ARTICLES

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COMMUNICATING SCIENCE TO THE PUBLIC IN JAPAN AND THE NORDIC COUNTRIES: AN APPLICATION OF THE INPUBLISHING/ OUTPUBLISHING MODEL

Introduction

The subject of this paper is scientific communication between science and society. Scientific communication itself is one of the important subjects in the sociology of science (e.g. Merton, 1977). Although there are many published articles on bibliometrics, citation studies, etc., interest in this subject seems to have been rather limited to the scientific community (Meadows, 1974; Kyvik, 1991; Sivertsen, 1992). Communication between science and society seems to have been considered as a marginal part of scientific communication until external studies of science began in the early 70's.

Historically, this subject has had several labels or epithets, such as popularization of science, vulgarization of science, scientific literacy, public understanding of science, communicating science to the public, and science and mass media. Studies on scientific communication between science and society were mainly pursued in the mass media/communication studies (Cronholm, 1981; Dornan, 1990; Friedman, Dunwoody/ & Rogers, 1986), and in research on science education (Pella et al., 1966). However, this subject hasn't been an important part of each discipline until now. We can find related articles in journals such as *Social Studies of Science, Science, Technology, and Human Values, Science Studies, Impact of Science on Society,* and journals of science education studies and of communication and mass media studies.

While the issue of public understanding of science attracted researchers before the 1980's, this issue gradually gathered momentum in the 80's[1] and has begun to be treated with more emphasis by researchers in the above-mentioned disciplines. In 1992,

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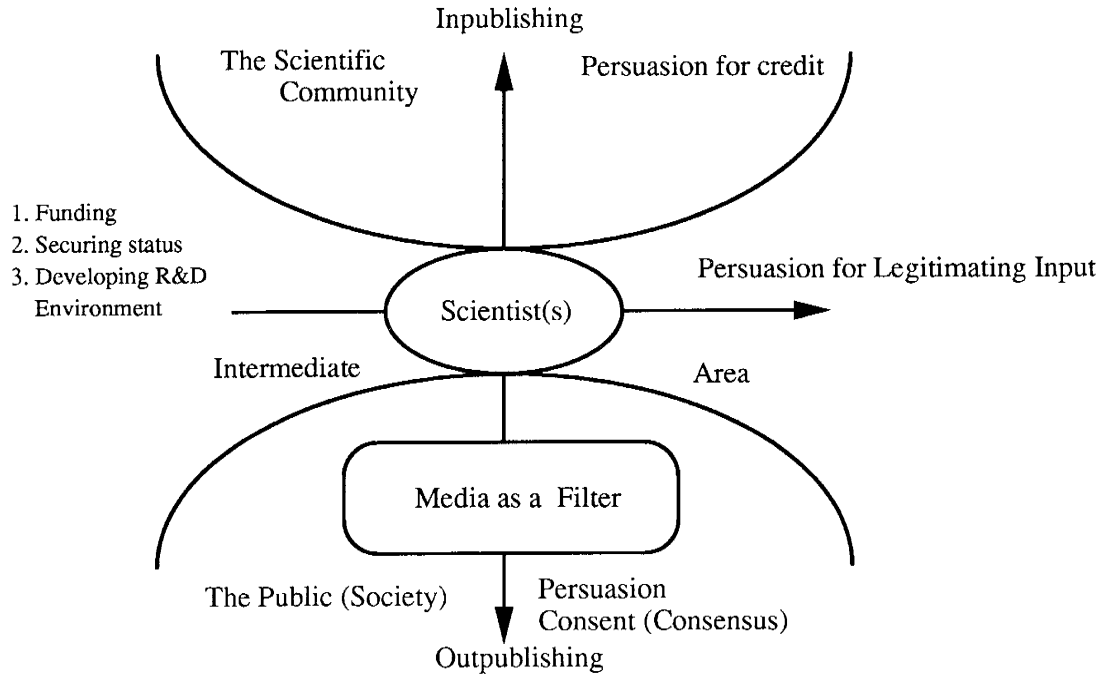
Figure 1. Inpublishing and Outpublishing Model.



we saw the birth of an academic journal concentrating on this issue: *Public Understanding of Science.*

The Inpublishing/Outpublishing model: a framework for considering "science and mass media"

Most literature dealing with STS communication adopts the idea of a continuous spectrum model of scientists' publishing activity. In the model it is generally understood that knowledge and information produced by scientists comes out from the scientific community, and gradually diffuses into society or to the general public as the often used term "dissemination" implies. The design of the model comprehends scientists' publishing as a continuous entity, even though its functions and effects are understood according to the fields and contexts of each communication. For example, Shin & Whitley (1985) propose a concept of "expository science", and analyze scientific communication in terms of its forms and functions. Hilgartner (1990) explicitly adopts a continuous spectrum model of scientists' publishing, which analyzes it according to its audiences and contexts and thus tries to understand it broadly, including the professional publishing perspective to the public understanding of science.

Is the nature of scientists' communication to society the same as that of their intra-professional communication ? Stimulated and inspired by the high temperature superconductivity fever[2], I devised a model explaining scientists' publishing activity (Figure 1). I classify their publishing activities into two categories. One is inpublishing (IP), the other, outpublishing (OP) (Wakamatsu, 1990;1991).

The criteria for this dichotomy is toward whom a scientist directs his or her findings

or results. Scientists "inpublish" their academic results inside the scientific community, and they "outpublish" their knowledge/information toward the general public or outside their own professional community.

The IP/OP model proposes that OP is different from, or in a sense, independent of IP or professional communication. This dichotomy elucidates the difference in intentions/purposes of scientists' communication. Inpublishing aims at gaining recognition of fellow scientists, while outpublishing responds, as is often said, to the need for the popularization of science. Thus, the division of IP and OP demonstrates the directionality and purpose(s) of scientists' publishing. This allows us to understand publishing as a confluence of intentions and purposes.

As to inpublishing, there are many studies, including scientometrics, citation studies, etc. I believe that the concept of "outpublishing" will open up a new perspective for scientific communication between science and society.

This dichotomy also brings to light the existence of an intermediate area between IP and OP. There are two types of publication which are difficult to classify into either IP or OP. The one is the case where the readership of a publication is not limited to a particular scientific community. This mainly depends upon how a publication is recognized and to what extent it is identified as contributing to a relevant discipline.

The other is an intermediate area in which it is difficult to decide whether a communication is "published" or not. For example, between scientists and science bureaucrats, communication for funding and policy-making is very active, and there are many proposals, reports, policy papers, etc. constantly being issued. This type of communication often escapes the keen eyes of journalists.

The purpose of communication in this intermediate area is neither soliciting credit (or recognition), nor popularizing science. For funding and policy-making, scientists have to get bureaucrats / politicians to understand the significance or merit of a particular project or plan in order to obtain consent, often after reaching a consensus among fellow scientists. Thus we can say that scientists persuade bureaucrats/politicians into accepting funding, plans, projects, etc. From the science bureaucrats' side, they also need to induce and persuade scientists to take particular directions of research for planning and implementing a particular policy.

Inpublishing and outpublishing are also grasped as persuading activities: IP is for persuading fellow scientists to accept findings and results, while OP is for persuading the general public to accept their expertise through popularizing science. This developing consensus among the general public can work as a supporting force for scientists to claim the relevance of their research to the fund-allocating bureaucrats / politicians or to their fellow scientists (Nelkin, 1987).

Setting the IP/OP model into a wider scientific communication model

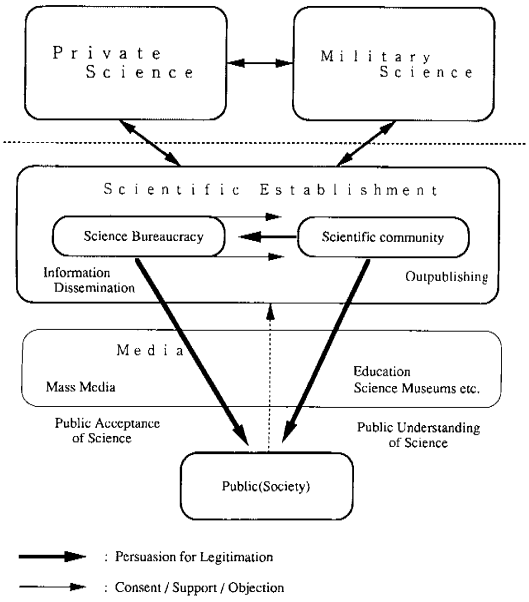
Guided by the above, I classify the field of scientific communication into three domains.

(1) Scientific communication inside the scientific community, which I call "professional scientific communication." For scientists, this is the domain of inpublishing.

(2) Communication between the scientific community and the bureaucracy of science, which I call "scientific establishment communication", since the bureaucracy of science and the scientific community together form the scientific establishment. As for scientists' publishing activity, this domain overlaps the intermediate area of the IP/OP model.

(3) Communication between science and society, which I call STS communication, using STS as an abbreviation for "science, technology, and society". As media between science and society, we find two important and influential sectors: the mass media and education. The importance and influence of education in terms of public understanding of science goes without saying, but in this paper I shall limit myself to the science and mass media issue. This is the domain of outpublishing for scientists. In this STS com-

Figure 2. Asymmetric Persuasion Triangle Model (APT-Model).



munication, scientists are exposed to the media environment as a source of scientific information/knowledge, since mass media crave news in this science and technology driven society. Accordingly, scientists are constantly under the pressure of mass media trying to pull news out from them, and thus working as an outpublishing inducing factor. On the other hand, as voluntary press releases by scientists suggest, outpublishing certainly has functions other than science popularization.

Considering that the main part of communicating science to the public is carried out by mass media, we should include the scientists' role as a source for mass media in outpublishing. This is because I judge that STS communication is mostly a flow of scientific information/knowledge from science to the general public, and that the basic character of this communication is mostly decided by the source and its socio-cultural context, even though journalists and mass media play the role of information processors or translators. This expansion of the concept "outpublishing" is helpful in investigating STS communication.

Having the scientists' logic of persuasion and the classification of scientific communication as premises, I have developed a conceptual model explaining the relationship among the scientific community, the science bureaucracy, and the general public (or society) (Figure 2). I call this model an "Asymmetric Persuasion Triangle" model (APT model), because I believe that the general public or ordinary people are always under persuasion either by the scientific community/scientist(s), or by the science bureaucracy/politicians. This APT model should be further developed and elaborated even as a conceptual model. Especially in this model, we need to investigate the internal structure of the public which corresponds to the existence of quite a few mass media audiences depending upon subjects and issues. But I will leave it for further research.

The underlying focus is scientists' publishing (communicating) activity, since it is the beginning point for STS communication. I will analyze the mass media situation, taking it as the media environment for scientists where they outpublish. Especially, the interface between science and mass media will be considered.

Why the Nordic countries and Japan ? Peripherality as a common factor

The APT model is almost devoid of cultural bias, although the model may be slightly tinged with Japanese characteristics. One of my aims in this study is to construct a model for investigating STS communication, and this aim will be furthered by searching into national characteristics, for example, of Japan, since scientific activity is certainly affected by national borders. I am hoping to illuminate the Japanese STS communication through comparison between Japan and Nordic countries. I also hope that this comparison may contribute to the Nordic community.

Japan has some peripheral characteristics in terms of scientific activity. Being an economic superpower, Japan has a respectable number of scientists and spends an appreciable amount of money on R & D (NISTEP, 1991). Thus, in many disciplines Japanese scientists produce a considerable number of academic papers. But, as a newly-conceived policy for creating centers of excellence shows, most of these centers are outside Japan. This is indicative of this peripheral relationship. Still today, many scientists confess that the language barrier for communicating with fellow scientists abroad is very high. Especially when we join discussions, we often feel lost. Of course, there are many Japanese scientists who can freely communicate with foreign scientists. But it is also true that as a whole Japanese scientists have a problem with the language barrier.

As a country or a region for comparison with Japan, peripheral characteristics work as a kind of connecting fulcrum. The Nordic countries (Denmark, Finland, Norway, and Sweden) are suitable for this comparison. Being well developed countries, they also have peripheral characters, geographically and linguistically(see e.g. Stolte-Heiskanen, 1987). Of course, the degree of peripheralness differs, and the size of population differs greatly: Japan's population is about 120 million while the total population of four Nordic countries is about 22 million. In spite of the difference in population density we can instructively compare periphery with periphery.

Besides a literature survey, the data used in this paper have mostly been obtained through interviews with editors, journalists, information officers of research councils / universities and scientists. As to the Nordic data, staying in Denmark in 1990 and visiting Finland, Norway, and Sweden, I interviewed resourceful and knowledgeable people in this field. Because of this limited field work, I must admit that the nature of my description and analysis is empirical and impressionistic.

Science and Mass Media in Japan

Japanese TV broadcasting and science news/programmes

Japanese TV broadcasting is a mix of the BBC type public broadcasting and commercial programmes. Japan is mainly covered by NHK (Japanese Broadcasting Corporation) public network, and 4 commercial networks (History Compilation Room, Radio & Culture Research Institute, 1977).

In terms of science programmes, two commercial TV stations, "TV Asahi" and "TV Tokyo", were originally licensed as educational (science & technology education) TV stations, and they were required to broadcast education and/or science programmes according to a certain ratio of time. Failing to fulfil the mandates, they turned into ordinary general TV stations in 1973. This means that science/education programmes don't sell well because they can't quite attract a large enough audience for advertizers.

The main provider of TV science programmes is NHK, and especially its channel called NHK Education TV plays the major role. But the role played by its main channel is also very important. For example, it broadcasts a 30-min. science programme, called "Let's Compare" on prime time every Monday, and a following 45-min. animal ecology programme, "World Family", the same night.

Commercial TV stations also feature science programmes in a different guise, such as a quiz show or a kind of talk show, using scientific films, which mostly feature rare and/or exotic animal/plant ecology in foreign countries. There is also a long-living programme sponsored by Tokyo Electric Power Company, but this is rather an isolated case.

The quality of science programmes in Japan is now comparable to that of the BBC. One of the epoch-making programmes that shows such high quality is NHK's "The Earth after a Nuclear War (Nuclear Winter) " broadcast in 1984, which was also shown abroad, for example, in Sweden. In 1991, NHK broad-

Table 1. Science Reporters in the Newspapers and News Agencies as of 1992.*

	Circulation** (thousands)	Science Section Launch Year	Science Reporters	Political News Reporters***
Asahi	7,949	1957	20	54
Mainichi	4,146	(1957)1984	9	36
Yomiuri	9,547	1968	21	48
Nihon Keizai	2,713	1972	20	30
Sankei	2,064	—	5(Aug.'91)	34
Kyodo	—	1959	18	65
Jiji	—	(1986)	4(city news)	30

* Although science reporters also deal with problems of environment, many environmental reporters belong to city news sections. Most of the papers have headquarters in several major cities, and the number of science reporters are of Tokyo headquarters, but they also include science correspondents stationed abroad. Major papers, although usually based in Tokyo, also employ science reporters in the western (Kansai) district, of which Osaka is the hub.
** ABC Statistics. January-June 1988 circulation figures.
*** In this column, the number of political news reporters is shown, revealing that science section in the press are relatively small.

cast a series of programmes entitled "Einstein Roman", featuring Einstein's relativity theory, impressively using computer graphic techniques. This series had quite a large audience in Japan.

The press and science reporting

Japan has a well developed press system: there are 5 national papers and quite a few local papers (Foreign Press Center/Japan, 1990). National newspapers, news agencies and their science reporters are shown in Table 1. This table shows us the degree of Japanese science reporting in the press. The number of science journalists in the press is certainly the largest in the world.

Efforts to organize science reporting in Japan began around 1954, when the accident of the "Daigo Fukuryuumaru" caused by the U.S. hydrogen bomb experiment in the Bikini Sea was scooped by the Yomiuri Newspaper. Incidentally, or coincidentally, Japan's nuclear power generation has its beginning at this same time. News on nuclear power or nuclear explosion demanded that journalists have some knowledge of nuclear physics, or at least some capacity to understand the information contained in the news in order to communicate it to the people. This created pressure on the press for specialists for science news. This pressure was augmented by other issues such as the Expedition to Antarctica in the International Geological Year, etc. Accordingly, specialists in science reporting were gradually gathered and trained.

In 1957, before the Sputnik launch, the Asahi established a science section (6 members) within its reporters' organization. The Sputnik shock accelerated the efforts in establishing a science section in the newspapers, and the next year we witnessed the births of many science sections, even in local papers such as the Kyoto Shinbun, etc. Thus we can say that organized science reporting by the press began in 1957. The newly-born section had usually a half-page or a full-page regular science column a week, which was a commentary related to contemporary events in science. In the beginning, the section mainly functioned as a reference section for scientific expertise.

Science sections in the press soon experienced a hard time and many newspapers discontinued the section in the 1960's. Generally, it was criticized that science reporters would write articles from the scientists' side. Or, simply put, their reports and articles were too difficult for ordinary people. Only the Asahi and the Kyodo News allowed their science sections to survive. In 1968, the Yomiuri, which hadn't established a sci-

ence section in the late 50's, began one with 7 science reporters. In the newspapers which lacked this specialized section, science reporters belonged to the general city news section which is usually the biggest section in the press.

Reporting the Apollo Moon landing in the summer of 1969, the Japanese mass media began to issue a flood of news on pollution and environmental destruction in 1970. In many newspapers, reporters of a city news section reported on pollution. In the 70's, news on environmental destruction and accidents at nuclear power stations were reported vigorously with only a short lapse during the 1973 oil crisis. It was in the late 70's or 80's that most of the newspapers created or revived their science sections.

According to a readership survey (Research Institute of Japan Newspaper Publishers and Editors Association, 1992: 88)[3], science news is not very popular among readers. According to a recent opinion survey done by the National Institute of Science and Technology Policy (NISTEP), people are not so interested in science and technology. One of the striking findings is that especially the younger generation (in their 20's) have dramatically lost interest in science and technology (Nagahama, 1992).

The press club system as a key device for information dissemination and news coverage

The press club is notorious among foreign journalists working in Japan. This club, nominally a friendship association of journalists reporting on the same government or local government agency, and industrial organizations' office for news coverage, actually functions as a device for publicity of the government and the respective bodies. Because the club is usually an exclusive society for national papers, news agencies and major local papers, it works toward excluding reporters of minor papers, magazines, and foreign journalists. Because of many complaints, the system has been slightly revised, but its basic character hasn't changed. This problem is still a major issue to be challenged.

This system also applies to science reporting, and it works as a central device in the science and mass media interface. This means that the Japanese mass media receive a heavy dose of information dissemination through the press club system. Some critics point out the fact that because of this rigid system the Japanese mass media depends too much upon press releases, press conferences, briefings, etc., and lacks in investigative reporting, since reporters are too busy to deal with the mass of information obtained through this system.

News gathering by Japanese science journalists may not be so different from their counterparts in the United States and European countries. They use academic journals such as the New England Journal of Medicine, Nature, Science, etc. and receive embargoes from them. Academic meetings are, of course, covered widely, especially when the issues discussed are related to industry and/or social problems. And science journalists have their own network of resourceful scientists, with whom they have constant contacts. Major newspapers sometimes prepare "A Guide for Collecting Materials" for reporters when reporting on a major issue related to science and technology demanding a certain amount of scientific and technical knowledge. Such issues include heart transplantation, pollution, environmental destruction, brain death, and so on.

Popular science magazines

The market for popular science magazines[4] is small, as shown by Table 2 compared with the population of 120 million. There are many specialty magazines related to science & technology, for example, astronomy, insects, natural history, etc. and also many science & technology-related trade journals. In Japan the majority of people seem to prefer acquiring scientific knowledge / information not through popular science journals but through television and general magazines, especially weekly magazines. They some-

Table 2. Popular Science Magazines (Monthly) and their Alleged Circulation.*

	Year of Launch	Circulation
Kagaku (Science)	1931	29,000
Kagaku Asahi	1941	105,000
Nikkei Science (a sister magazine of 'Scientific American')	1971	27,611**
Newton	1981	420,000
Quark	1982	120,000
Utan	1982	300,000
Suuri Kagaku	1963	15,000

* This circulation data are from 'Monthly Media Data' (June 1991) except Nikkei Science. From my experience as an editor, these numbers must be halved or even quartered. Most people concerned know that these circulation figures are greatly exaggerated. The majority of the Japanese magazines haven't joined the Japan Audit Bureau of Circulations, because the business customs in advertising don't absolutely require that accurate circulation figures be acknowledged.
** Average circulation as of Jul. to Dec. 1991 by the Japan Audit Bureau of Circulations.

times publish investigative articles although they are often blamed for sensational reporting. Weekly magazines' articles featuring science & technology are not rare, especially on health, medicine and the environment.

The recognition that science popularization is vital for science policy may be prevalent among science bureaucrats. But in Japan, this does not automatically cause government agencies to subsidize this effort. The idea of subsidizing popular science magazines has never been considered. Furthermore, many public agencies have their own publicity magazines. For example, Science Technology Agency publishes one named 'Science & Technology Journal', which looks very much like a popular science journal.

Scientists' attitude toward science reporting and popularization

The Japanese scientific community is not very active in publicity-seeking activities, so that the role played by academic societies doesn't seem to be prominent in science reporting and science popularization. Also, this tendency may be reinforced by the fact that discussions on technology assessment and public acceptance of science are quite muted, in contrast to the rather active discussions in the 1970's.

Consequently, Japanese popularization of science mostly relies on commercial popular science magazines, the press and TV broadcasting. And scientists have often been blamed for not being cooperative with popularization. But it is also noticed by many journalists and editors that some scientists are keen on popularization of their work and also that some of them are very good at it. It is often pointed out by journalists that scientists try to outpublish their research results and/or projects at the time of budget-making. In an interview a Swedish science reporter mentioned the same situation using the term "budget submarine". As an ex-editor, I have also been a witness to all of this .

This situation may be explained from some viewpoints: one is that in Japan there is no comprehensive nation-wide scientists' organization such as the American Association for the Advancement of Science (AAAS), and this situation can explain the lack of organized efforts for publicity. The second is that this situation may be one of the reflections of the Japanese scientific system, in which the science bureaucracy embraces prominent and able scientists within the system to aid in policy-making and funding. Accordingly, scientists' efforts to influence scientific activities are concentrated within this science bureaucracy. This situation would certainly explain the presence of the intermediate area between IP and OP, since communication between scientists and bureaucrats is usually not open to the public, and it often escapes the scrutiny of keen-eyed journalists. The establishment in Japan almost always tries to be free of the general public's scrutiny and criticism unless a controversy occurs, and the scientific establishment is no exception. The third point is that popular articles are not regarded as contributions to science, or simply put, they are generally not helpful for attaining professional positions or for promotion. As a consequence, scientists

Table 3. Nordic Science Journalists in the Press. (as of 1990. Source: Interviews in 1990.)*

		Circulation	Science journalists
Denmark	Berlingske Tidende	120,000	3
	Information	35,000	1
Finland	Helsingin Sanomat**	450,000	3
Sweden	Dagens Nyheter**	330,000	11
	Svenska Dagbladet**	210,000	6
	Upsala Nya Tidning	—	3

* In each country there are some journalists who report on science and technology, even though not as a specialized reporter.
** In these papers there is a science news section.

are usually not motivated to write for the people. This situation is almost the same in the Nordic countries.

Science and Mass Media in the Nordic Countries

TV broadcasting and science reporting/ popularization

The Nordic TV and radio broadcasting is mainly supported by the public sector, as is the BBC of the United Kingdom.

Despite efforts in establishing TV science programmes in the Nordic countries, I sometimes hear that they haven't been very successful. For example, a Finnish physicist told me that the science programmes broadcasted are often imported programmes from, for example, the BBC, etc., and even an original science programme produced in his own country is so unimaginative as to merely be of scientists interviewed in front of the Foucault Pendulum in the Heureka, the Finnish Science Center.

My overall impression is that TV science reporting/popularization in the Nordic countries is still waiting for maturity. I did, however, find organized science popularization efforts being made by the Nordic radio stations. In each Nordic country, there are some radio science journalists who are responsible for producing science programmes, most of which have a long tradition.

Science reporting by the press

Generally speaking, the Nordic people are a newspaper-loving people (Picard, 1988). They also recognize the importance of the press for their democracy, and most of the Nordic countries secure survival by subsidizing the press, possibly to have plural papers in each region. As for national papers, there are 8 in Denmark, 4 in Finland, 4 in Norway and 4 in Sweden. The role played by regional and local papers is also very important in the Nordic countries as well.

Tor Nørretranders, a well known science journalist in Denmark, testifies that science journalism in his country lacks enough science journalists, and is waiting for maturity, comparing his country's situation with that of the United Kingdom, where, he admits, there are plenty of talented specialists and their organized efforts in communicating science to the public guarantees a high quality of science reporting.

Science news sections in the press are found in Denmark, Finland, and Sweden (Table 3). Two Swedish major national papers, the "Dagens Nyheter", and the "Svenska Dagbladet", have a science section as shown in Table 3. In Denmark, the "Berlingske Tidende" (one of the major national papers) has a science section with 3 reporters. Also, in Finland, we find a science section in the biggest national paper, the "Helsingin Sanomat" with 3 science journalists. In 1992, I found that this situation had chaged drastically because of the recent economic reces-

Table 4. Nordic Popular Science Journals Publicly Supported.

		Launch Year	Circulation
Denmark	Naturensverden*	1917	6,000
	Forskning og Samfund		several thousands
Finland	Tiede 2000	1980	45,000
Norway	PM**	1986	15,000
Sweden	Forskning och Framsteg	—	52,000

* This magazine is published by Rhodos. The magazine is actually a non-profit enterprise, and receives subsidy from research councils (1/3). Editing staff are part-timers without wages. its yearly price is 256 Danish Kroner. In an interview with the chief editor, Bl(ae)del, I have found that they usually have a manuscript stock sufficient for four years of future publishing.
** PM closed in Dec. 1991.

sion. For example, the "Svenska Dagbladet" has now only one science editor and 2 science journalists. This situation seems to be quite similar in other Nordic countries.

Although Table 3 is not comprehensive, it gives us a general overview of science journalism in the Nordic press. In Sweden, a regional paper called the Upsala Nya Tidning has 3 science journalists ("university reporters"). Considering the limited circulation, the number of science reporters in Sweden seem to be quite large. In Denmark, we find a science journalist in the jointly owned "Information". He is mainly concerned with environmental problems, but has also to deal with other issues. The main reason for this situation may be the size of circulation in addition to the editor's policy. This reason could also explain the situation in the other Nordic countries, with the Swedish case being the exception.

Maybe Norway's case is one extreme, where we don't find a single science reporter in the press. Once, the Aftenposten (morning edition circulation, 230,000), the major national paper, had some science reporters, but in a 1990 survey, there was no specialized science section or science journalists. According to the interviews with science journalists and information officers of the research councils, the paper uses free-lance science journalists. Of course, there are some semi-specialized science reporters, for example, one in the "Bergens Tidende".

By analyzing the situation of organized science reporting in the Nordic press, we can presume that Nordic science journalism/reporting generally has not been well developed, and thus it does not play a strong role in inducing scientists to outpublish.

Popular science journals in the Nordic countries

In the Nordic countries, we find two types of popular science journals. One is the publicly subsidized journal, and the other, commercial.

Each country has a journal founded and supported by public institutions such as research councils. This means that the public acknowledges the importance of popular science journals but that they are unable to survive without subsidization. Table 4 shows publicly supported Nordic popular science journals.

Among such magazines, the Finnish one, Tiede 2000 seems to be very successful. "Tiede" means science in Finnish and corresponds to the German word "Wissenschaft". The situation is the same with the other Nordic countries, and we find articles of social sciences and humanities in popular science journals. According to Tuula Koukku, the chief editor of Tiede 2000 (interview, 29th, July 1992), the magazine contains about 40 % of social sciences and humanities articles in 1990 and 1991. Established by many public institutions, among them the Academy of Finland, in the fall of 1980, and published by a non-profit organization, this magazine has 8 issues a year. In 1984, fairly soon after its launch, it became financially independent. In the fall of

1990, it welcomed a circulation of 45,000. This number certainly shows its success as a popular science magazine compared to the population of 4.93 million (1987). If this population/circulation ratio were applied to Japan, the circulation would be more than a million.

Its readership survey shows us an interesting readership structure. According to the then chief editor, Jali Ruuskanen, women readers composed 32 % in 1984, and the percentage rose to 48 % in 1990. According to the common knowledge of popular science journal editors and publishers (at least in Japan), this high percentage of female readers is quite surprising. One of the possible explanations for this readership structure is that the educational level of women in Scandinavia is very high. For example, in Finland, women make up nearly half (49%) of all graduates, 32 % of all licentiates, and 28 % of all of PhD's (Lestinen,1988: 66; Sjöberg, 1991).

In Norway, we find PM, established by NAVF (Natural Science Research Council) in 1986. According to its chief editor, Georg Parmann, it received 30 % financial support in 1990. The circulation in 1990 was 15,000. Its Swedish counterpart, Forskning och Framsteg (meaning research and progress), also received about a 20 % subsidy from research council etc., and the circulation in the fall of 1990 was 52,000.

The Danish Illustrated Science was established in 1984, with the cooperation of Science Digest. This magazine's translated versions are also published in Norway, Sweden, Finland and France after being modified with articles of national concern. Its circulation in respective countries is astonishing. The controlled circulations as of 1989 are shown in Table 5.

If the Danish figure were proportionally translated into the Japanese population, it would be more than 2.6 million. This comparison may be too simplistic, but it gives some idea of the relative importance of this magazine. And also we can say it has been a big success in terms of developing a readership.

According to its readership survey in 1990, 80 % are sold by subscription, and 48 % readers are under the age of 30. 58 % are men, and 42 % are women. Already mentioned in the case of Tiede 2000, the proportion of women readers is significant (Olesen, 1988: 381). From this survey, we can at least infer that the magazine is supported by both the young and female readers.

Table 5. Illustreret Videnskab Circulation in the Nordic countries.*

Denmark	113,466	Norway	103,250
Finland	61,963	Sweden	138,162

* Source: letter of B.Engen, Chief Editor of Illustreret Videnskab, dated 7 June, 1990. By Controlled Circulation, Danish and Finnish figures are from July-December '89, Norwegian and Swedish figures are from January-June '89.

Interestingly enough, many scientists and science journalists don't seem to rate this magazine very high, although they are equally surprised at the circulation. They criticize that many of its articles, mainly written by journalists are "Gee Whiz" stories that lack a critical stance toward science. Although it is mainly oriented toward entertainment through science, it is certain that the magazine has succeeded in developing an increased appreciation for science.

The Interface between Science and Mass Media

In each country of the Nordic region, there is an association of science journalists. They constitute a Nordic chapter of the European Union of Science Journalists Associations (EUSJA). According to the liaison officer of the Swedish Association, Erland Rost of the weekly technology paper, Ny Teknik, the Association, established about 20 years ago, has 150 members. They are mainly from publishing media, especially from daily papers, but there are also TV reporters and information officers of government agencies among its membership. The structure of the

membership is similar in the other associations. They are mostly composed of science journalists and information officers of universities and research councils. The Finnish Association of Science Editors and Journalists (FASEJ), established in 1986, has a different origin, as its name shows, and there are editors of scholarly journals among its membership.[5]

It may be argued that these associations make a kind of forum for science journalists and information officers of universities and government agencies, etc. This may be called a loose connection between science and mass media, working as an interface. The interaction among members, especially between journalists and information officers is very important, since they can communicate with each other through this forum. Journalists can understand the direction of government policies, and conversely can communicate their understanding of the people's attitude towards science and technology. Information officers can monitor, in a fashion, their citizens' attitudes toward science and relevant government policies. This type of communication occurs informally. At least both parties have access to the other in this bi-directional information dissemination. It should be also mentioned that in the Nordic countries journalists move from one medium to another, and to information offices, and vice versa. This certainly helps communication between journalists and public information officers, and is not usual in Japan.

In addition to these associations, there is a network of Nordic university information officers. This network has a directory of information officers of Nordic institutions of higher education. According to law the universities in Denmark, Norway, and Sweden have a responsibility to disseminate research results or scientific information to the society (Olesen, 1988: 379). For example, this task of science information is compulsory for universities in Sweden since 1977. Of course information activities vary from university to university. The case of the University of Tampere, Finland deserves special mention. There are four officers in its information office, and one of them has the title of "Science Journalist". She gathers data from her university scientists and writes one or two articles a month for the newspapers, which are distributed to about 20 small newspapers through a network called the "Article Net". This may be a special case among Nordic universities, but from this example we can understand that some universities are likely to have a strong desire to disseminate information to society.

Public agencies seem to be willing to disseminate information. My experiences in this region show that the access to information stored in the public institutions is fairly easy. Compared to the Japanese scene, the openness in terms of information dissemination is remarkable. Behind this openness I see the Nordic peoples' belief that the free flow of information is vital for their democracies.

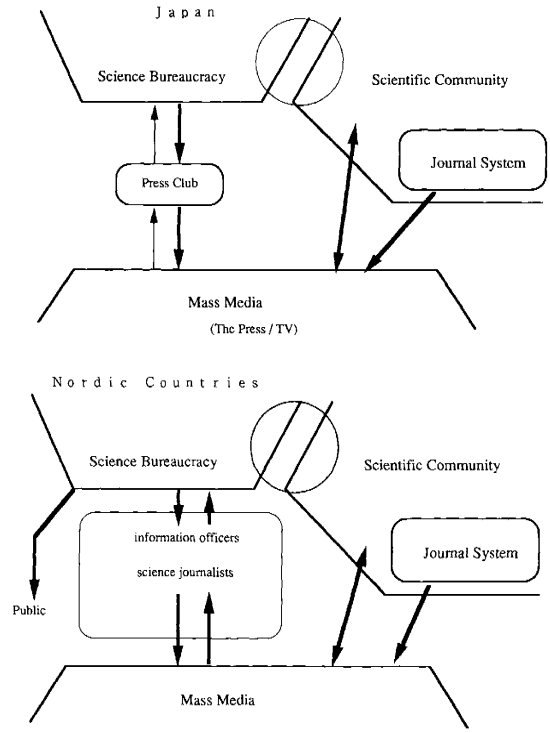
Among other things, the activity of FRN (the Swedish Council for Planning and Coordination of Research) is unique (Dyring, 1988). One of its tasks given by the Parliament is to bridge science and society. For this task the research council has quite a few programmes. Since its inauguration in 1977, the council has provided many projects to encourage and secure contacts between science and society. In particular, it supports two kinds of publication. One is an anthology series entitled Front Lines of Research, and FRN commissions the manuscripts and pays the publisher. The other is a debate series called "Fount" (Källa), published by FRN under its own auspices. According to FRN, this series aims "at reflecting public debates on the vantage point of the research community. 34 issues of Källa have appeared so far (Feb. 1990), with contributions by 120 researchers" (FRN, 1990). According to the programme director of FRN, A. Dyring, the total sales came very close to covering the cost of publishing in 1989.

In Denmark the consensus conference is a new tradition (the Danish Board of Technology, undated). The idea came to Denmark from the United States and was adapted to a Danish need that scientific expertise should

be shared with the public. Thus, in the Danish consensus conference, a laymen's panel reaches a certain consensus after hearing from experts who often have conflicting ideas and opinions. Agencies and organizations that have convened them until now are the Danish Board of Technology (1992), the Council of Ethics (1992a; 1992b), the Social Science Research Council, the Medical Research Council, the Danish Hospital Institute, etc. Issues already debated have included food irradiation, genome mapping, technological animals, etc. Consensus conferences are widely covered by mass media, and have a certain influence on the Parliament and the Government. Thus, we can say that consensus conferences in Denmark work as an effective medium for information dissemination, and that this also shows the willingness of science bureaucrats for information dissemination or issue-raising.

Nordic bureaucrats are not afraid of having debates on issues important to the people. On the contrary, they try to activate debates and to reflect the discussions into rebuilding their policies. Their information activity is essential to the policy-making system.

Figure 3. Two Types of Science / Mass Media Interface



Concluding Remarks

In the above analysis of organized science reporting and popularization, it is shown that Japanese scientists are more exposed to mass media than their Nordic colleagues. This shows that Japanese scientists are more likely to outpublish than Nordic scientists.

In both Japan and the Nordic countries, it appears that scientists' efforts to communicate and popularize science, or to outpublish, are not well organized. In Japan, these efforts are replaced or substituted for by science journalists, editors and the mass media. On the other hand, public relations efforts by the scientific establishment are complemented and completed by the rigid press club system which government agencies and industries have as a connecting device. In the Nordic countries, there is a loose connection of science journalists and information officers between science and mass media, realized in science writers' associations, and the information officers' network. This connection seems to provide a forum for both parties to communicate. Figure 3 shows a model for the difference in the science and mass media interface between the two regions. This difference is one of the reflections of how democracy works in the respective areas of the world.

In Japan, scientists are not actually required to popularize science, although there are many discussions and suggestions in governmental reports and policy papers and sometimes in society journals that urge scientists to aid in this work toward acquiring public consensus. This lack of popularizing efforts is very likely due to the research environment of Japanese scientists, where sci-

ence policy and funding do not greatly involve the general public. But as the superconductivity fever and press releases show, there are some disciplines which pursue these popularizing efforts to acquire public support for their field, since such fields are rather new and they don't have firm roots in the research environment. In Japan, research on "public understanding of science" has yet to be organized. This suggests that Japanese scientists don't feel the necessity for public understanding of science so strongly or that it isn't yet an earnest and pressing issue for scientists.

Through examination of mass media in terms of STS communication, I have found two factors that affect outpublishing activity in addition to the media situation. One is the information dissemination pattern, the other, the decision making pattern. The three factors correlate with one another.

In the Nordic countries, information dissemination is aimed at securing a free flow of information, and bureaucrats, including information officers, are active in promoting debates on socially important issues. From the case of FRN and Danish consensus conferences, we have seen that scientists are invited to outpublish and speak out in order to give their ideas to the public, especially on controversial issues. These invitations are not so rare, and public agencies are trying to activate scientists' communication to the public. Some Nordic research councils sometimes even hold seminars for scientists teaching them how to cope with journalists. This means that Nordic scientists receive outpublishing stimulation from the scientific establishment.

Whereas in Japan, information dissemination is abundantly done, but it is a controlled flow of information. In actuality, Japanese bureaucrats always try to evade criticism by the public. In this situation, scientists' outpublishing is likely to be controlled in favor of the direction of a particular policy.

In terms of decision making, Japan's case is often explained as a bureaucrat-initiated pattern, and the Nordic case is characterized as public involvement pattern. The latter is shown by the public involvement movement in the 1970's, with for example, debates over nuclear power generation, etc. (Mouritsen, 1977: 98–144). And thus, we can say that outpublishing is promoted in order to secure public involvement. Issues involving scientific expertise have to be shown clearly in front of the public eye, and this necessitates scientists' outpublishing.

In Japan, and maybe in any country, outpublishing can be used as a legitimating resource for science bureaucrats and scientists themselves since outpublishing is often used as an indicator of public consensus if, upon publication, it is not severely contested.

It is often mentioned or confessed by science journalists that science critique, or taking a critical stance towards science is very difficult. This is mainly because scientific expertise demands a highly trained capacity to understand. Besides, it is also very difficult to assess or forecast the results or significance of a particular line of research, a research field, or any other scientific activity, not only within the scientific community but also in society in general. Because of these difficult conditions, science reporting and science popularization often work as a kind of publicity for scientists and science bureaucrats. Accordingly, we need to investigate the nature of outpublishing more in order to understand STS communication.

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NOTES

1. In 1981, 'Journal of Communication' featured "Science: News, Controversy, Drama" in its vol. 31, No.1, and included 9 related articles. In 1983, vol.112, No. 2. of 'Daedalus' featured "scientific literacy". The Royal Society of London published a report entitled

"The Public Understanding of Science" in 1985. This report gave a big push to the research of public understanding of science. And No.151 & No.152 (1988) of 'Impact of science on society' featured "the public perception of science" and "science popularization in a changing world" respectively.

2. In early December, 1986, the world witnessed the beginning of the high temperature superconductivity fever. In this fever, many researchers rushed to publish their results through press releases. From the traditional view of scientists' ethics (Merton,1977) this seemed to be a violation of the norms of the scientific community.
3. According to the second National Newspaper Credibility Survey done from May 16th to 31st, 1991, 11.5 % (18.6 % of men, 4.5 % of women) of the readers usually read science & technology news. Among 29 kinds of news items, science & technology news is ranked as 24th. I should add that 40.7 % of the readers usually read medicine & health news.
4. We experienced two popular science magazine booms after World War II. The first came soon after the war, and faded out about 5 years later because of the post–war economic distress affecting the publishing business and readership alike. The second boom began in 1981, and most of the newly established journals employed a strategy to be very graphic. In the late 1980's, this boom seemed to subside, and one of the prestigious popular science journals, 'Shizen (meaning nature in Japanese), which had been born in 1946, died during this period. It doesn't necessarily mean that people's interest in science & technology has lost vigor, but the readership for popular science certainly decreased. Or we should say that the readership has diverged.
5. An interview with Prof. Paul Fogelberg at the University of Helsinki, one of the founding members of the Association, 30th Jul. 1992.

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