Some Thoughts on the Education of Science Documentalists

科学ドキュメンタリストの教育について

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要　　旨

はじめに「科学ドキュメンタリスト」とは何であるかを定義し，更にこれに関連して「専門図書館員」は「科学ドキュメンタリスト」に比べてどのような点が相違し，またどのような点が同じかを論じた上で，本文では両者を含めて一般的に科学情報を取り扱う者の資質に関する問題を取り上げた。

素質　科学情報担当者も，すぐれた素質が要求されることは，他の知的専門職における場合と同様である。

一般教育　他の専門職と同様，科学情報担当者も専門職教育以前の大学一般教育の質，広さ，深さに左右されることが大きい。更に専攻ないしは副専攻として自然科学系の学問を修めることは不可欠であろう。しかしこれは自然科学系の科目の主題知識を獲得することが一番重要なのではなく，これらを通して科学的な考え方，実験技術，科学的な問題解決法，科学的正確さの必要な理由，科学的誤謬の原因等を理解することに意義がある。

一般的に学部課程の外国語は初歩的であり，科学文献の翻訳には更に一層の勉強が必要であるが，その程度でも文献探索には十分と考えられる。また世界中の科学文献の約半分は英語で書かれ，あとの大部分は独，仏，露，日，伊，中国，和蘭，西班牙語で書かれている。このことは，科学者と同様，科学文献翻訳者もまず科学英語が判り，程度の差はあれ，その他の外国語を理解出来なければならないことを意味する。

専門職教育　科学情報担当者の専門職教育の基準を1つにすることは，それ以前の教育や経験があまりにも多岐に亘るので不可能である。科学情報教育の課程が極端に高度になり特殊化されると，雇用者側にとっては卒業生の一般的有用性が減じてしまう傾向が生じ，学生にとっては就職先の選択，変更の機会が減り，専門職としての見透しが限定されてしまうことになる。自然科学の主題知識にのみ重点を置けば，その学生は情報機関における有用性を減ずることになる。科学文献ないし科学情報教育課程を修めたものが，科学技術の分野の大学院課程を履修することは非常に有益である。しかし，科学それ自体の教育のみで，科学文献・科学情報の教育をおろそかにしては，最善の科学情報担当者は得られない。

科学情報業務の中には事務的なものも多く入っているので，科学ドキュメンタリストは，部下を監督

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訓練する必要上，必要な事務的業務も知っていなければならない。事務的なものに対して専門職業務と呼ばれるものは，情報源の同定・発見，情報の捜査・評価・選定，ナマの情報および情報源としての資料の分類・目録・索引作成，書誌的探索，再抽出された情報の抄録・注解・解釈，経営管理・研究方法の確立・システム分析などである。

翻訳には語学知識が必要であり，プログラミング，コーディング等には電子計算機の知識が必要であるが，これらは科学情報教育課程外で習得することが出来る。抄録，情報解釈に科学分野の知識が役立つけれども，科学文献を取扱ううちに現場教育によっても十分な知識を授けうる。索引作成は抄録ほど主題知識を必要としないことが判っている。

科学情報専門職教育課程　次のような分野が科学専門職教育課程とも言うべきものである。1）情報機関——経営管理，2）情報コレクション——情報源，情報資料など，3）情報処理——主題分析，転換原理など，4）情報再抽出——書誌的探索，主題分析など，5）選択科目として，外国語，言語学，自然科学系科目，サイバネティックス，人間関係論。現在このようなまとまった科学情報専門職教育課程はどこにも設けられていないが，部分的には各所に見られるものである。

訓練，経験，教育，日本のための示唆　大学院で専門職教育を受けないで，現職訓練や独学によってすぐれた情報担当者が作られることは事実であるが，いかにすぐれた訓練，経験，独学によっても，それだけでは大学院課程で与えられるような基本的な理念，専門家としての広い視野，創造的知性，資料情報源に関する鋭い感覚や適正な知識を身につけることは出来ない。

終身雇用制度や科学情報教育課程の現在の窮状を考えると，日本では図書館の協会，諸大学，図書館学科，専門図書館，科学情報センター，国公私立の科学研究機関など，すべて科学情報専門職教育に熱意を有するものが力を合わせる以外に打開の道はないと思われる。日本としては，次のような方策が可能ではなかろうか。1）現在の図書館学科を強化拡充し，大学院課程に発展させ，前述のような課程を発展させる。2）全く新たに，この線に沿った大学院課程を新設する。3）図書館学科のコースの一部と専門図書館，情報センターにおける実習とを合わせて科学情報担当者に適した2-3年間の特別課程を設ける。4）上記3）の如き特別課程に専門職短期講習，図書館学科セミナーを組合わせる。5）外国の大学院課程に留学させ，卒業後，帰国前にすぐれた専門図書館，情報センターで実習経験を積ませる。6）現在の図書館学科ないし科学系の教員を外国の大学院課程に留学させ，経験を積んで帰国してから，上記1）または2）の大学院課程の教員に任命する。　(T. S.)

Good science documentalists, just as good special librarians and good subject-literature specialists, do not rise out of the sea full-blown: they must be created, they must be developed from ordinary mortals.

It is the purpose of this paper to identify, if possible, some of the more important qualifications that must be developed in ordinary mortals that will make them good science documentalists for the rest of their lives, and then to suggest that most of these qualifications can be developed through education (preferably), through training, through experience, or through self-study. But first I want to explain what I mean by "science documentalists", "special librarians", and "subject-literature specialists" as used in this paper.

"Science documentalists" will mean those persons who deal regularly with science information, its collection, its processing for subsequent recovery, its storage, and its retrieval for use. Their sole purpose in doing this is to serve the science information needs of their authorized clientèle.

It seems to be commonly assumed that science documentalists normally deal with small

and perhaps highly specialized segments of science or technology such as may be treated in certain science information centers where the emphasis is on handling specialized information, on handling particularized data, rather than on handling whole works such as monographs or treatises or even journal articles. Their regular clientèle, obviously, are quite as specialized in their subject interests as the documentalists or the centers are: and information about those subjects is all that really matters.

It seems also to be assumed that special librarians (as distinguished from science documentalists) normally deal not only with similar small and specialized segments of science and technology but also with broader and more general (and often merely related) aspects of particular subject fields. Emphasis is still on information, on data, but considerable attention is also paid to the repositories of information, the journals, the monographs, the reference works, and the accessory bibliographic tools to exploit them, the concerns, generally speaking, of subject literature specialists. Their clientèle are more varied in their subject interests and tend to be more sensitive to the overall welfare of the organizations in which they all, including the special librarians, are co-workers.

Thus, both science documentalists and special librarians give pretty much the same kind of specialized information service, albeit to slightly differently oriented clientèle. This paper, then, will discuss the desirable qualifications of all those persons—whatever they are called—who deal regularly with science *information*, its collection, its processing, its storage, and its retrieval.

Parenthetically, it is not yet very clear just what defferentiates special librarians or, indeed, vice versa, but I would like to suggest that a suitable criterion for deciding which are which (if it is as vital to decide as it is made out to be) is the emphasis they put on *information service* in relatively limited, well defined subject areas.

I would also like to suggest at this point that many of the features of special libraries which are often said to be distinctive and hence definitive (e.g., highly personalized service, well organized collections, well defined subject interests, specialized subject clientèle, co-worker clientèle, small staffs, industry oriented administration, profit motivated management, well developed public relations) are features which can be identified in almost any top-notch library of any type. That the ideal is not found in most public, university, and school libraries is not what distinguishes them from special libraries: it simply means they just are not top-notch libraries.

Every good accredited library school teaches the ideal; it may well be that only in special libraries (as we have come to know them) is the ideal put into practice to any appreciable degree. If this is so, we must indeed find out why, to help other libraries become better. To me the distinctive feature of a special library still is that it collects, processes, stores, and retrieves information rather than just library materials. But there is nothing to prevent a good public, university, or school library from doing this, too; a good subject-literature specialist is all you need to get started.

Another matter I would like to bring out before I discuss qualifications and education for science information workers is the mobility-flexibility-adaptability pattern found so often in special library and science information workers in the United States and Canada which perhaps may not be found in their counterparts in Japan. In the United States, for example, there is a tendency for persons to move rather often, to shift from one job to another within an organization, to change organizations completely, and even to switch subject fields entirely, to say nothing of kinds of libraries or information agencies. In other words, the first job is certainly not the only job, the first subject interest (or type of library or kind of information service or whatever) is not necessarily a lifetime or career-length interest. In addition, by far the greater majority of special libraries, for example, small professional staffs, only one person in most instances. So special librarians and science in-

formation workers in the United States have to be both flexible and adaptable in whatever job they find themselves. This mobility-flexibility-adaptability pattern must be taken into account in any discussion of qualifications or of education for science information workers in the United States, if not in Japan. It is simply one of the facts of life.

Innate Traits

Certainly the basic personal qualifications required for sucess in science information work are the same ones required for success in any other intellectually disposed profession. Integrity, sense of purpose, mental alertness, intellectual curiosity, willingness to work hard, adaptability, flexibility, self-discipline, ability to communicate clearly and effectively, ability to make decisions, and ability to improvise are among these essential basic qualifications.

In addition, the successful science information worker or special librarian must be proficient in dealing with people and in handling emergencies and he must have the tenacity of a bulldog, the tracking sense of a bloodhound, the patience of the biblical Job, and the gift of serendipity. Many of these inborn traits may, of course, be sharpened and developed through practice and experince but they will be difficult to instill if they are not already present.

General Education

Again as in most other professions successful and satisfying job performance later on in science information work depends to a surprisingly large extent on the breadth, depth, and quality of one's general pre-professional education back even as far as primary and secondary schooling because it is in the early years that important reading, study, and other personal (and social) habits are planted and nurtured.

A broad general (" liberal arts ") substantive college education consisting of courses in the humanities, the social studies, and the sciences (including mathematics) is to be preferred over vocational, parochial, or otherwise very specialized college work; and a major, or at least a minor, in one of the physical or life sciences is considered almost indispensable for later work in science information. But not, please note, primarily for the subject content of the science courses. Such courses are valuable, it seems to me, mostly for giving students an acquaintance with scientific patterns of thinking, with scientific techniques of experimentation, with scientific methods of approaching problems, and with the reasons for scientific precision and thoroughness and the causes of scientific error and malfunction, all of which will be helpful later on in understanding a research worker's point of view and why and how he uses science information.

Actually, a good case could be made for recommending that all persons who work with information of any kind—all librarians, for that matter—should have had at least a few courses in science including one or more in mathematics. Indeed, many American colleges consider biology, botany, physics, chemistry, and mathematics as regular liberal arts courses, and all students take them.

Most liberal arts degree programs (i.e., in the United States) require two years of a foreign language. Sometimes this requirement can be met by having had four years of some one foreign language in secondary school thus making it possible to take a second language in a normal college program. Often a college chemistry department will require its majors to take at least a year of scientific German to qualify for the degree; occasionally some other language may be substituted. Generally speaking, however, undergraduate language courses can be considered to be only introductory, and language competence for scientific translation work takes both considerable additional study and a lot of practice. On the other hand, though, college language courses can give enough working skill for most bibliographic searching needs.

It is believed that about half the world's science literature is published in English with most of the rest being published in German, French, Russian, Japanese, Italian, Chinese, Duch, and Spanish; the order of these other

languages varies with the subject. This means that most of the world's scientists and science literature translators will have to be able to read and understand scientific English, and then in varying degrees of competence the other languages, if they want to read much of the world's primary scientific literature. Otherwise they will have to make do with translations, but they also will have to know where adequate translations can be obtained.

Science information agencies which attempt thorough coverage of the world's scientific literature will have to have on their staffs persons who are transliterate in all the important languages in order to be able to give prompt information service. If promptness is not normally expected the services of commercial translators will be quite satisfactory in most instances. Ordinary bibliographic searches can be made by those with introductory foreign language knowledge, as was noted earlier, or even by those with just dictionary competence.

Perhaps this is the place to suggest that it is in the undergranduate science and language courses that students ought to begin to learn about the international literature of science and to begin to learn how to use it, and they also ought to begin to learn about science information work as a career. If these ideas are planted soon enough we will have, in due time, younger, more eager, and better qualified science literature users and science information specialists than ever before, and at the same time more of them.

Professional Education for a Career

It is virtually impossible and certainly inadvisable to prescribe one precise standard program of professional or advanced study for everyone who plans just "to go into science information work," simply because interests, educational backgrounds, and experiences among people differ so widely. Nor is a program of nothing but specialized courses very desirable, either. It seems to me that a too-highly specialized science information program tends to be not only selective but also restrictive, and has the effect of limiting, first of all, the general usefulness of the student to his prospective employer, the information agency; secondly, the natural opportunities of the student either to choose or to change jobs; and thirdly, the professional outlook of the student especially toward other types of information agencies such as, for example, libraries (public, academic, special, school). A diet of all caviar at school may bring on occupational diseases months later at work.

Similarly I believe that advanced subject study without considerable information-handling traning also tends to limit a student's overall usefulness to an information agency unless, of course, the work involves overwhelmingly more science than information. And unless a scientist (i.e., some one with advanced degrees in a science) continues unceasingly to work as a scientist he very soon no longer is a scientist, and the agency might better have hired a science-literature specialist or a science-information specialist in the first place.

Furthermore, unless the scientist is intellectually and productively satisfied himself with what he does on the job he won't stay in information work very long. (Neither will any other specialty-educated college graduate, for that matter.) It must be remembered that not all information work—and probably much less of library work—is equally stimulating for all types of intellectual and professional growth.

On the other hand, an advanced science or engineering degree *in addition* to professional science-literature/science-information education is a very definite advantage: it helps one in getting a job; it gives one assurance in bibliographic searching, annotating, and abstracting; it hastens one's acceptance in the scientific community and among the information agency's clientèle; and it adds prestige both to the worker and to his organization. But I am not yet convinced that it is absolutely necessary for top-notch performance as a science information worker or special librarian, nor do I believe it will compensate for an inadequate professional education in science literature and science information handling.

What, then, does make up a suitable pro-

fessional education and training progrom for science documentalists and special librarians, those persons who deal regularly with science information, its collection, its processing for subsequent recovery, its storage, and its retrieval for use?

First, let us see what is actually involved in science information work as I have depicted it.

Collection, to me, implies intentional acquisition of information and includes the indentifying and locating of sources of all kinds whether bibliographic, biblothecal, personal, or any other; the detecting, evaluating, and selecting of individual items; and the ordering, receiving, and recording of the materials selected.

Processing for subsequent recovery implies purposeful handling of the raw information and includes at one time or another classifying, cataloging, indexing, coding, converting to machine language, binding, clipping, microduplicating, labeling, and whatever else may be thought necessary.

Storage implies the planned arrangement of information and information sources in files, on shelves, on cards, on tape, or in some other manner, and includes the attendant and related facilities required to assure the immediate availability of whatever is stored.

Retrieval for use implies not only directed recall of what is stored but also that it be in usable form, and so it includes, among other work, bibliographic searching, compiling, tabulating, programming, print-out, photo-copying, translating, abstracting, annotating, interpreting, and, possibly, transmitting.

In addition, as science information agencies become larger and more complex there is increasing demand for persons schooled or experienced in administration, in training programs, in research methods, in systems analysis, and in machine development, so there is a growing need to include such matters in the educational programs of all science documentalists and special librarians.

It is at once apparent much of the work involved in dealing with science information is clerical or technical (in the sense of technique) once an information agency is in operation. (Getting an agency set up and into operation, of course, is another matter and requires the services of an expert who is well versed in science information work generally and in the needs *in toto* of the particular information agency specifically.) It is important to remember that science documentalists themselves must know something about the necessary clerical and technical work that goes on in the agency in order to supervise it and in order to train others to do it; a good bit of it can be dealt with as it comes up in the various professional courses, and the rest can be learned on the job.

What remains, then, is the *professional* part of science information work, the part demanding discrimination and judgment based on sound principles and practice in its successful completion. This, I believe, would include (1) identifying and locating of sources; (2) detecting, evaluating, and selecting of individual items; (3) classifying, cataloging, and indexing of raw information (and information sources); (4) bibliographic searching; (5) abstracting, annotating, and interpreting of retrieved information; and (6) administration, research methods, and systems analysis.

Translating, to me, is a technical matter requiring, to be sure, expert working knowledge of at least two different languages, but usually not requiring judgment. Similarly, programming, coding, and converting to machine language require expert knoweldge of computers at least once in the lifetime of a particular information system, but be it never so crucial and time-consuming, still no judgment may be called into play. The expert knowledge required to do these things proficiently can generally be acquired outside the science information program, in formal college courses, in short courses and institutes, and on the job.

Subject knowledge comes most into use in abstracting and in interpreting retrieved information since both require evaluative comparison with what is already known about the subject from other sources. In many instances adequate subject competency can be developed

in the process of working in, on, and with the subject literature on the job regularly. How specialized or how advanced any one science documentalist's subject education should be depends largely, I believe, on the number of science documentalists in the information agency, on the uniqueness and depth of the agency's interest in the subject, and on the amount of the subject literature readily available to keep the documentalists satisfyingly busy.

Indexing, like abstracting, requires considerable expertness in determining the essential new information in the publication under review. But experience has shown that indexing, unlike abstracting, does not require much subject specialization on the part of the indexer in order to do a satisfactory job. As a matter of fact, specialists often are not consistent in their use of scientific-technical terms and they sometimes are not careful and precise in following a subject-term authority list. And since they are specialists they frequently tend to overlook information not directly related to their specialties.

Professional Education for Science Information Work

In the United States and Canada professional education is graduate education; that is, students interested in professional study must already have a bachelor's degree from an acceptable college or university before they can be admitted to a professional school.

In no field is a *substantively solid* undergraduate education so important as in the field of science information work, as by now it must be quite plain considering the variety of knowledge, ability, and background normally expected of those who go into it. By the same token the first year of professional education for this field must be *professionally solid* so that it truly prepares a student for a lifetime career and not for just a new job, and so that it truly provides a firm foundation for meaningful professional experience, for more specialized learning, and, potentially, for research and advanced study in the field, either on one's own or in a formal Ph. D. program.

The following areas of study are basic, I believe, in professional education for science information work:

1. *The information agency itself.* Administration (policy, program, procedure, service). Management (operations, records, systems analysis, personnel, equipment and machines, information storage facilities, preservation, duplication, distribution, communication). Clientèle (research interests, information needs). Relationship to other information agencies (cooperation, resource complementarity). Related clerical and technical work.

2. *Information collection.* Sources (identification, location; national, trade, and subject bibliography). Materials (forms, detection, evaluation, selection, acquisition). Related clerical and technical work.

3. *Information processing for recovery.* Subject analysis (classification, cataloging, indexing). Conversion principles (coding, machine language, tape, punched cards). Related clerical and technical work.

4. *Information retrieval for use.* Bibliographic searching (indexing and abstracting services, bibliographies, card and printed catalogs, punched cards, mechanical and electronic systems, programming, other devices). Subject analysis (abstracting, annotating, interpreting). Related clerical and technical work.

5. *Electives.* Foreign languages. Linguistics. Additional sciences. Advanced sciences. Cybernetics. Human relations.

To the best of my knowledge no graduate school anywhere offers such a program as I have outlined above. But most of it I think is available one place or another under a variety of course names and in larger or smaller doses depending on the predilection, interest, experience, and background of those in charge of the schools in question. In every science information program offered anywhere I would hope for the broadest interpretation possible of all the topics mentioned so that virtually all aspects of the entire field of information would be covered reasonably well. We simply must have more science information specialists—science documentalists, if you will—who are wide-

ly informed, and not only about science information.

Training, Experience, Education, and a Program for Japan

Regardless of how well educated or experienced a person is he will always need some training on the job when he first starts to work in a new location. This type of introductory training is often referred to as "orientation" and it usually consists of informal briefing, observing, and visiting in order to familiarize the newcomer with the policies, procedures, and personnel of the organization. The time spent on it may be very short, but no newcomer ever skips it entirely.

However, on-the-job training to prepare one for a career in science information work in lieu of professional education at the graduate level is a much more serious, time-consuming, complicated, and, I feel, debatable matter. This is not to say that a well-trained science information worker could not succeed in his chosen field without graduate professional education, for after all, many countries have been producing good librarians and information workers for years through only on-the-job and self-study programs.

As a matter of fact, I believe that much, if not all, of what one does in science information work—including, mind you, the "professional" part as I interpreted it earlier—*can* be learned through experience (i.e., extended practice, drill, and discipline, really prolonged on-the-job training) or through a self-study program.

But I also believe, and quite strongly, that even the soundest training, the choicest experience, the most profitable self-study, can *not* give the prospective science information worker the basic philosophical principles, the broad professional perspective, the creative, intellectual stimulation, and the discerning knowledge of materials and sources that he can gain in a year of graduate professional education and that will be so important to him for the rest of his professional career. Most on-the-job training necessarily is particularized and practical, and while the job itself may indeed be in the best information agency of its kind it still is only one kind and the trainee's experience is perforce limited to that one situation. He is, in truth, being trained for a job, not a career.

Yet it may very well be that in Japan where it is not at all uncommon for a worker to spend his entire productive life in one company, this inherent specialization and built-in deliberateness of on-the-job training actually makes it the best kind of career preparation imaginable. Furthermore, in Japan where there are no strong graduate-level professional schools for science information workers, on-the-job training is perhaps the only kind of preparation for them available at all!

If one feels, as obviously I do, that on-the-job training is wholly inadequate to prepare one for a career in science information work, the question then arises, what should, or can, be done about the plight of education for science information work in Japan?

The answer, it seems to me, depends first of all on the desire and then on the ability of the numerous groups in Japan concerned with science information to pool their resources (personal, intellectual, material, financial) and to attack the problem in a united effort. The several library associations, the various information groups, the interested universities, the already-established library schools, the existing special libraries and science information centers, the governmental and private scientific research organizations, the national and local scientific societies, and any others that care to join, all acting together can do far more than any one group or part of a group can do by itself.

Several possibilities suggest themselves for consideration by such a group of interested organizations:

1. Improve and upgrade an existing library school to graduate level; broaden its program to include the topics mentioned earlier, strengthen its faculty to include persons competent to teach these topics, and recruit students who have the necessary qualifications and the prerequisites to be admitted to the graduate program.

2. Establish an entirely new graduate school of library and/or information service, and then proceed as in (1) above.

3. Develop a two- or three-year science-information-oriented work-study program combining the appropriate parts of the programs of existing library schools with on-the-job training periods in each of three or four of the stronger special libraries and information centers in the area, preferably those with different subject interests, different organizational structures, different kinds of clientèle, and so on; recruit and admit only mature students with as many as possible of the qualifications mentioned earlier.

4. Develop a work-study program as in (3) above but substitute professional short courses, institutes, and seminars for the library school semester courses.

5. Send qualified students to graduate programs in other countries (mostly the United States and Canada, I should guess) and arrange for suitable work experience after graduation in outstanding special libraries and information centers there before they return to Japan.

6. Send qualified faculty members of existing library schools or of university science departments to graduate programs in other countries, arrange for suitable work experience afterward, and on their return to Japan appoint them to the graduate school faculties and programs suggested in (1)-(4) above.

Perhaps one of these suggestions, or a modification of one of them, will be helpful in at least getting people to think and to talk about doing something about the plight of education for science information work in Japan. And in other countries, too, maybe, like, for example, the United States.

Note

This paper was prepared at the kind invitation of Dr. Takahisa Sawamoto who suggested the topic, "Qualifications of science documentalists."

It is, in effect, both a synthesis and a distillation (1) of personal experience, (2) of much recent (and unpublished) discussion and correspondence with library educators and with persons directly involved in science information work, (3) of papers written for the 1963 Denver meeting of the Special Libraries Association and for the 1963 Chicago meeting of the American Documentation Institute, (4) of many catalogs and announcements of universities, library schools, and science information programs, and (5) of the resulting re-interpretation and up-dating of my own previous thoughts expressed in various papers on this subject over the past several years.