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ABSTRACT

The technique which can be applied to extract information from the literature, that is from all published sources, seems to be a subject which attracts little attention. This is surprising considering that "information" is now widely appreciated as a valuable commodity - to be developed and exploited like natural resources. Indeed today research scientists, engineering designed R and D managers, etc. all spend a great deal of their time searching for and communicating information. This document is an introduction to the art of gleaning information from what is called "the literature". To succeed, an engineer must not only be fed with new information on his own specialized subject (which he can do by visiting his library regularly and keeping tabs on the literature) but he must be able to carry out investigations into fields in which he may have no background knowledge, or previous experience. Therefore, this article is geared mainly to guide investigators when they are using "the literature" and searching for published material in a field which is completely new to them. (Author/NH)

I.R.C.

INFORMATION RETRIEVAL

from

the Engineering Literature

Basis of lectures to members of the Cambridge University Engineering Department (when delivered, amended and slanted in two ways, to meet the needs of (1) Research students and (2) students on P/G courses).

K.A.Knell

Librarian

Second edition, Revised
Dec.1972.

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SLIDE NO.1A

Supramar PT50 hydrofoil.
Length 92'. Two 1100 h.p. Dailmor-Benz diesels
Screws 40 m.p.h. 105-155 passengers
Hydraulic flapped bowfoil

I would like to start this little talk by making a reasonable assertion. At least I hope you will think so. That is:-

'Without the use of facts, or information, disseminated widely by the published literature, advanced technological projects (such as the Supramar hydrofoil craft) would not have proceedod so swiftly, or successfully.'

Therefore in the next half-hour or so I shall try to introduce you to the art of gleaning information from what we all call 'the literature'. The reason for choosing a hydrofoil craft for our first slide will be apparent later.

The technique which can be applied to extract information from the literature, that is from all published sources, seems to be a subject which attracts little attention. This is surprising considering that 'information' is now widely appreciated as a valuable commodity - to be developed and exploited like natural resources. Indeed today research scientists, engineering designod R and D managers, etc. all spend a great deal of their time searching for and communicating information.

It was Dr.Johnson who provided me with a suitable opening gambit for a talk such as this, when he said, 'Knowledge is of two kinds. We know a subject ourselves, or we know where to find information upon it'. Today when an increasing proportion of our creative working population is engaged in scientific and technical activities, and when one realises that the amount of information being generated doubles every 10-15 years, we can appreciate the significance of Dr.Johnson's second kind of knowledge only too well.

To succeed, an engineer must not only be fed with new information on his own specialised subject (which he can do by visiting his library regularly

and keeping tabs on the literature) but he must be able to carry out investigations into fields in which he may have no background knowledge, or previous experience. My subsequent remarks, therefore, must be geared mainly to guide investigators when they are using 'the literature' and searching for published material in a field which is completely new to them. Perhaps at this point I should pause and recommend a couple of books; I must not be accused of failing to provide some literature on the subject of making use of literature!

SUBJECT BIBLIOGRAPHY

CAREY (R.J.P.)	Finding and using technical information.	Arnold, 90p.
VICKERY (B.C.)	Techniques of information retrieval.	Butterworths, £3.30.
HOUGHTON (B.)	Mechanical engineering; the sources of information.	Clive Bingley, £3.75.
GROGAN (D.)	Science and technology; and introduction to the literature.	Clive Bingley, £2.25.
WALFORD (A.J.)	Guide to reference material. Vol.1, Science and technology.	The Library Association, £5.

Well what exactly do we all mean when we refer to 'the literature' and what is its degree of magnitude? It is said that we are at present living in the throes of one of this world's many revolutionary phases; this particular one being labelled 'the Scientific and Technological Revolution'. Fortunately, these days at least, we mainly enjoy the fruits of this - except perhaps for a few side effects such as pollution and (maybe) the torrent of new literature generated, which we all have to take some note of, or be ready to harness as required. Failure to do this could be disastrous to one's particular line of business and eventually to the country if we wish to remain an important engineering nation. This torrent of literature is often given another tag, 'the information explosion', perhaps I should not perpetuate these expressions, but they do seem to describe the situation only too well.

Our Information Explosion then is generated, sustained and communicated by a vast collection of literary items which we can divide as follows:-

SLIDE NO. 1B

'INFORMATION EXPLOSION'

ENCYCLOPAEDIAS (A good national encyclopaedia is a matter of national prestige)

HANDBOOKS. DATA BOOKS

BOOKS. MONOGRAPHS (20.000 in print in U.K.)

UNIVERSITY DISSERTATIONS (6,000 British science theses approved annually)

GOVERNMENT PUBLICATIONS (Committee Reports, Committees of Enquiry, etc.)

SCIENTIFIC AND TECHNICAL REPORTS (50,000+ 'open' reports from Governmental Research Organizations, Industrial Research Labs, Universities, etc., received by the N.L.L. annually)

JOURNALS (45,000 different scientific and technical journals published throughout the world)

CONFERENCES. SYMPOSIA (Published 'Proceedings' now an important way of disseminating current information)

TRANSLATIONS (In particular the cover-to-cover translated journals)

and

in order that one can attempt to harness the required sections of the 'explosion' we fortunately have today a great army of bibliographers and processors all engaged in indexing, classifying, abstracting, taping and computerizing their contents. Their results are available in a variety of what can be termed Information Retrieval Tools such as :-

SLIDE NO. 1C

Info. Retrieval

INFORMATION RETRIEVAL

SLIDE 1C

BOOK SELECTION AIDS

Bibliographies, Catalogues and Indexes including the great national bibliographies, select bibliographies and book publishers' catalogues. They embrace general or specific subjects, they have both the author and subject approach.

ABSTRACT AND INDEXING SERVICES

2,000 different services produce a variety of classified abstract journals which themselves include coverage of much of the contents of the world's 45,000 different scientific and technical JOURNALS in their original or translated forms, individual scientific and technical REPORTS, as well as selected BOOKS, THESES, CONFERENCE PROCEEDINGS and PATENTS.

SCIENCE CITATION INDEX

Covers 25,000 different journals. Main index lists authors and journal references, followed by other authors who have CITED the original reference plus the journal references of the citations.

COMPUTER BASED SDI SYSTEMS

In particular the 'profile scanning' Selective Dissemination of Information systems; the data banks of which may include one or more of the above abstracting services.

You may be interested to learn something of how the computer and the information scientist are attempting to help us in harnessing the publication explosion. There are several dozen different systems available, mostly from the States. I think one may say they are still in the experimental stages. In this Department we are making use of two such computerised SDI systems (Selective Dissemination of Information) to support certain research activities.

ESRO/ELDO Space Documentation Service

I will first introduce the ESRO/ELDO Space Documentation Service (SDS). For this is a facility that should be aired. The world space programme embraces almost every conceivable branch of modern technology. This service was established in 1965 to develop means of accelerating the transfer of technological advances made in the course of world space programmes to the European community as a whole.

It currently offers two types of Information Retrieval services; a 'current awareness' system and a 'retrospective search system'. The 'current awareness' system is that in which information is supplied monthly, in the shape of full references to all recently published journal and report literature, on a certain subject.

SLIDE No.2A (ESRO/ELDO-SDS STANDARD TITLES)

1. The Space Documentation Service, in close co-operation with NASA, provides references to recently released reports and journal literature in SCIENCE AND TECHNOLOGY, selected to be of interest to the industrial and academic community. These are gathered together in certain 'packages' and called STANDARD TITLES. This slide shows the leaflet which is available. THE PRICE OF EACH OF THE 'STANDARD TITLES' IS 200 FF (~~£~~23.00).

If you do not find your own particular field of interest covered by the 'Standard Titles' package, or if you have some special area in which you wish to be kept informed, the Space Documentation Service offers a special service, which is called SELECTIVE DISSEMINATION OF INFORMATION (S.D.I.). This is a TAILOR-MADE Service in so far as the client himself defines the TOPIC AREA. The cost of this is somewhat higher.

2. The second system is a RETROSPECTIVE SEARCH SYSTEM which will search certain literature backwards for a given period up to about ten years.

SLIDE No.2B (ESRO/ELDO-SDS)

The service is based at Darmstadt and we contact this via the on-line computer terminal housed at the Technology Reports Centre, St.Mary Cray (Kent). This is referred to as the RECON terminal, short for REmote CONsole. One can therefore, via TRC, gain access to the large collection of scientific and technical literature stored in the ESRO computer, in both current awareness and retrospective search form, and it enables the TRC staff to search for us over 500,000 references to reports and journal literature in aerospace and related topics by the on-line interrogation.... and to obtain a printout of relevant items.

THE INFORMATION

The input, or data-base of the system consists of a multitude of lists and abstract journals such as:-

Scientific and Technical Aerospace Reports. 1962- (STAR)
This fortnightly abstract journal covers scientific and technical reports issued by NASA and its contractors, other U.S. government agencies, and official bodies, industrial organizations, universities and research establishments throughout the world. Many theses and translations are also included.
(To really appreciate the coverage of the abstract journals I mention one really has to inspect them at leisure, at the moment all I can do is to wave a few at you!)

INTERNATIONAL AEROSPACE ABSTRACTS. 1962- (IAA)

These abstracts are also issued fortnightly. (The shear bulk of references is frightening!) IAA covers periodicals, books, conference proceedings (issued by professional societies and academic organizations) and translations of journals.

GOVERNMENT REPORTS INDEX. 1970- (U.S. Dept. of Commerce)

Yet another fortnightly abstract journal and this one announces reports of U.S. Government R and D released to the public through the 'National Technical Information Service'; for example it includes the vast range of American 'Atomic Energy Commission' reports as well as other U.S. Government sponsored research.

In addition to the above the data-bank also includes:-

Metals Abstracts from 1968 - (Inst. of Metals and American Soc. for Metals)

and another vast abstracting service,

Nuclear Science Abstracts from 1968- (U.S.A.E.C.)

and last but not least, and of the greatest importance to 'engineers' is the news that service now includes 'COMPENDEX'. 1969-

COMPENDEX is the computerised version of Engineering Index Monthly, but more about the COMPENDEX service later.

Subjects covered by the data base include

SLIDE No.3

(Subjects covered by ESRO/ELDO SDS)

AERODYNAMICS
ELECTRONIC EQUIPMENT
FLUID MECHANICS
MECHANICAL ENGINEERING
PHYSICS
PROPULSION SYSTEMS
STRUCTURAL MECHANICS
THERMODYNAMICS AND COMBUSTION
etc., etc.

Each report or article referred to in STAR and IAA is allocated a number of subject indexing terms (also called Keywords or Descriptors): the terminal operator locates references by selecting the appropriate indexing terms and combining them to form a search profile.
We would supply the basis for this on the appropriate TRC form

SLIDE No.4

(TRC Request for literature Search Form)

This is the standard request form, but requests may also be made on the telephone or Telex. The subject should be stated in concise natural language plus any background information which may be necessary to classify the enquiry, plus suggested specific keywords from the requestors' own vocalulary, and if possible indicating the combinations of these keywords to be used in the search. Searches may be limited by year.

The charge per search at the moment per profile is £37.50 to industrial organisations and £23 to academic institutions. The print-outs look like this:

SLIDE No.5

(Output from TRC)

(COMPENDEX)

The other computer based IR system we are using is called COMPENDEX. Compendex stands for COMPuterzied ENgineering InDEX and the service we are using is run by the University of Calgary Information Systems.

SLIDE No.6

(COMPENDEX)

This is a current-awareness service consisting of print-outs of the titles of articles and papers and their abstracts which are currently being produced; these are taken from EI Monthly. It does not work retrospectively yet. Now EI is the leading source of abstracts on the world's engineering developments. The data-base consists of the 6,000 abstracts which appear in each EI Monthly. To obtain these EI reads more than 3,500 sources of engineering literature and their important contents are abstracted and indexed. Coverage includes journals, publications of engineering organisations, conference papers, books, government reports and patents. COMPENDEX consists of all this information put on to machine readable magnetic tapes for computer processing. The tapes are leased at $6,000 per year to organisations possessing the IBM-360 computer system, together with the necessary Programs. In our case we are using the service offered by Calgary, although I have been trying to persuade our own Cambridge Computing Laboratory to run the service in Britain. As it is it looks as though TRC will beat us to it.

SLIDE NO. 7

Simplified Compendex Profile and Output. (The words STATOR, CASCADES, and TRANSONIC formed part of the very complicated profile produced to support this particular R/S project.)

The Profile is data rather than a program; it consists of significant words linked by logical connectors (OR, WITH, ADJ) to form search expressions in several layers of search logic; one level combined with logical connectors to make a second or third level.

Each group of expressions is given a shorthand name AI- and at some level we arrive at the final grouping for which we are searching and we name these CON 1-

CON is a computer instruction but I think we could think of it as short for CONNING, as when conning a document.

The computer is programmed to react to these search expressions; when the required degree of matching occurs the computer prints out, on to a card, not only the full reference, but also the abstract. (See bottom part of slide.) It is an important feature of the EI-Calgary system that the abstracts are scanned as well as the actual references. The cost of a profile with Calgary is at present $100 for one year's output, produced in twelve monthly instalments. So far the percentage of relevant items, or 'hits' equals about 1 in 5 of the total number of cards received; over 50 cards per month are coming in as the result of one profile.

I have spent more time describing the two computerized IR systems than the good old-fashioned IR tools such as bibliographies, catalogues and abstracting services because firstly they are comparatively new, and secondly most people are already to some extent familiar with the latter. Judging by the results so far obtained, I think the computer systems will never totally supercede the older I.R. tools which form the basis of a 'Do It Yourself' system. A translator we once had made a Do it yourself kit into a Do it yourself kid, and boy do I believe strongly in the 'Do it yourself kid' when it comes to searching for information in the literature, or just keeping up to date.

Sometimes it is most difficult to describe a specialised bit of research in language form, mixing up technical jargon with common or garden verbs and nouns and all the other vagaries of language, e.g. a typical research paper could be entitled 'A correction factor for the effects of finite span on the unsteady lift or moment on a wing with a spatially invariant spanwise downwash distribution'; a cosy little titbit of information not too easy for a requestor to make a machine pick out for him by a pre-selected list of Keywords and connectors and text comparison. A researcher may pick out a paper such as this more easily from one of the larger abstract journals under a general heading such as AEROFOILS; or indeed by scanning the best of the relevant journals themselves. I still think a weekly visit to the library to scan a pre-selected list of journals and watch the book accessions list is a necessity

as well as a pleasure. Unlike the human mind, a computerised system can only react to what it is programmed specifically to do; it cannot think for itself, or discriminate. To sum up, then, I think there is room for the Do it yourself kid and the computer. Indeed there is at present quite a wide divergence of opinion in this Department about the effectiveness of machine aided literature search systems.

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Well let us put all this theory into practice and review the results of an actual literature search undertaken by Joe Bloggs, one of our finer research students.

SLIDE NO. 8
(JOE BLOGGS)

Please remember that the following remarks are intended as a guide to searching published material for a certain bit of information when the field is completely new to the investigator, or to the person initiating the research. The sequence to be outlined has been found to produce the required information with the least effort. Of course when the basic technology is already known and only specific information on a particular branch of the field is required, some of the initial steps of the sequence can obviously be by-passed.

SLIDE NO. 9
(Water Skier)

This slide has a dual purpose:

(one) I hope it may wake up anyone who is dozing off, and

(two) it forms a charming introduction to one of Joe Bloggs' current main interests (apart from girls). This lady is hydroplaning across the surface of water; Joe's interest in water lies a bit deeper - he is interested in hydrofoils.

Joe's proposed research topic can be described in these words 'Control systems for hydrofoil ships operating in a random seaway'.

The problem is roughly as follows:-

SLIDE NO. 10
(HYDROFOIL CRAFT)

'Hydrofoil craft, when travelling at speed, become dangerously unstable when encountering large rising and falling wave formations of a pattern unfavourable to the lift characteristics of hydrofoils in set positions. This could be solved by devising a sensor, whether in the form of projecting arms or a radar beam, to 'feel' the oncoming sea surface and to use this information automatically to control the position and lift of the main front foils'.

I think Joe was particularly anxious to try and apply this to 'Surface-piercing' type, lower left on the slide.

Joe's literature search on this subject can conveniently be based on the items of literature already shown forming the main structure of our Information Explosion shown on a previous slide.

Joe knows nothing about the subject yet, let's go then Joe!

SLIDE NO. 11

It is a Boeing research hydrofoil propelled by a water jet. (Water for which enters a scoop at base of aft strut and is forced out at rear by a double action centrifugal pump.)

This slide is of no direct concern to our discussion except that it will serve to keep our minds on the end product and anyway it is a most beautiful picture.

Joe's first action was to gain a broad outline of the subject: in the University Library he gained this by consulting the articles on Hydrofoils in (1) the Encyclopaedia Britannica, 1970 edition, and (2) McGraw-Hill's Encyclopaedia of Science and Technology, 1960. (3) He also searched the U.L. and Engineering Department Library catalogues for specialised encyclopaedias and handbooks on related fields.

Having thus gained a broad outline of the subject, books dealing specifically with hydrofoil craft were sought using:-

(1) Engineering Dept. Library subject catalogue
(2) Cumulative Book Index (1970 back to 1940)
(3) British National Bibliography (back to 1950)
(4) Whitakers Technical Books in Print, 1970
(5) The University Library's Name Catalogue.

These gave Joe three works:-

SLIDE NO. 12

(Selected References)

Books
Bibliographies
Dissertations

As you see the latest was dated as recently as 1969. Collectively they provided a valuable survey up to that date and they helped him to summarize, up to a given period, the state of the art.

Then Joe sought any bibliographies on the subject using

1. Library catalogues under the heading

BIBLIOGRAPHY

2. Bibliographic Index (1970 back to 1956)

3. World Bibliography of Bibliographies (1966 ed.)

The results were as shown on the slide.

In case someone else had thought of attempting this, or a very similar subject for his Ph.D. Joe checked the ASLIB Index to theses (U.K.) and the American Dissertation Abstracts B. In the latter he found a most significant reference which is shown at the bottom of the slide. For current Ph.D. work in progress Joe no doubt checked D.E.S's Scientific Research in British Universities. Vol.1.

If there had been a serious accident to a commercial hydrofoil craft in service this would have been the subject of a governmental enquiry in which much valuable information might have come to light. Fortunately this has not happened, as far as I know, so Joe left this source unchecked.

Technical and Scientific Reports, the contents of the world's journals, proceedings of conferences and symposia. Joe knew that these items would contain the most significant and up-to-date information on the subject. First he sat down (probably with a cube of ice on his head) looking for likely report literature, with the indexes to STAR kept in our library and 'USGRDR'

(United States Government Research and Development Reports) kept in the Scientific Periodicals Library down the road. The results added to something like this:-

SLIDE NO. 13

(Selected References: Report Literature)

By the way I do not expect you to read everything in this and the next two or three slides.

The purpose is to give you an overall impression of the amount and relevance of the literature discovered.

You may like to note odd titles and cast your eyes over the references (which will be underlined).

Next Joe wanted to search the periodical literature, and learn about any relevant Conference Proceedings. There are numerous abstract and indexing services available (? over 2,000 I believe). I have given you a list (printed in red ink) of those we in the Engineering Department have found most useful. Joe picked out three from this list: Engineering Index back to 1960: British Technology Index and Computer and Control Abstracts. We decided to leave IAA to the ESRO/ELDO computer.

All in all Joe and ESRO turned up over 100 references, but the list of the most useful to him is as follows:-

SLIDE NO. 14

(Selected References: Periodical Literature)

SLIDE NO. 15

(Selected References: Conference Proceedings)

I am bound to add that in this particular literature search at this period of time, Joe, (using his library service properly) was more successful than the Computer. He found the Science Citation Index at the Scientific Periodicals Library extremely useful in checking who had cited the most significant papers.

XXX

Having traced all these references to the literature, all Joe's work, and the computer time, would have been wasted if he were not able to lay his hands on the most important as he wanted them. For this he would have contacted his library.

In Cambridge the supporting library resources are vast as can be seen by this chart.

SLIDE NO. 16
(Cambridge Libraries Chart)

Every Faculty and department boasts a library collection of some degree: some are highly significant in their respective fields. In the centre there is the excellent Scientific Periodicals Library, which currently holds some 1,500 different and carefully selected scientific journal titles, as well as certain conference proceedings. (For lecture to Eng.Dept. Research students quote details from Page .....) and even larger the vast collection offered by the Cambridge University Library. This is a copyright library, which means it acquires by law a copy of every book produced or sold in this country bearing a British imprint. This library holds over 2 million volumes and it currently receives the parts of some 12,000 different scientific and technical journals. (For research students quote further details from Page ....)

Large as the local collection is it does not by any means hold all the results of the mighty 'publications explosion'. So in addition to the local collections most departmental librarians have formed their own locating, borrowing and copying network based on the even larger national and government sponsored libraries.

SLIDE NO. 17A
(Inter-library loan Network)

This slide shows something of the interlibrary system as operated by us here in the Engineering Department. The heavy lines indicate volume of usage and you will observe that 80% of our outside requests are directed at the NATIONAL

LENDING LIBRARY FOR SCIENCE AND TECHNOLOGY. The way I feel about this library is this: if I do no more today than introduce you to its great collection and service I shall not have wasted our time.

I have given you each a copy of its brochure among the handouts which describe it in detail; here perhaps I may draw your attention to its aims which are 'To obtain all literature which is likely to be of interest to the practising scientist and technologist' and to make this literature available to all. The latter is achieved by loan procedures, or in the form of xerox copies, operated on a mail order basis via your own library organization. If your current situation does not boast a library and staff then there are certain libraries acting as local agents in key towns throughout the U.K.

The N.L.L.'s current list of Periodicals and Reports series totals nearly 40,000 different titles from over 100 countries. Their holdings also include books and are particularly strong for Conference Proceedings.

Perhaps I should also draw your attention to the new National Reference Library of Science and Invention in London, which has taken over the Patent Office collection. This library, as the name implies, does not supply loans but will supply copies on request. If further information is required I can supply a copy of their brochure.

By the way the total number of requests we handle for material not held in Cambridge amounts to over 500 items per year.

SLIDE NO. 17B

(Inter-library loan Network, 2.)

If this slide is shown it would demonstrate the complexity of a library loan network and the various stages in a hunt for documents

XXX

Finally it would be nice if I could say there was a happy ending to this little story about Joe, the 'Do it Yourself Kid', who had armed himself as a result of a literature search, with all the background material he needed to go forward with his own research, and this could have been supported by a profile with COMPENDEX to keep him up to date if required. Unhappily I have to admit this is not so. Towards the end of his search Joe turned up two significant papers. Having consulted these he came to the sad conclusion that the work embodied in these papers left little scope for further modern control research on these particular lines.

SLIDE NO. 18
(Key Papers)

So, this particular essay in the art of Information Retrieval and literature searching was negative. But think of Joe's position in three year's time if he had proceeded on these lines; he would have found out, sooner or later, that his research project was not original and it therefore would not have entitled him to the Ph.D. degree.

So Joe reluctantly abandoned this project and is now forging full steam ahead on something else.

SLIDE NO. 19
Hovertrain

He is now working in an entirely different field, on the hovertrain! However I think he has (by this little case-history) demonstrated the point that the knowledge of 'the literature' and making good use of a library can be one of those intangible assets of prime importance; not only to the individual, but to the organization which employs him.

Scientific Periodicals Library

Likely to be of considerable help.

Jointly managed and financed by Cambridge Philosophical Society and University. As name implies mostly a library of journals - 1,500 on the list. Also acquires certain number of Conference Proceedings and has an excellent collection of Reference Books, including Abstract Journals.

Periodical collection carefully chosen by a Committee of members and covers all branches of science studied at the University.

Strongest in Maths, Physics, Chemistry, general Biology - with emphasis on the non-British journals. (U.L. takes care of U.K.)

Full details of membership given in their brochure. Subject to certain formalities it is roughly as follows:-

Members of this University may use SPL as a Reference Library.

Cambridge graduates are eligible for full membership for a fee of £2.20 p.a. Privileges include borrowing rights.

Graduates of other Universities can become Associates. This includes borrowing rights.

University Library

Registered R/S automatically given BA or MA status.

-25 = BA status

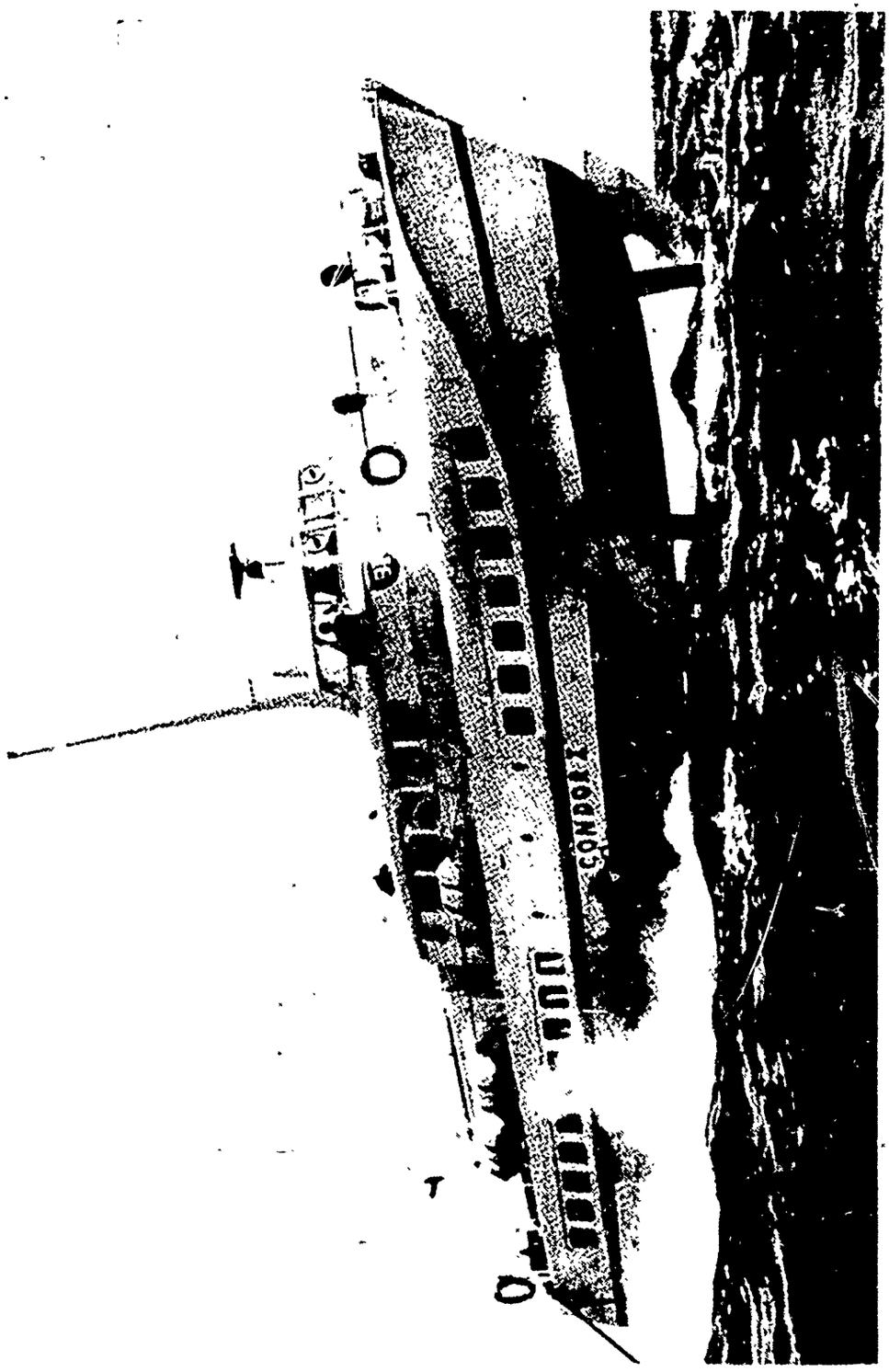
+25 = MA status

Pamphlet available at Door

Talks given

Guided tours M., W., F. 2.15 p.m.

SLIDE 1A



"INFORMATION EXPLOSION"

ENCYCLOPAEDIAS

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CONFERENCES. SYMPOSIA (Published "Proceedings" now an important way of disseminating current information)

TRANSLATIONS (In particular the cover-to-cover translated journals)

SLIDE 1B

INFORMATION RETRIEVAL

BOOK SELECTION AIDS

Bibliographies, Catalogues & Indexes including the great national bibliographies, select bibliographies and book publishers' catalogues. They embrace general or specific subjects, they have both the author and subject approach.

ABSTRACT AND INDEXING SERVICES

2,000 different services produce a variety of classified abstract journals which themselves include coverage of much of the contents of the world's 45,000 different scientific and technical JOURNALS in their original or translated forms, individual scientific and technical REPORTS, as well as selected BOOKS, THESES, CONFERENCE PROCEEDINGS & PATENTS.

SCIENCE CITATION INDEX

Covers 25,000 different journals. Main index lists authors and journal references, followed by other authors who have CITED the original reference plus the journal references of the citations.

COMPUTER BASED SDI SYSTEMS

In particular the 'profile scanning' Selective Dissemination of Information systems; the data banks of which may include one or more of the above abstracting services.

SLIDE 1C

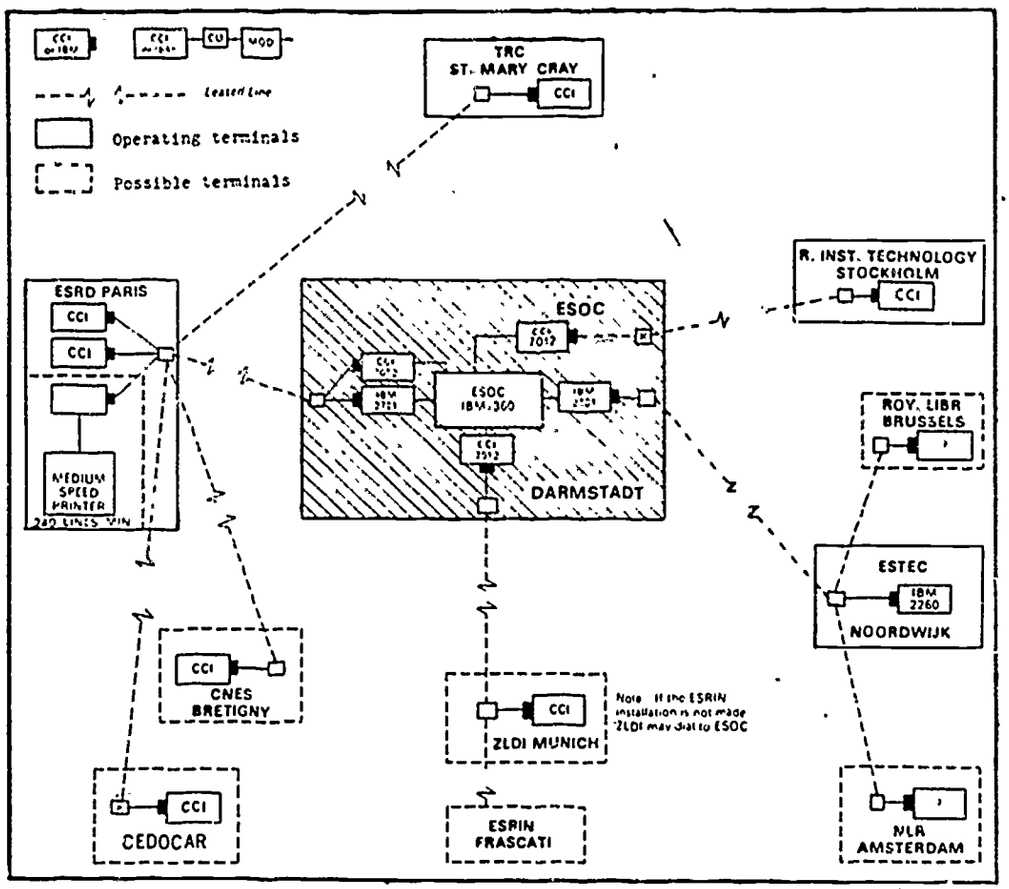
SLIDE 2A

SPACE DOCUMENTATION SERVICE
STANDARD PROFILES
designed to
a service you with
provide you on the latest
information in your field
developments
SPACE DOCUMENTATION SERVICE
INDUSTRIAL TOPICS
a service designed to
provide you with
information on the latest
developments in your field

SLIDE 2B

TRC ON-LINE TERMINAL TO ESRO /ELDO-SDS

A NEW INFORMATION SERVICE



SLIDE 3

Subjects covered by the data base are:-

Aerodynamics
Aircraft
Auxiliary Systems (includes hydraulic, pneumatic and electrical systems)
Biosciences
Biotechnology
Chemistry
Communications
Computers
Electronic Equipment
Electronics
Fluid mechanics
Geophysics
Instrumentation and Photography
Masers and Lasers
Materials (includes corrosion, physical and mechanical properties, plastics, metallurgy)
Mathematics
Mechanical engineering
Meteorology
Navigation and Guidance
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Physics, Plasma
Physics, Solid-state
Propellants
Propulsion Systems
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Some recent search titles are:-

Reliability of optical systems
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Laser machining
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SLIDE 4

C-553 Q.

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SUBJECT Please state the subject as specifically as possible

Analysis and design of automatic control systems for controlling the motions of a hydrofoil boat operating in ocean waves

BACKGROUND Give any technical background information that you think necessary to clarify your inquiry (Continue overleaf if necessary)

Not interested in hydrodynamics of fluid flow around a single hydrofoil blade. Interested in systems for controlling overall motion (eg. pitch, heave, roll, yaw etc.) of a hydrofoil craft operating in random or irregular waves not smooth water. Also interested in computer simulation of the topic.

REFERENCES Please list authors, corporate sources or NASA (A or N) accession numbers of any relevant references already known to you (Continue overleaf if necessary)

KEYWORDS Please suggest subject terms in your own vocabulary. If you are familiar with coordinate indexing a brief search profile incorporating OR, AND and NOT links would be helpful.

HYDROFOIL CRAFT OR BOATS
(AUTOMATIC) CONTROL SYSTEMS
OPTIMAL CONTROL
DYNAMICS OF HYDROFOIL CRAFT
MATHEMATICAL MODELS
COMPUTER SIMULATION
AUTOPILOTS FOR HYDROFOIL CRAFT
RANDOM OR IRREGULAR (SEA) WAVES
MOTIONS OF HYDFOIL CRAFT.
SEA-KEEPING PERFORMANCE

LIMITATIONS ON SEARCH

1. Size
Maximum number of references required ...150.....
If fewer than ...10... are retrieved, please broaden search.
Revised subject:
Motion of hydrofoil craft in sea waves.

2. Type of document. Please indicate (/)
a) STAR (report) items only .....
b) IAA (journal) items only .....
c) Both .....✓.....

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SLIDE 5

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69A14084 ISSUE 03 CATEGORY 02 00/11/68 UNCLASSIFIED REPORT

HOVERCRAFT. (HOVERCRAFT AND APPLICATIONS OF AIR CUSHION PRINCIPLE, DISCUSSING LARGE AND SMALL SIZE VEHICLES, AUTOSTABILIZATION, HYBRIDS AND RAM WINGS)

STANTON-JONES, R.

INIT- AERONAUTICAL JOURNAL, VOL. 72, P. 911- 919 14. DATE- NOV. 1968.

/*AIRCRAFT DESIGN/ AUTOMATIC CONTROL/*HOVERCRAFT GROUND EFFECT MACHINES/ HOVERING STABILITY/ HYDROFOIL CRAFT/ STABILIZATION

68N27673 ISSUE 16 CATEGORY 10 00/00/67 UNCLASSIFIED REPORT

OPTIMAL CONTROL OF A MULTIVARIABLE STOCHASTIC PROCESS AS APPLIED TO A HYDROFOIL BOAT (OPTIMAL CONTROL OF MULTIVARIABLE STOCHASTIC PROCESS AS APPLIED TO HYDROFOIL CRAFT)

ASSEO, S. J.

STATE UNIV. OF NEW YORK AT BUFFALO. (S1123588)

DATE- 1967 COLL- 289 P AVAILABLE FROM UNIV. MICROFILMS- HC 13.05/ MF 3.75 ORDER NO. 67-10116

/ BOATS/ DYNAMICS/*HYDROFOIL CRAFT/ LINEARITY/*OPTIMAL CONTROL/ PROBABILITY THEORY/*RANDOM PROCESSES/ RANDOM VARIABLES

68N27553 ISSUE 16 CATEGORY 12 TR-463-10 AD-668700 NOBS-90224 N00014-67-C-0417 00/11/67 UNCLASSIFIED REPORT

HYDROFOIL CRAFT DYNAMICS IN A REALISTIC SEA INCLUDING AUTOMATIC CONTROL (EQUATIONS FOR HYDROFOIL CRAFT DYNAMICS IN REALISTIC SEA INCLUDING AUTOMATIC CONTROL)

MARTIN, M.

HYDRONAUTICS, INC., LAUREL, MD. (H9217180)

DATE- NOV. 1967 COLL- 105 P REFS

/ ANGLE OF ATTACK/*AUTOMATIC CONTROL/ DRAG/*EQUATIONS OF MOTION/ FEEDBACK CONTROL/*HYDRODYNAMICS/*HYDROFOIL CRAFT/ LIFT/ SIMULATION/ STABILITY DERIVATIVES/ SURFACE WAVES/ WATER WAVES

SLIDE 6

COMPENDEX

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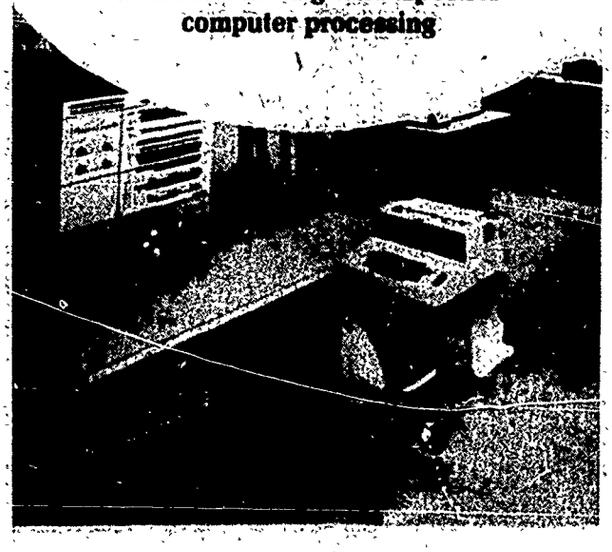

SLIDE 7

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000362 1     DS THOMPSON                              CAMB CU  ENGDEPT 12/70      01
000362 A1    UNSTEADY$* OR NON-STATIONARY OR PERIODIC$* OR FLUCTUATI$* OR       C02
000362       TRANSONIC OR SUPERSONIC OR SHOCK$ OR OSCILLAT$*                    03
000362 A2    NON ADJ STATIONARY                                                 04
000362 A3    HIGH WITH MACH OR MACH-NUMBER                                      05
000362 A4    HODOGRAPH$* OR CHARACTERISTIC$ OR TIME-MARCHING                    06
000362 A5    TIME ADJ MARCHING                                                  07
000362 A6    PRESSURE ADJ TRANSDUCER$                                           08
000362 A7    FINITE ADJ ELEMENT$                                                09
000362 A8    FINITE-ELEMENT$                                                    10
000362 A9    A1 OR A2 OR A3 OR A4 OR A5 OR A6 OR A7 OR A8                       11
000362 A10   TURBOMACHIN$* OR TURBINE$ OR PUMP$ OR COMPRESSOR$ OR DIFFUS$*      C12
000362       OR PROPELLER$ OR IMPELLER$ OR ROTOR$ OR STATOR$ OR CASCADE$        C13
000362       OR AEROFOIL$ OR AIRFOIL$ OR FAN$ OR BLADE$$$                       14
000362 A11   TUNNEL$                                                            15
000362 A12   BOUNDARY ADJ LAYER$                                                16
000362 A13   FLUID$ ADJ FLOW$                                                   17
000362 CON1  A9 AND A10                                                         18
000362 CON2  A6 AND A11                                                         19
000362 A14   A1 OR A2 OR A3                                                     20
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CENTRAL STORES OF CIS

CIS QUESTION LISTING PAGE 35

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000362 A15   A7 OR A8                                                          21
000362 CON3  A12 AND A14                                                        22
000362 CON4  A13 AND A15                                                        23
000362 CON5  KUTTA$* OR JOUKOWSKI$ OR ZHUKOVSKI$                                24
000362 CON6  ROTATING ADJ STALL                                                 25
000362 CON7  ACTUATOR ADJ DISC$                                                 26
000362 END                                                                      27
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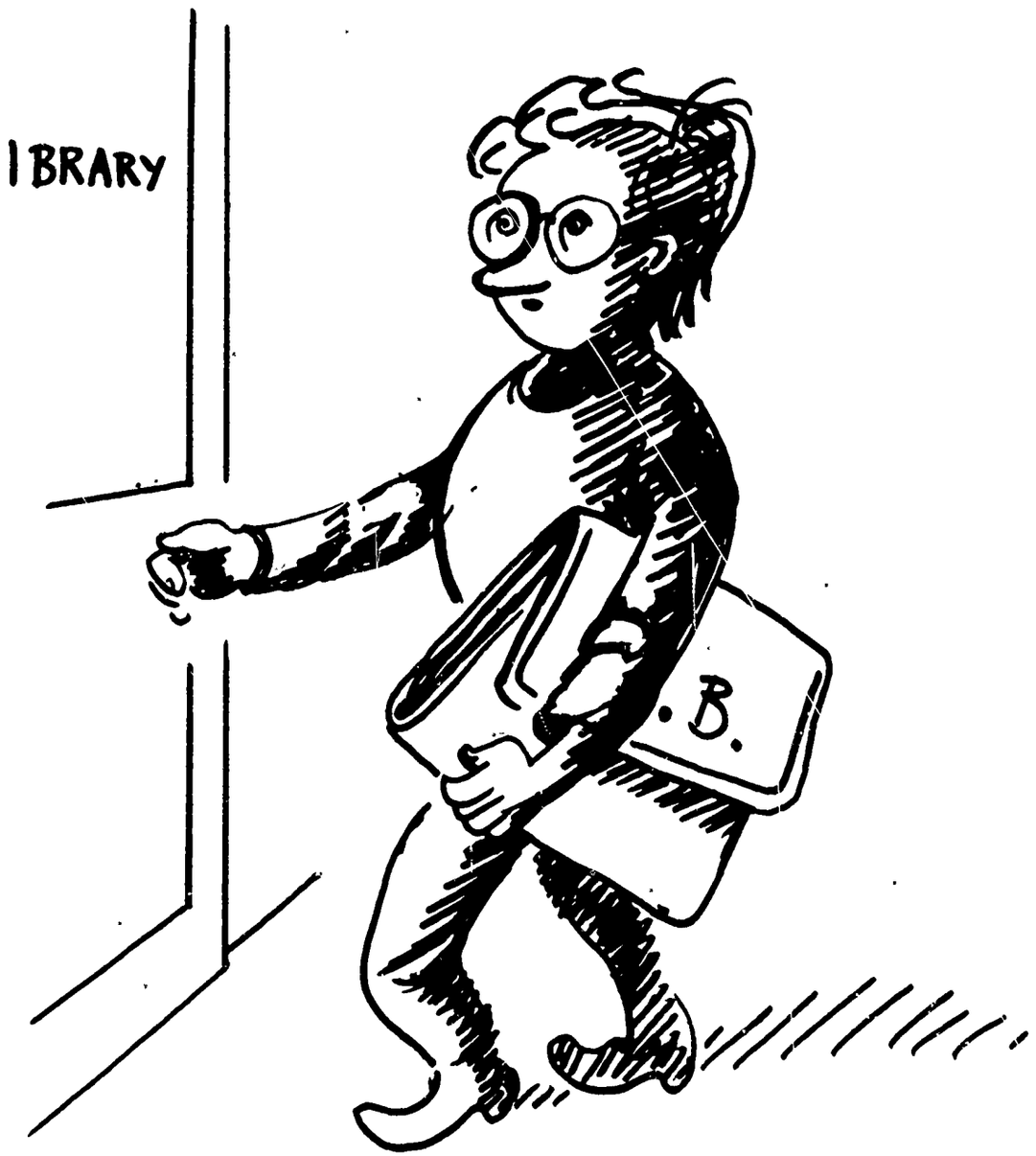
7CX 03305 10/30/70

PERFORMANCE PREDICTION FOR HIGH TURNING LOW ASPECT RATIO STATOR CASCADES IN THE TRANSONIC REGIME
FTX7CX103305
GRIEPENTROG HEL
ASME PAP 70-GT-62 FOR MEETING MAY 24-28 1970, 9 P
GUTEHOFFNUNGSHUETTE AG, OBERHAUSEN-STERKRADE, WEST GERMANY
METHOD FOR THE PREDICTION OF THE TRANSONIC FLOW FIELD IN A HIGH SOLIDITY, HIGH TURNING CASCADE, SUITABLE FOR USE AS STATOR OF A SHOCK- IN- ROTOR SUPERSONIC COMPRESSOR STAGE. EFFECTS OF SHOCK BOUNDARY LAYER INTERACTION IS TAKEN INTO ACCOUNT BY EMPIRICAL CORRELATION, VALID FOR BLADE ASPECT RATIOS BELOW UNITY. USE OF PARTIAL SLOTS FOR REDUCTION OF THE SECONDARY FLOWS IS BRIEFLY DISCUSSED AND A CORRELATION ON SLOT EFFICIENCY IS PRESENTED. 20 REFS. 44037

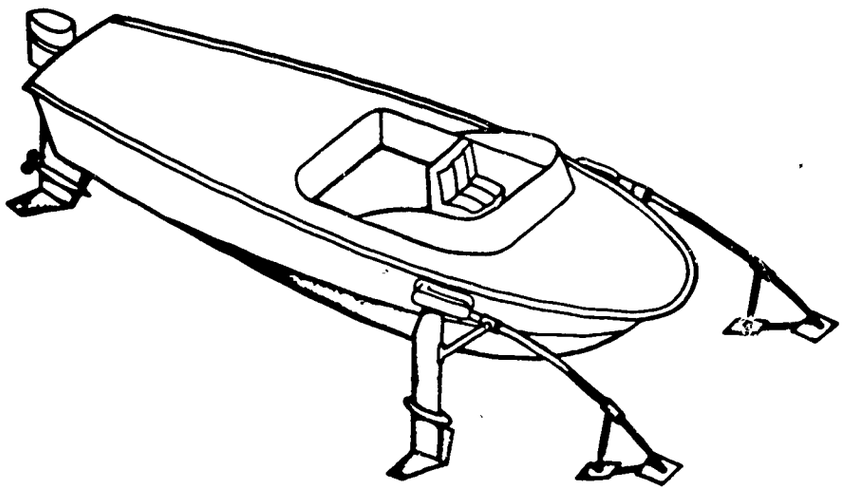
RELEVANT A1 and A10

SLIDE 8



SLIDE 9

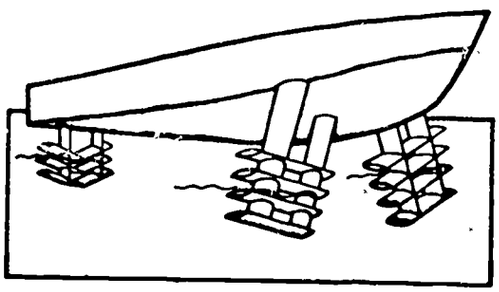
SLIDE 10



The original Hydrofin *was developed by Christopher Hook to counteract the inherent instability of submerged-foil craft. Projecting arms "feel" the oncoming sea surface and use this information to control the lift of the main front foils.*

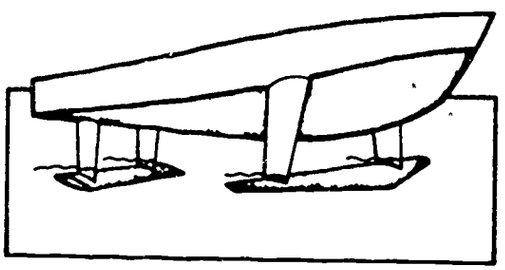
four main types of hydrofoil in use today

Foil ladder

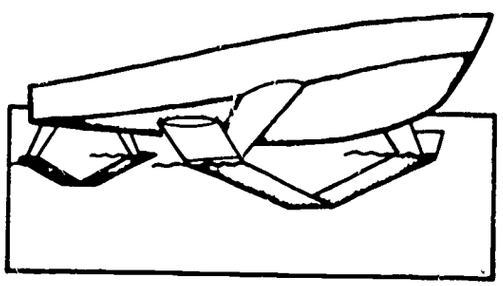


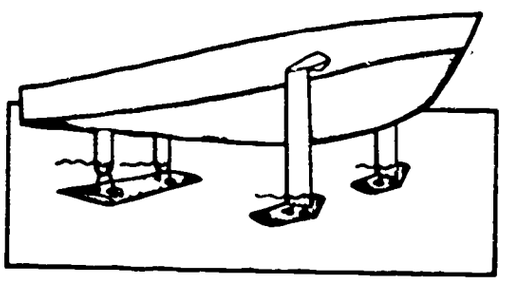
Surface-piercing

Depth effect



Submerged





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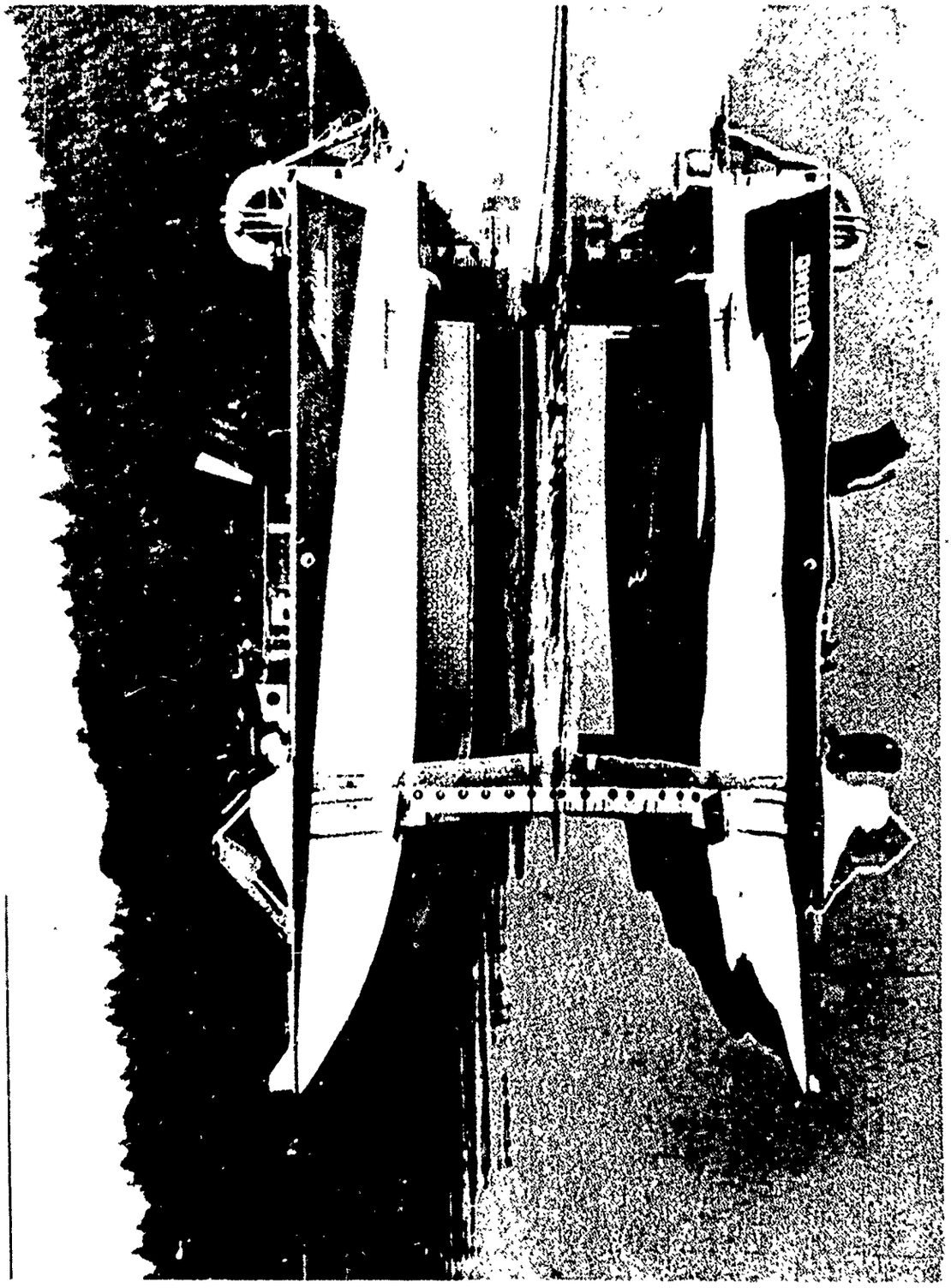

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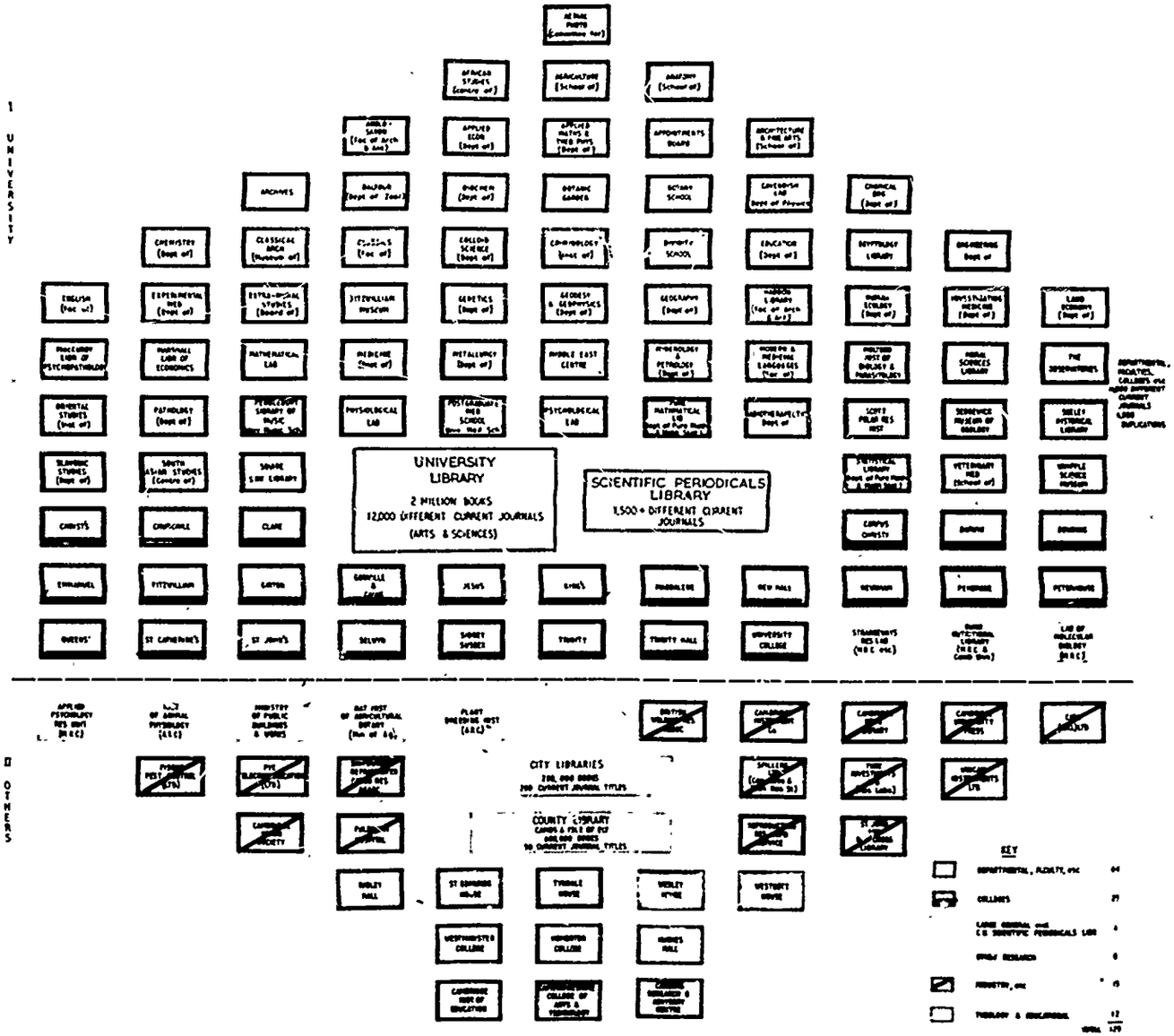

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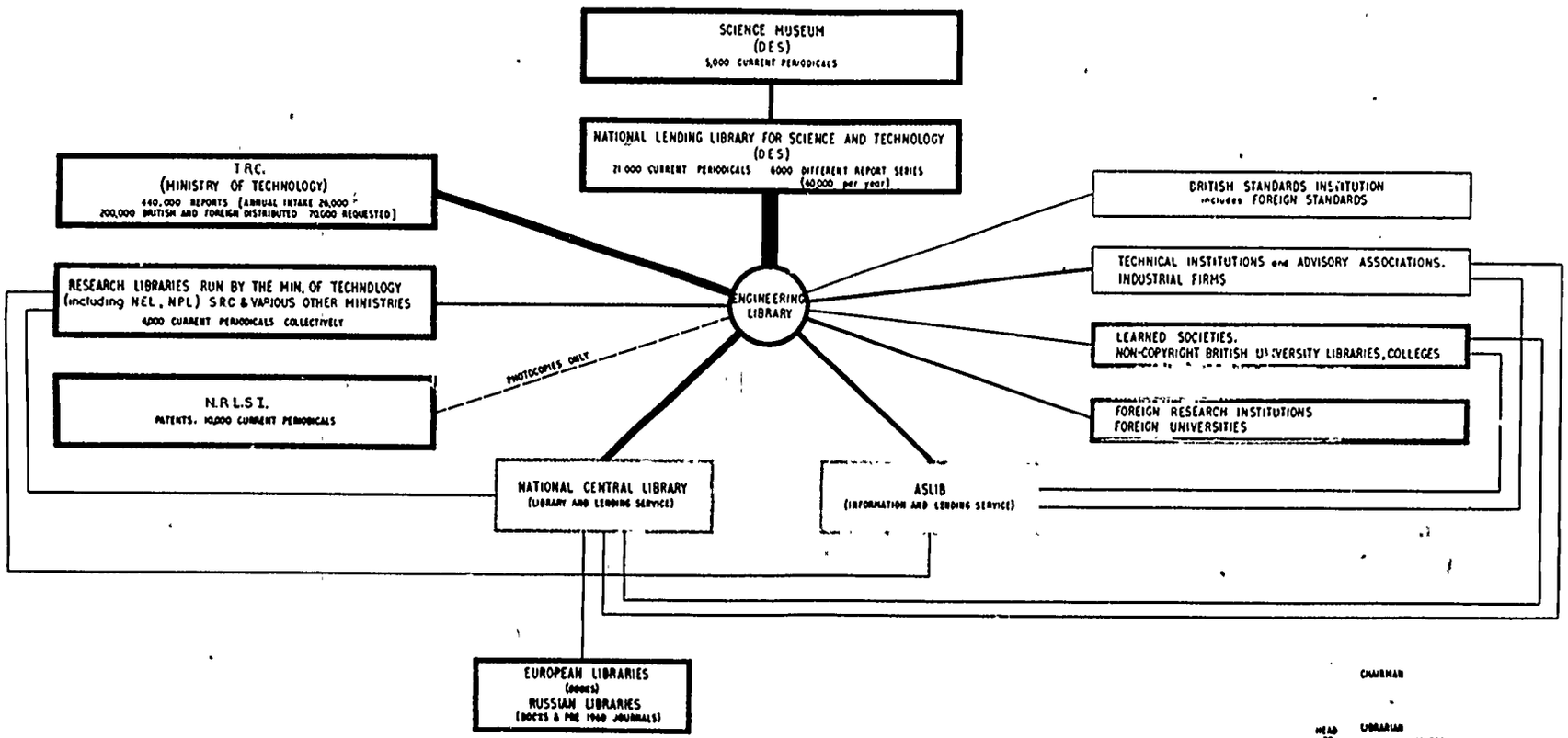

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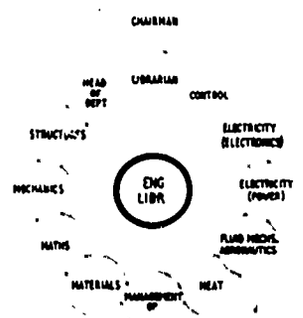

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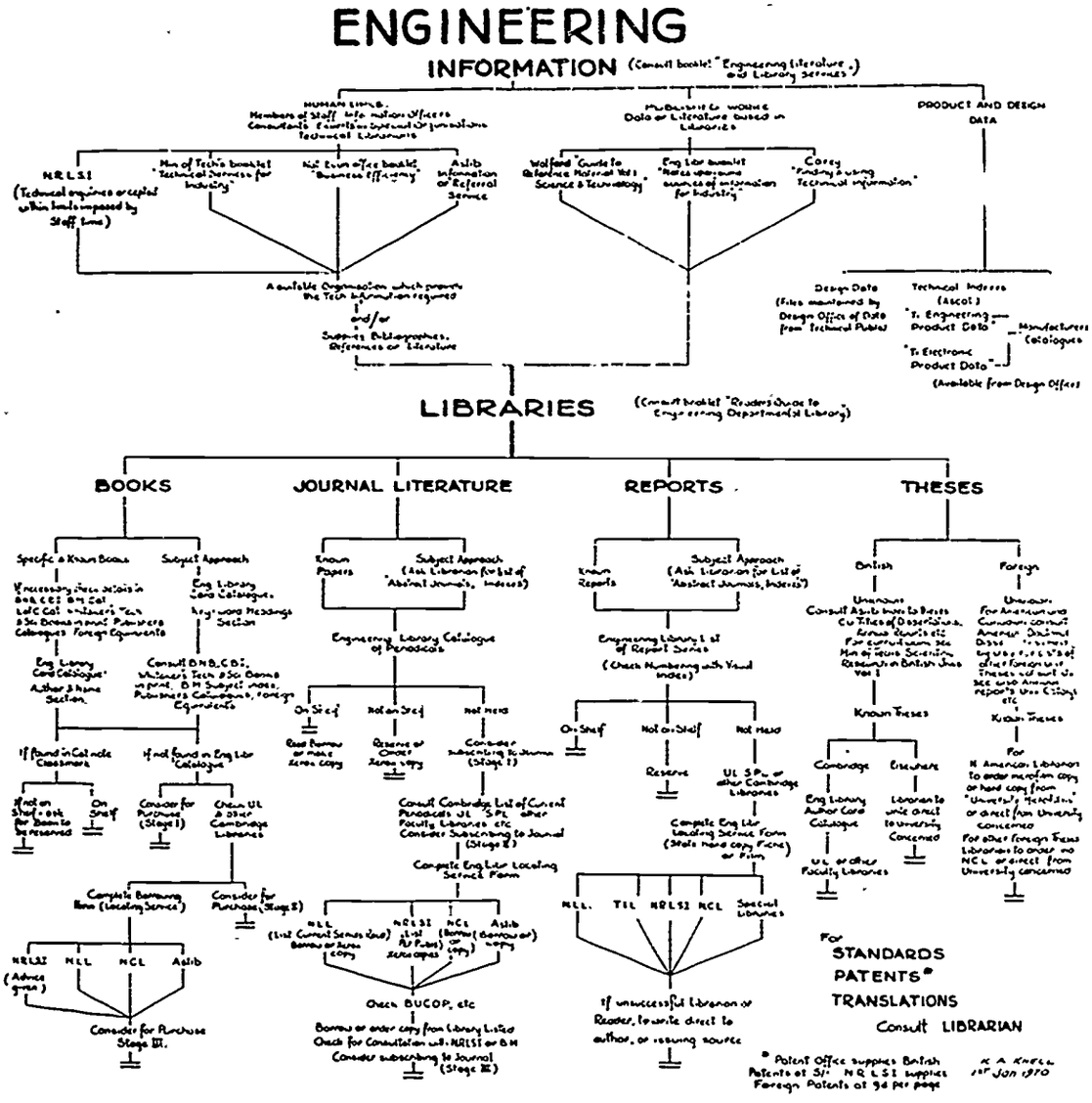
SLIDE 17B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