Dalhousie University, Faculty of Dentistry

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Research Workshops

Two research workshops were conducted at the recent 11th International Symposium on Dental Hygiene, held in Ottawa June 28th - July 1st, 1989. "Getting Started in Research", a full day workshop held June 28th, attracted the maximum allowed number of registrants (25) from seven countries. The workshop was coordinated by Michele Darby and Marnie Forgay(Dalhousie), Facilitators included Dr. M. Walsh, (UCSF), Dr. Kathleen Lukken, Webber (State College, Utah), Jan Pimlott, (University of Alberta), and Joanne Clovis, (Dalhousie) . A shorter workshop on June 30th was entitled. Fostering Dental Hygiene Research", and was facilitated by Prof. Denise Bowen, (Idaho State University). Michele Darby and Denise Bowen are co-authors of the text "Research Methods for Oral Health Professionals".

Welcome Back Mike

Dr. Micheal Cohen has returned from his sabbatical spent at the Royal Dental College Copenhagen. During his sabbatical year Mike organised two major scientific meetings dealing with genetics. In addition Mike wrote 14 papers which have been accepted for publication and a further two books are also in press. In his spare time Mike was an invited speaker giving 22 lectures during the year. We are pleased that Mike was able to have a good rest during the past twelve months and is now ready for some hard work.

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NOTE: Deadline for IADR/AADR Abstracts FOR CINCINNATI to be in the Central Office of the IADR is 29th September 1989

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Why we need to understand scientific reasoning

The impact of scientific and technological developments on the practice and teaching of dentistry during the past ten years has been so great that faculty members cannot afford to be ignorant of these developments. In one respect there is little danger of anyone having to remain uninformed of new trends in dental science or technology. The amount of information dealing with dental science and technology is overwhelming. The number of dental research papers presented at the AADR-IADR meetings during the past six years totals 13,796. We are entering the "information age" much of the new information in our daily lives concerns science or technology in fields outside dentistry such as molecular biology, bio-engineering or computers. We can take advantage of much of this scientific information to improve our ability as teachers of a specific subject area. However, in order to be able to understand what is being reported, we often need to be able to evaluate the results which are reported. This inevitably involves us in some level of understanding of the scientific process and the acquisition of some special skills in evaluating scientific information. We thus have a very sound logical reason why we should develop some understanding of scientific reasoning. We require this skill if we are to function effectively as a professional teachers in our chosen subject area of dentistry. One of the easiest ways to develop such skills is to undertake some research projects of our own. The thrill and excitement of creating some new knowledge by your own efforts will be sufficient to convince you that a university scholars life is well worth while. Such findings may excite your curiosity. Scientific subjects lie on a spectrum from those which are primarily intellectual in nature to those which are of obvious practical application. Thus, research into the nature of genetics and the size of jaws and teeth and the impact that this has had on the development of "80% of the abnormal" dentitions which have much more profound implications than merely orthodontics, since it influences how we should think about dentistry in general. However, such intellectual studies will probably not have a great deal of impact on anything which you may do tomorrow in the dental laboratory, the clinic or the classroom. On the otherhand, research based on a clinical trial of a particular material or technique may change your

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view of the practice of restorative dentistry. The popular press often report details relating to new types of dental restorative materials and procedures and are quick to report on the nonscientific utterances of individuals about the dangers of dental mercury to the general public. Such incidents as these place an obligation on us to interpret studies involving these reports and to be able to scientifically evaluate and comment on them. We need to be able to understand reported results without necessarily being an expert in the field. The questions to ask yourself are, can you identify the theories in question? Can you distinguish the theories from the facts? Do you know the difference between a "theory" and a "fact"? Can you tell which factors are relevant to which theories? Which results of the experiments would support which theory? Is it possible to "prove" any theory? How could you tell when a theory has been "proven"? You should be able to understand and evaluate similar scientific episodes in a variety of sciences all the way form physics to chemistry to biology to the applied science of dentistry.

Is there really a mercury problem in dentistry? This topic has generated heated discussion within the profession as well as in the public media - television, newspapers and magazines. The reason for the excitement was clear. As one newspaper headline put it "Patients are being Poisoned by Dental Fillings". Sound scientific reasoning is required in order to deal with issues such as this and correct any misunderstandings which may influence the public.

Communication to the Public

"The communication of modern science to the ordinary citizen, necessary, important, desirable as it is, cannot be considered an easy task. There is also the difficulty of making scientific discoveries interesting and exciting without completely degrading them intellectually"

John Ziman.

The end of an experiment

"Sunrises, according to the anthropologist, may suggest something of the weather to come. But the sunset, refracted through the dust and droplets kicked up by all that has happened, recounts in compressed form the whole story of the day: The end of an experiment resembles this sunset, recapitulating in a human context the encounter of reason with the world."

Peter Galison

Double Dutch

Last year we had five students from universities in the UK spending the summer months involved in laboratory research as part of their elective programmes. We had four students from the University of Dundee and one from the University of Birmingham. Two of our research presentations made at the IADR meeting in Dublin carried the names of these student visitors in recognition for their involvement with our biomaterials research projects.

This year a further two students will be visiting us at Dalhousie bringing our total of overseas students conducting elective programmes to ten since we commenced this program in 1986. The two students this year will be visiting us from the Academic Centre for Dentistry Amsterdam (ACTA) of the University of Amsterdam, the Netherlands. Constant Durville and Ernst van der Jagt will arrive in September and will spend three months at Dalhousie conducting research in our biomaterials research laboratory. These elective research programmes provide a most interesting experience for our visiting students, in addition to the research experience they also have contact with the North American way of life and have opportunities to meet Canadian students and exchange ideas and compare and contrast our Canadian dental programme with the one back home.

Elected

Terry Mitchell was elected first vice-president and member of the executive of the Canadian Dental Hygienists Association at a recent board meeting in Ottawa. Derek Jones was also confirmed as President-elect of the Dental Materials Group of the International Association for Dental Research at the recent IADR meeting in Dublin.

The Modern Way of Life

"It is not sufficient to understand the discoveries that scientists have made about the world; we must also learn to see scientific research as an integral part of the modern way of life" John Ziman

The Next Decade

"Three megatechnologies will dominate the last decade of the twentieth century: information technology, biotechnology, and new materials". T.Forester.

REALITY

"To have good reason for holding a theory is ipso facto to have a good reason for holding that the entities postulated by the theory exist".

Wilfrid Sellars.

Publish or ?

It is obvious to those who are regular readers of the Dental Research News that the editorial policy clearly supports and encourages presentation of papers at national and international dental scientific meetings. However it is also very important to try to turn these abstract papers into full papers. As John Ziman has said "The most important medium of scientific communication is the primary paper in a learned journal." The writing of a full paper and getting it published in a good quality journal takes a lot of effort and determination. Numerous drafts will inevitable be required. This may be particularly true following review by the journal editor and the comments from his expert-reviewers. Much frustration can be eliminated by making sure that you follow very closely the instructions and form required by the specific journal. You should forward the paper to our Dental Editorial Committee which will help you to further refine your paper prior to submission to the selected journal. As John Ziman further states. "A paper conventionally represents a certain amount of successful research by an individual author. The number of papers one has published is thus a crude measure of one's scientific 'productivity'."

Faculty members often discuss and debate about how many papers should be published by a faculty member in order to provide the evidence to support tenure or promotion aspirations. The general consensus is that we should avoid the numbers game. A simple case report cannot compare with a paper which deals with a five year clinical study for example. John Ziman quotes the surprising statistic that "most 'scientists' have published no more than one scientific paper: only about one percent of the scientific community have published more than about ten papers (which would be the least expected of someone of professional standing): only one scientist in a 1000 publishes as many as a hundred papers in his lifetime: the record for a single individual is said to be about 1000 publications, which works out at one paper a fortnight for forty years." [John Ziman from the Force of Knowledge - Cambridge 1976]. However, it is clearly quality not quantity which counts, as Derek de Solla Price has put it: "Who dares to balance one paper by Einstein against even a hundred papers by John Doe Ph.D." I must close this discourse now since I have to write my regular fortnightly research paper.

Ten Reasons Why a Grant Application May Fail?

Emphasis and research fashions change as do the availability of financial resources. Each of these is beyond the control of the individual. There are many opinions why research applications may fail to receive support. Ten of the possible reasons are listed below.

Applications may contain one or more of the following:

1. poor scientific writing with ambiguities and inaccuracies, such as experiments based on apparent misconceptions of the current status of the field, or misinterpretation of the pertinent literature. A lack of understanding of the published work in the field may be indicated by a poor survey of the literature.

2. insufficient foundation to warrant investigation based upon present knowledge and methodology contained within the proposal. Further, the experimental approach suggested may contain a questionable scientific rationale.

3. a proposal by the principle investigator who has not the necessary background and experimental approach suggested may contain a questionable scientific rationale.

4. an apparent lack of new or original ideas in the proposal.

5. a superficial, rambling, diffuse or unfocused research plan.

6. insufficient experimental detail and an uncritical approach; failure to indicate possible pitfalls in the research and the way that the applicant proposes to deal with such pitfalls.

7. an attempt to conduct an unrealistically large amount of work or too superficial a study within the allotted time period.

8. unsatisfactory budgeting for the proposed investigation.

9. failure to follow precisely the guidelines set forth by the granting agency. Or

10. the application may fail to be funded because it does not receive a sufficiently high rating by the appropriate agency in competition with other applications in order to receive a share of the very limited funds available for distribution.

Evaluation of Research Grant Applications

The guidelines used by the Research Development Committee in the preevaluation of research grant applications are as follows.

a. Presentation of Material - clarity of ideas expressed, the format of the presentation and whether the application conforms to the guidelines outlined by the granting agency are among some of the important features assessed.

b. Scientific Merit of the Application - basically the members of the Committee attempt to define whether the project is scientifically sound. Emphasis is placed on the quality of the experimental design.

c. Knowledge of the Relevant Literature

d. Capabilities of the Applicant - in assessing the applicant's ability to carry out the research proposed, the Committee will look for demonstrated ability of the applicant in the field by examining the nature of his/her research publications.

e. Budget - is the budget realistic in relation to the objectives of the proposal?

f. Time Involved - it is reasonable to expect the objectives outlined in the application to be reached within the proposed time?

g. Facilities Available and Requested the Committee will attempt to assess the quality and quantity of the facilities available for the project and the personnel needed to carry out the research.

h. Confidentiality - the Committee will maintain confidentiality with regard to the applicant's proposal.

i. Ethics - any project involving examination or treatment of humans or animals requires an evaluation by our human Ethics Committee or the university Animal Ethics Committee. The human ethics committee is a subcommittee of the Research Development Committee and independently evaluates the ethics of the proposal. However, general ethical considerations are considered by the Research Committee in any overall assessment of the science of a project.

Life Begins at 40 for NHRDP

Last year, 1988 marked forty years of federal support for public health research through the Department of National Health and Welfare (DNWH), initially under the Public Health Research Grant (PHRG) and, since January 1, 1975, through its successor, the National Health Research and Development Program (NHRDP)

The NHRDP's basic mandate is the support of research related to national health objectives. It is the only federal program specifically constituted to support public health and health services research and plays a complimentary role to the Medical Research Council whose main "raison d'être" is the support of biomedical and clinical research.

The last two years, have witnessed an evolution in the ay the NHRDP addresses the question of priority areas for research related to national health objectives.

The program is currently operating with two sets of priorities. Firstly, those resulting from the specific federal initiatives related to AIDS, Child Sexual Abuse/Family Violence, Drug and Alcohol Abuse and conditions affecting Seniors' Independence, for which dedicated funding for research through the NHRDP has been approved; and secondly, our current broad general priority areas, which have evolved from those in effect in earlier years, and which a re regularly published in our Guides.

In all the specific priority areas, except AIDS, the type of research eligible for support under these special programs is that which is normally eligible for NHRDP funding (i.e. public health and health services research). In the AIDS research are eligible for NHRDP funding including biomedical and clinical studies.

The NHRDP is currently operating in a mix of proactive and reactive modes. We are continuing to hold the regular NHRDP annual open competitions for research and demonstration projects and for career and training awards. Open competitions have always and will always continue to play a major role in NHRDP operations. We, in the NHRDP and our departmental colleagues, are fully aware that we must continue to look to the research community to generate new ideas from which improvements in Canadian health will eventually flow. Specific requests for proposals **(Cont. on page 9.)**

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have however, been issued from time to time, related both to the priority areas for which dedicated funding has been obtained and to other areas, within our more general priorities, where it was felt that an increased research effort would be in the national interest.

Efforts have also been made during the past two years to improve the diffusion and application of NHRDP funded research results. Abstracts of completed projects have been published in selected journals. Workshops have been help to bring together researchers, policy makers and administrators to specifically address questions related to knowledge transfer. Initial reactions to such efforts have been favorable and similar ventures will, undoubtedly, be undertaken in the future. The overall level of funding available to the NHRDP has steadily increased over the years.

Genome Data Base

The U.S. government have a commitment to advance the understanding of human biology and genetic diseases by identifying and mapping the entire DNA sequence on every human chromosome a total of three billion bits of information The National Science Foundation research center announced in April a new computer chip and software that will make the analysis of such a large data base possible.

Acording to Leroy Hood, biology professor and director of an NSF Science and Technology Center a the California Institute of Tech-nology, scientists working at individual computer stations will be able to detect similarities and patterns in the burgeoning human genome data base hundreds of times faster than has previously been possible with access to advanced supercomputers. "The current data base consists of 25 million units of sequence information about the humans and other organisms, and it is now gaining 10 million more each year," Hood said. "As new instruments for sequencing DNA are implemented, the rate of growth of the data base will increase greatly. Clearly, alternative approaches to sequence analysis are needed. "It took one day to compare a 10,000-bit gene to the pre-existing data base on an advanced supercomputer, the Cray 2, and ten days on a VAX. With the new technology it takes only ten minutes."

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Genome Data Base(cont)

If the DNA sequence of the human genome were translated into a volume of books at six letters per word, 1,000 words per page, and 500 pages per volume, the information would fill 1,000 volumes. Mapping this genome, a project headed by the National Institutes of Health with major participation by the Department of Energy, is likely to take more than a decade. Research in medicine and dentistry will never be the same again, after the year 2,000 ?.

Hood's laboratory team at the Center for the Development of an Integrated Protein and Nucleic Acid Biotechnology, largely through the efforts of computer scientist Tim Hunkapiller, adapted a text-searching data chip developed by TRW, Inc., for use in identifying patterns and similarities in DNA sequences.

The TRW chip, the Fast Data Finder, incorporates "pipeline architecture," a design strategy that permits large amounts of data to be handled in an assembly-line approach. Instead of waiting for a single operation to be performed on the entire data set, the chip performs distinct operations simultaneously at different points in the data stream. Performance is limited only by the rate at which data can be pumped through the chip, up to 10 million bits of information per second.

Hood's team has written software for the chip to identify similarities and patterns among sequences of DNA in the data base. The identification of patterns can lead to the recognition of common motifs that govern life processes at a genetic level, permitting insight into how living cells grow, divide, and control basic processes.

Sequence information will have important medical and dental applications, since changes or mutations in sequenced can lead to genetic diseases such as sickle-cell anemia, and also to a predisposition toward specific forms of cancer and other illnesses. Researchers will be able to obtain the DAN analyzing software free from Hood's laboratory. The software developed thus far can be used with the TRW chip and connecting hardware in individual computer work stations capable of using the UNIX operating system, such as Sun Microsystems, Inc. computers.

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Genome DataBase (cont)
The development represents the first major success by Hood's lab in continuing efforts to apply specialized computer chips and parallel-processing computer architecture to the genetic data being collected for humans and other organisms. The sequence data, already proving difficult to analyze in its infancy, is destined to grow several-hundred-fold over the next few decades. This will have a significant impact on medical and dental research.

Each gene consists of long chains made up of four kinds of DNA bases, called nucleotides. In the human genome, the three billion nucleotides are divided among 100,000 genes in 23 chromosomes. Most genes consist of 10,000 to 150,000 nucleo-tides. To date, about 4,500 genes in humans have been identified (not necessarily sequenced), and only about one-third of these have been located on specific chromo-somes.

The National Science Foundation has for many years supported Hood's work to develop biological instrumentation, including the successful invention by Hood's team of advanced instruments for sequencing DNA and proteins.

In December 1988 NSF funded Hood's proposal to pool the talents of experts in molecular biology, protein chemistry and data analysis to find more powerful and efficient mean of sequencing DNA and proteins, and to analyze the information thus collected. NSF made the grant under its new Science and Technology Centers program, an initiative to foster the study of complex research problems that are large scale, of long duration, and that may require special facilities or collaborative relationships. First-year NSF funding for the Center is just over $3 million, with additional contributions from Caltech, and from private industry and foundations.

Hood has developed a cooperative relationship over the years with Applied Biosystems, Inc., of Foster City, Calif., which has successfully commercialized sequencing instruments developed by Hood's team. Applied Biosystems has moved to conclude an exclusive licensing agreement with TRW to commercialize the Fast Data Finder for biotechnology and analytical chemistry in other computer systems.