everyday work. Gerd Folkers believes this is because knowledge, a public good, is being addressed as though it were a competitive, private good. While competition may work for private goods, it is unsuited to public goods. The machine of science no longer has its rationale in providing new insights and original knowledge, but it justifies itself, and we feed this machine in order to have economic turnover. As a result, we have lost long-term critical thinking, and we need to regain it.

The main conclusion of all three presentations, to Walter Stoffel, is that we need to retreat somewhat from the "economization" path we have taken.

However, Walter Stoffel argued, even if the University of Bologna when first created was meant to be independent of both Pope and King, it was never independent of wealth. One needs to consider not just government in this context but wealth and the economy as well. We ran a global experiment during the 20th century: in the Soviet Union, economic and political spheres were merged, while they remained separate in capitalist countries. That ended in 1989 with the Soviet Union losing both the economic and the political contest.

The general perception is that a market-driven economy performs better. It is also perceived as providing greater freedom and more individual rights. The figure of the entrepreneur is held in high esteem when market thinking is adopted. This affirmation does not reflect a major change to the economy itself, but perhaps more in the public conception of it.

Democratic states function through authoritative decisions that are made by the citizenry, and nation-states are territorially limited. By contrast, a market economy functions through decentralized decisions and by selling products that can be acquired by any buyer. The economy has become globalized. This process has increased openness, but it also limited the impact of decisions taken authoritatively in limited territories.

Academia has generally welcomed openness and globalization, and has been happy to have less control exerted over it by government. It has also been happy to sell marketable products, including through patents, start-ups, and the like. When the government opened up the decision market for scientists, academia was eager to get involved in decisions based on science. In effect, academia likes some aspects of globalization less (competition, for example), but has accepted them too.

For a market to function, it needs both property rights and the freedom to make contracts.

Property rights means it must be possible to attribute success and failure to those who make the decisions. Those who make good decisions are the winners who earn money, while those who make bad decisions will fail—unless they happen to be "too big to fail". However, the precondition is that we can measure the return on investment in *monetary* terms (success/profit or failure/loss). We cannot measure return in terms of power or prestige. Such an economically based model therefore does not apply to academia, for success and failure cannot be attributed to researchers themselves in the same way.

The freedom to make contracts means each operator has to decide, freely, on all the parameters that apply between buyer and seller, including the contract that binds them together. Without a buyer, the competitive market does not work. Yet in academia, there are normally no "natural" buyers other than the government itself—though there are a few exceptional fields, such as biotechnology, as we have learned.

Walter Stoffel derived two conclusions from this seminar.
First, we should steer away from trends to reverse the current development, and welcome the openness and globalization. In turn, we must accept accountability as a necessary element in our relationship with the public or society, and we must be accountable over the longer term.
Second, we should understand that "market" means decentralized decision-making. Since bringing market-related elements into the university opens a wider space for deciding and acting bottom-up rather than top-down, such a trend actually is in accordance with the wishes expressed by most academics.

Bibliography

Agar, Jon. 2008. What happened in the sixties? *British Journal for the History of Science* 41(4): 567–600.

Balogh, Brian. 1991. *Chain Reaction: Expert Debate and Public Participation in American Nuclear Power, 1945–1975*. Cambridge: Cambridge University Press.

Beck, Ulrich. 1992. *Risk Society: Towards a New Modernity*. Newbury Park: Sage.

Benner, Mats, and Hans Löfgren. 2007. The bioeconomy and the competition state: Transcending the dichotomy between coordinated and liberal market economies. *New Political Science* 29(1): 77–95.

Bhattacharjee, Yudhijit. 2011. Saudi universities offer cash in exchange for academic prestige. *Science* 334 (9 December): 1344–1345.

Boisvert, Valérie. 2005. Bioprospection et biopiraterie: le visage de Janus d'une activité méconnue. Cahier du GEMDEV, n° 30—Quel développement durable pour les pays en développement? Accessed July 11, 2013, http://koyre.in2p3.fr/IMG/pdf/BOISVERT-biopiraterie.pdf.

Boudia, Soraya. 2007. Global regulation: Controlling and accepting radioactivity risks. *History and Technology* 23(4): 389–406.

Broglie, Louis de. 1941. *L'avenir de la science*. Paris: Plon.

Brown, Wendy. 2005. *Edgework: Essays on Knowledge and Politics*. Princeton: Princeton University Press.

Bruno, Isabelle. 2008. *A vos marques®, prêts… cherchez! La stratégie européenne de Lisbonne, vers un marché de la recherche*. Bellecombe-en-Bauges: Editions du Croquant.

Castel, Robert. 2008. *La montée des incertitudes. Travail, protections, statut de l'individu*. Paris: Seuil.

Clark, Burton. 1998. *Creating Entrepreneurial Universities. Organizational Pathways of Transformation*. New York: IAU Press.

Dahan, Amy, and Dominique Pestre. 2004. *Les sciences pour la guerre*. Paris: EHESS.

Dejours, Christophe. 1998. *Souffrance en France. La banalisation de l'injustice sociale*. Paris: Seuil.

Demeritt, David. 2001. The construction of global warming and the politics of science. *Annals of the Association of American Geographers* 91(2): 307–337.

Dupuy, François. 2005. *La fatigue des élites, le capitalisme et les cadres*. Paris: Seuil.

Edgerton, David. 2008. *The Shock of the Old: Technology and Global History since 1900*. London: Profile Books.

Ehrenberg, Alain. 2000. *La Fatigue d'être soi. Dépression et Société*. Paris: Odile Jacob.

Etzkowitz, Henry et al. 2000. The future of the university and the university of the future: Evolution from ivory tower to entrepreneurial paradigm. *Research Policy* 29: 313–330.

Etzkowitz, Henry, and Loet Leydesdorff. 1998. The endless transition: A 'triple helix' of university-industry-government relations. *Minerva* 36: 203–208.

Fanelli, Daniele. 2009. How many scientists fabricate and falsify research? A systematic review and meta-analysis of survey data. *PLoS ONE* 4(5): e5738.

Forman, Paul. 2007. The primacy of science in modernity, of technology in postmodernity, and of ideology in the history of technology. *History and Technology* 23(1–2): 1–152.

Fressoz, Jean-Baptiste. 2009. La fin du monde par la science. Innovations, risques, régulations, de l'inoculation à la machine à vapeur (1750–1850). PhD diss., Paris: EHESS.

——— 2012. *L'apocalypse joyeuse. Une histoire du risque technologique*. Paris: Seuil.

Funtowicz, Silvio, and Jerome Ravetz. 1993. Science for the post-normal age. *Futures* 25: 735–755.

Galison, Peter. 1997. *Image and Logic. A Material Culture of Microphysics*. Chicago: University of Chicago Press.

Geuna, Aldo. 2001. The changing rationale for European research university funding: Are there negative unintended consequences? *Journal of Economic Issues* 35(3): 607–629.

——— and Alessandro Muscio. 2009. The governance of university knowledge transfer: A critical review of the literature. *Minerva* 47(1): 93–114.

——— and Lionel Nesta. 2006. University patenting and its effects on academic research: The emerging European evidence. *Research Policy* 35(6): 790–807.

Gibbons, Michael et al. 1994. *The New Production of Knowledge. The Dynamics of Science and Research in Contemporary Societies*. London: Sage.

Giddens, Anthony. 1991. *Modernity and Self-Identity: Self and Society in the Late Modern Age*. Cambridge: Polity Press.

Hasselberg, Ylva. 2012. Demand or discretion? The market model applied to science and its core values and institutions. *Ethics in Science and Environmental Politics* 12: 35–51.

Hessels, Laurens, and Harro van Lente. 2008. Rethinking new knowledge production: A literature review and a research agenda. *Research Policy* 37: 740–760.

Jas, Nathalie. 2007. Public health and pesticide regulation in France before and after Silent Spring. *History and Technology* 23(4): 369–388.

Jinha, Arif. 2010. Article 50 million: An estimate of the number of scholarly articles in existence. *Learned Publishing* 23(3): 258–263.

Le Masson, Pascal, Benoît Weil, and Armand Hatchuel. 2006. *Les processus d'innovation. Conceptions innovantes et croissance des entreprises*. Paris: Hermes, Lavoisier.

Mallein, Philippe. 2008. Usage des TIC et signaux faibles du changement social. Accessed July 11, 2013, www.ensmp.net/pdf/2008/TIC%20et%20Paradoxes%20philippe%20Mallein.pdf.

Merton, Robert. 1973. *The Sociology of Science: Theoretical and Empirical Investigations*. Chicago: University of Chicago Press.

Moreau-Defarges, Philippe. 2001. Gouvernance. *Le Débat* 115 (May–August): 165–172.

Murray, Fiona, and Scott Stern. 2007. Do formal intellectual property rights hinder the free flow of scientific knowledge? An empirical test of the anti-commons hypothesis. *Journal of Economic Behavior & Organization* 63: 648–687.

OECD. 2002. *Frascati Manual. Proposed Standard Practice for Surveys on Research and Experimental Development*, 6th edition. Paris: OECD.

Pestre, Dominique. 2003. *Science, argent et politique, un essai d'interprétation*. Paris: INRA.

——— 2007. Science, Society and Politics: Knowledge Societies from an Historical Perspective. Report to the Science, Economy and Society Directorate (European Commission). Accessed July 11, 2013, http://ec.europa.eu/research/science-society/document_library/pdf_06/historical-perspectives_en.pdf.

——— 2008. Challenges for the democratic management of technoscience: Governance, participation and the political today. *Science as Culture* 17(2): 101–119.

——— 2009. Understanding the forms of government in today's liberal societies: An introduction. *Minerva* 47: 243–260.

Pierru, Frédéric. 2007. *Hippocrate malade de ses réformes*. Bellecombe-en-Bauges: Editions du Croquant.

Posner, Richard. 2002. The law and economics of intellectual property. *Daedalus* 131(2): 5–12.

Price, Derek de Solla. 1961. *Science since Babylon*. New Haven: Yale University Press.

Rabinow, Paul, and Nikolas Rose. 2003. Thoughts on the concept of biopower today. Accessed July 11, 2013, www2.lse.ac.uk/sociology/pdf/rabinowandrose-biopowertoday03.pdf.

Rai, Arti. 1999. Regulating scientific research: Intellectual property rights and the norms of science. *Northwestern University Law Review* 94(1): 77–152.

Rhoten, Diana, and Walter Powell. 2007. The frontiers of intellectual property: Expanded protection versus new models of open science. *Annual Review of Law and Social Science* 3(1): 345–373.

Rose, Nikolas. 2007. *The Politics of Life Itself. Biomedicine, Power, and Subjectivity in the Twenty-First Century*. Princeton: Princeton University Press.

Schaffer, Simon. 2005. Public Experiments. In: Latour, Bruno, and Peter Weibel (eds.), *Making Things Public. Atmospheres of Democracy*, 298–307. Cambridge: MIT Press.

Sennett, Richard. 2006. *La culture du nouveau capitalisme*. Paris: Albin Michel.

Slaughter, Sheila, and Larry Leslie. 1997. *Academic Capitalism: Politics, Policies, and the Entrepreneurial University*. Baltimore: Johns Hopkins University Press.

——— and Gary Rhoades. 2004. *Academic Capitalism and the New Economy: Markets, State and Higher Education*. Baltimore: Johns Hopkins University Press.

Stokes, Donald. 1997. *Pasteur's Quadrant: Basic Science and Technological Innovation*. Washington: Brookings Institution.

Tallacchini, Mariachiara. 2009. Governing by values. EU ethics: Soft tool, hard effects. *Minerva* 47: 281–306.

Topçu, Sezin. 2010. L'agir contestataire à l'épreuve de l'atome. Critique et gouvernement de la critique dans l'histoire de l'énergie nucléaire en France (1968–2008). PhD diss., Paris: EHESS.

——— 2013. *La France nucléaire. L'art de gouverner une technologie contestée*. Paris: Seuil.

Winner, Langdon. 2002. *La baleine et le réacteur. A la recherche de limites au temps de la haute technologie*. Paris: Descartes & Cie.

Zimmer, Carl. 2012. A sharp rise in retractions prompts calls for reform. New York Times, April 16, 2012. Accessed July 11, 2013, www.nytimes.com/2012/04/17/science/rise-in-scientific-journal-retractions-prompts-calls-for-reform.html?pagewanted=all&_r=0.

About the guest speakers

Dominique Pestre

Dominique Pestre, currently Directeur d'Etudes at the Ecole des hautes études en sciences sociales (EHESS, Paris), was first trained as a physicist and then as a historian. He is a former director of the Centre d'histoire des sciences et des techniques (Cité des Sciences et de l'Industrie, La Villette, 1992–1995) and of the Centre Alexandre Koyré (1997–2005). Among numerous guest professorships and fellowships, he has been Fellow at the Collegium Helveticum Zurich and at the Wissenschaftskolleg zu Berlin. From August 2012 to June 2013, he was Visiting Scholar at the Max Planck Institute for the History of Science, Berlin. His first publications were focused on the history of physics in the first half of the 20th century in France *(Physique et physiciens en France, 1918–1940,* 1984), on the deployment of science, engineering and innovation in local, territorial contexts *(Louis Néel, le magnétisme et Grenoble,* 1989), and on *the History of CERN* (3 volumes, 1987–1993). Since the late 1990s and his co-editorship of *Science in the Twentieth Century* (1997), he has focused on three main areas: science, war, and the military *(Les Sciences pour la guerre, 1940–1960,* 2004); science, the economy, and social life *(Science, Argent et Politique,* 2003); and the governing of (techno-)science (special issue of *Minerva,* co-edited with Peter Weingart, vol. 47 [3], 2009; *A Contre-Science. Politiques et savoirs des sociétés contemporaines,* 2013).

Peter Weingart

Peter Weingart studied sociology, economics, and constitutional law at Freiburg University, the Free University of Berlin, and at Princeton University. He was professor of Sociology, Sociology of Science, and Science Policy at the University of Bielefeld from 1973 to 2011, and was simultaneously Director of the Centre for Interdisciplinary Research (ZiF) from 1989 to 1994 and of the Institute for Science and Technology Studies (IWT) from 1993 to 2009. Since 1997, he has been a member of the Berlin-Brandenburg Academy of Sciences, and since 2008 of the Academy of Engineering (acatech). He has served or is serving on the editorial boards of *Scientometrics, Science, Technology and Human Values, Minerva,* and *The Yearbook Sociology of the Sciences.* He has published widely in the sociology of science *(Wissensproduktion und soziale Struktur,* 1976; *Die sog. Geisteswissenschaften: Aussenansichten,* 1991) and is co-editor or co-author of numerous books *(Perspectives on the Emergence of Scientific Disciplines* [1976], *The Social Production of Scientific Knowledge* [1977], *The Social Assessment of Science: Issues and perspectives* [1982], *Representations of Science and Technology* [1992] and *Nature as Society—Society as Nature, Metaphors* [1995]). In 2009, with Dominique Pestre, he co-edited a special issue of *Minerva* (47:3) on the problems of *Governance of and through Science and Numbers.*

Abbreviations
Abréviations
Abkürzungen

Art.	Article
Cal Tech	California Institute of Technology
CERN	Organisation européenne pour la recherche nucléaire
CSST	Conseil suisse de la science et de la technologie
CUDOS	Communalism, universalism, disinterestedness, originality, skepticism
DNA	Deoxyribonucleic acid
EHESS	Ecole des hautes études en sciences sociales
ETH	Eidgenössische Technische Hochschule
GEMDEV	Groupement d'intérêt scientifique pour l'étude de la mondialisation et du développement
IAU	International Association of Universities
INRA	Institut national de recherche agronomique
IPCC	Intergovernmental Panel on Climate Change
KAU	King Abdulaziz University
KSU	King Saud University
NASDAQ	National Association of Securities Dealers Automated Quotations
NGO	Non-governmental organization
OECD	Organization for Economic Co-operation and Development
PhD	Doctor of philosophy
R&D	Research and development
Sect.	Section
SSTC	Swiss Science and Technology Council
SWTR	Schweizerischer Wissenschafts- und Technologierat
TIC	Technologies de l'information et de la communication
UC	University of California
US	United States of America
WWII	Second World War

Impressum

Schweizerischer Wissenschafts-
und Technologierat SWTR
Hallwylstrasse 15
CH-3003 Bern
T 0041 (0)31 323 00 48
F 0041 (0)31 323 95 47
swtr@swtr.admin.ch
www.swtr.ch

ISBN 978-3-906113-05-0
Bern 2013

Lektorat: John Bendix, Doris Tranter, Stéphane Gillioz
Gestaltung: VischerVettiger, Basel
Titelfoto: Mélanie Roullier

Schweizerischer Wissenschafts- und Technologierat SWTR
Hallwylstrasse 15
CH-3003 Bern

T 041 31 323 00 48
F 041 31 323 95 47
swtr@swtr.admin.ch
www.swtr.ch