

The Israel Academy of Sciences and Humanities

**Report of the Committee for the
Assessment of the State of Biomedical Research in Israel**

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Jerusalem,
November 2008

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**Annex A. Report of Visiting Committee for the
Assessment of Basic Biomedical Research in Israel**

**Annex B. Report of Visiting Committee for the
Assessment of the State of Clinical Research in Israel**

**Annex C. Report of the Visiting Committee for the
Assessment of the Interface between Biomedical
Research and Biotechnological Industry in Israel**

Report of Visiting Committee for the Assessment of Basic Biomedical Research in Israel

Summary

The Visiting Committee recognizes the enormous potential of Israeli biomedical science but also the great burdens under which Israeli scientists operate due to the modest level of available funding. Further, it believes that increased investment in the biomedical science will not only enhance the health of Israelis and all mankind and but can make a major contribution to the Israeli economy through its generation of biotech spin-off firms and development of valuable intellectual property that can also help support Israeli academic institutions. We make the following recommendations:

1. Rescinding the recent 25% cut in budgets to Israeli research universities.
2. The development of an *Israel Biomedical Research Fund* with a research budget of ~100M USD per year.
3. Enhancing the infrastructure for biomedical / life sciences research in Israel.
4. Aggressively recruiting the best Israeli post-doctoral fellows, most of whom train abroad, to return to academic and industry positions in Israel with adequate recruitment packages.

It is our opinion that a greater Israeli government investment in biomedical/ life sciences research will bring rich returns both in the discoveries made that will be of benefit to all mankind and in the growth of the economy of the State.

Report

The Committee, consisting of Professor Eva Klein, Karolinska Institute, Stockholm, Professor George Klein, Karolinska Institute, Stockholm, Professor Andrew Marks, Columbia University, New York and Dr. William Paul, National Institutes of Health, Bethesda, met in Jerusalem from March 25 to March 28, 2008. It had the opportunity to hear from key individuals representing the full gamut of scientists and administrators concerned with Israeli life sciences research ranging from university presidents to pre-doctoral students.

The committee was enormously impressed with the dedication to science and the talents of all with whom it spoke, but most particularly with faculty who led individual laboratories and with the students who worked in those laboratories. The pool of talent represented by these individuals represents an enormous strength and a national resource for Israel. The accomplishments of many of the scientists with whom we spoke were at the highest level representing a credit to the State of Israel and providing important advances in biomedical science. Such advances can lead to the improvement of health for all and can provide the knowledge base for the development of new drugs, other therapeutics and vaccines that could markedly strengthen the biotech/ pharma industry in Israel and make a major contribution to the Israeli economy.

However, it was equally clear that Israeli biomedical scientists function under unusually severe burdens that limit productivity by all but the very leading individuals. These burdens, to a very large extent, are due to the great complexity in raising sufficient funds to run laboratories that excel at an international level. Indeed, despite the enormous pool of research talent in Israel, the productivity of the biomedical / life sciences research enterprise, when measured according to the highest international standards, lags behind that of some advanced countries of similar size, such as Switzerland and Sweden. Based on bibliometric data, success rates in grant applications and the opinion of knowledgeable observers, one may conclude that while Israel performs very well in some fields of the life sciences, its performance in others is not impressive.

It is the opinion of the Committee that there would be an enormous advantage to the State of Israel to strengthen biomedical / life sciences research in Israel, both economically and for the health of the Israeli people. In other nations, the support of basic biomedical / life sciences research has been the key to the development of a thriving biotechnology industry and to the development of new drugs, vaccines and biomedical devices. As an example, there has been robust development of biotechnology firms in those areas of the United States in which local universities have taken the lead in modern basic biological sciences under the auspices of generous funding from the U.S. National Institutes of Health. In the Boston metropolitan area, home of Harvard and MIT, the growth of the biotechnology industry is nothing short of remarkable and similar growth is seen in the San Francisco/ Palo Alto area where UCSF and Stanford have powered this growth as well as in Southern California where UCLA, Cal Tech, UCSD, the Scripps Research Institute and the Salk Institute have been powerhouses in modern biological sciences. Unfortunately, the low level of investment in Israel has led to an only modest development in the biotech sector.

To appreciate the difficulties faced by Israeli biomedical / life scientists, an assessment of costs to run laboratories and resources available is instructive. To operate a world class laboratory in Israel requires 150,000 to 250,000 USD per year (and in many cases substantially more than that). Currently, funds available to biomedical / life sciences researchers from Israeli sources are severely limited. The Israel Science Foundation (ISF) provides grants that, in most instances, can be no more than 50,000 USD per year and these grants do not come from a pool of resources dedicated to the biomedical/ life sciences but rather shared among all science so that levels of funding can vary from year to year. Furthermore, an individual scientist may hold only one such grant at any time. Virtually all other Israeli sources make grants of 50,000 USD or less. Thus, scientists are forced to seek support from multiple sources and much or most of their funds are derived from foreign sources, including the EU and the United States. A proportion of Israeli scientists are unable to garner more than a minimum amount of support and operate laboratories at considerably less than an international standard.

Continual grant and report writing occupy scientists to the detriment of research. Even the most successful scientists are in a continuous process of fund-raising in order to be certain that their laboratories are adequately supported. This is particularly burdensome in Israel since research laboratories are staffed largely by students and a limited number of technicians. There are few post-doctoral fellows and few, if any, senior research associates so that only the Principal Investigator provides long-term continuity to the research program.

We strongly recommend a series of important steps. First, the recent cuts in support to Israeli universities has had a major impact on biomedical / life science research in that many costs that the Universities previously bore have been transferred to individual laboratories. University contribution to technical support in laboratories has been severely limited and, with some variation among institutions, support for students has also diminished. Contributions to infrastructure (see below), for which universities are often the only source, has had to be severely curtailed. We strongly recommend that the cuts in grants to the universities be rescinded and a period of planned growth be considered. We do point out that university support of faculty salaries is a key strength of the Israeli system and strongly recommend its continuation.

Second, and most important, we propose the development of a dedicated fund to support biomedical / life sciences research in Israel. The proposed *Israel Biomedical Research Fund* would make grants of sufficient size to operate a laboratory on an internationally competitive scale. Grants in the range of 125,000 to 150,000 USD should be made, and in some instances, larger grants should be permitted. Such dedicated medical research funds are found in most western countries, such as the National Institutes of Health (NIH) in the United States, the Medical Research Council (MRC) in the United Kingdom, Institut National de la Santé et de la Recherche Médicale (INSERM) in France and the Canadian Institutes of Health Research (CIHR). At the outset, the Israel Biomedical Research Fund could be administered by the existing ISF system, which is widely regarded as efficient and successful, albeit underfunded. In addition, we recommend shifting to a system of two rather than one funding cycles per year so that

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scientists whose grants are not funded on an initial attempt can submit revised proposals without losing a full year of valuable research time.

Ideally, the Israel Biomedical Research Fund should have an annual budget of ~100M USD for research project grants, which would allow a total of 600 to 800 total grants¹. The bulk of these resources should be allocated to research project grants that should be funded based on merit but a portion of the funds could be allocated to specific areas that require particular emphasis or in which, with additional investment, Israel could become a dominant force. For this portion of the funds, requests for applications (RFAs) should be announced and peer review of submissions should govern awards, with the proviso that the submissions should deal with the subject of the RFA. Areas that might be considered for such targeted funding would include genetic studies of defined populations to identify disease-related genes and studies of embryonic stem cells to strengthen the already outstanding accomplishments of Israeli scientists.

We believe that the ISF, itself, should continue to support those aspects of life sciences research that may be regarded as outside the purview of biomedical research, much as the U.S. NIH supports research in the biomedical sciences and the U.S. National Science Foundation covers other areas of basic life sciences research. Further, we emphasize the need for adequate support for the physical and chemical sciences in Israel as they are critical to the State in their own right and as they provide tools and approaches for advances in the biomedical sciences.

Third, there is a major problem in infrastructure investment in Israel. Key pieces of equipment are extremely difficult to obtain, particularly for mid-career scientists, so that many investigators have very limited access to research tools essential for their work. This includes instruments that are dedicated to individual laboratories and those that are used by many scientists and are in central facilities. Mechanisms for dealing with new expensive technologies must be thoughtfully considered. In many instances, these will be needed as central facilities in individual research universities and institutes but in other cases, it may be more appropriate to develop

¹ For comparison, the NIH budget is ~28 billion USD. The U.S. economy is ~ 100 times larger than that of Israel so that a budget of 100 million USD for *Israel Biomedical Research Fund* would represent an investment on a GDP basis of ~1/3 that of the U.S.

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centralized, national facilities open to any Israeli researcher. While restoring university budget cuts can partially redress the infrastructure issue, national planning and provision of funds for equipment and centralized facilities will be of importance. Such funding could also be processed through the proposed Israel Biomedical Research Fund.

Israel also needs to develop an aggressive strategy to attract home the very brightest Israeli scientists who go abroad to do their post-doctoral work. Many of these young scientists, while preferring to work in Israel, accept opportunities in the North America or Western Europe because of the superior facilities and the greater access to funding. Bringing these individuals back to positions in Israeli institutions is key to the future of Israeli biomedical science. It is essential that adequate "packages" for recruitment are available. We note that considerable progress has been made in this area and that start-up packages being offered now are often quite substantial.

While clinical research does not fall within the direct mandate of this Assessment Committee, we have heard from many that there is a crisis in clinical research and wish to lend our voice to those favoring the vigorous development of a robust and effective clinical research enterprise. Indeed, without such a step, it may not be possible to achieve the promise implicit in the Israel biomedical research enterprise.

It is the committee's belief that placing Israeli biomedical / life sciences research on a firm financial basis will insure that Israeli scientists will thrive and make research contributions that will propel Israel to the very top ranks of nations in biomedical research rankings. We are convinced that there is an outstanding pool of talented, highly dedicated scientists in Israel. Exploiting this human capital could make Israel a leader in biomedical / life sciences research. Further, investment in the biomedical / life sciences has the potential to make an important contribution to the establishment and growth of numerous biotechnology firms and to the development of drugs that can provide substantial income to Israel. Examples of major therapeutics that were developed through basic research efforts in Israeli institutions are *copaxone* and *interferon- β* , and the development of medical devices including coronary artery stents for treatment of heart disease.

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It is our view that adequate investment in the basic biomedical / life sciences sector in Israeli universities should result in the discovery of numerous drug and vaccine candidates with enormous economic implications. Thus, the establishment and appropriate funding of the *Israel Biomedical Research Foundation* could be of great value to the growth of the Israeli economy.

We believe that the strength of Israeli scientists and students and the remarkable group of research universities Israel has established are resources of the first magnitude. For a nation that depends on the products of innovation and intellect for its economic growth, exploiting this resource is essential. We are impressed with what has been accomplished with the relatively modest sums available and are enthusiastic that a greater investment will bring rich returns both in the discoveries made that will be of benefit to all mankind and in the growth of the economy of the State.

We thank the members of the Israel Biomedical Research Evaluation Committee, the leadership of the Israel Academy of Sciences and Humanities and particularly Professors Ruth Arnon and Alex Keynan for giving us the privilege of assisting in this important evaluation. We particularly wish to thank Dr. David Friedman for his efforts to insure that our meeting ran smoothly, that all needed materials were present, and that logistic matters were handled with utmost efficiency.

Respectfully submitted on April 5, 2007:

Eva Klein
George Klein
Andrew Marks
William E. Paul

Report of Visiting Committee for the Assessment of the State of Clinical Research in Israel

June 26, 2007

SUMMARY

The Visiting Committee for the Assessment of Clinical Research in Israel was impressed with the quality and commitment of the physician scientists and leaders of teaching hospitals and medical schools, with whom we met over an intensive three-day visit. It was clear to us that a national investment in expansion and strengthening of clinical research will produce major dividends for medical care, science and the economy in Israel.

We offer the following recommendations:

1. Funds to support clinical research.
 - 1a. Funding of research performed by physician scientists.
 - 1b. Funds for research infrastructure in hospitals.
 - 1c. Funding of Centers of Excellence in hospitals.
2. Funded career track for physician scientists, fully integrated into the medical faculty.
 - 2a. Salary support providing protected time for physician scientists.
 - 2b. Career track for clinical researchers with mentoring and appropriate university recognition.
3. Expansion of the pipeline of physician scientists.

INTRODUCTION

The Visiting Committee was presented with a briefing document, dated May 14, 2007, which provides an excellent and detailed summary of issues that must be addressed, in order to enable clinical research in Israel to achieve its tremendous potential. Our committee also notes the conclusions of the previous visiting committee that assessed basic biomedical research in Israel in April 2007. They were greatly impressed by the strength of Israeli science despite the difficulties that were identified. Strength in basic biomedical science is crucially important to what has traditionally been termed clinical research. There is, therefore, a sound base for building towards comparable achievements in clinical biomedical research.

The term “clinical research” no longer refers solely to the classical investigation of diseases in the whole patient. There is a continuous spectrum between the laboratory analysis of normal and abnormal genes, molecular mechanisms of disease, disease manifestations in the whole patient, deriving novel treatment and population studies. This has introduced new complexities in the organization and funding of clinical research. In the USA and the UK, there is as much research activity in the teaching hospitals as in the medical schools. They typically join together to create an academic medical center. Much research today is interdisciplinary and depends on the collaboration of laboratory scientists and physician scientists with mutual appreciation of their

fields of study and areas of expertise. The perceived need to transfer advances in understanding disease mechanisms to diagnosis and treatment as rapidly as possible has given rise to the concept of “translational medicine” and the adaptation of research organization to this concept.

The Visiting Committee defined “clinical research” to include both laboratory based research investigating human tissues and cells obtained directly from patients, and research involving clinical trials and epidemiologic studies aimed at improving the prevention, early detection and treatment of human disease. We use the term “physician scientist” to describe hospital-based faculty who initiate and carry out clinical research.

One point about clinical research in Israel deserves clarification. In the briefing document we received, it was stated that the number of publications per capita in clinical research ranks fourth in the world (far ahead of the USA). However, the quality of clinical research as judged by average number of citation’s per paper ranked 22nd (below the world average). While there are many possible explanations, the Visiting Committee felt that a major contribution is the large number of multidisciplinary company-sponsored trials published by clinical faculty based in the teaching hospitals, and the observation that qualification for promotion to the clinical professor rank evidently depends on the absolute number of publications in many of the medical schools. The incentive appears to be for quantity, rather than novel, high impact clinical trials. Based on the presentations to the visiting committee, we suspect that if laboratory-based clinical research and investigator-initiated clinical trials were broken out from the total clinical research publications, these publications would demonstrate far higher impact.

We feel that thriving clinical research programs are important for Israel. They country’s economy is knowledge-driven. Israel’s universities, research institutes and companies have a strong tradition of making discoveries leading to successful commercial applications. Expansion of clinical research can bring many benefits, including: discovery of new drugs and devices to improve care of patients; strengthening the impact of research in the country’s medical schools and their affiliated hospitals and improving the image and world-standing of Israel’s science; improving clinical outcomes by establishing among physicians a culture of evidence-based clinical care; and through expansion of research in spin-off companies, adding to the economy of Israel and creating wealth. Our discussions with representatives of Israel’s biotechnology and pharmaceutical industries lead us to conclude that there would be significant economic benefits from future collaboration between these enterprises and an enlarged, suitably trained corpus of physician scientists.

Israel has an unusual population mix which is especially relevant to studies such as disease susceptibility and drug tolerance. Furthermore, sophisticated bioinformatics systems are in place for the analysis of these issues. The country is in a position to capitalize on these assets.

ASSESSMENT

During the three-day site visit we met with officials from the ministries of health and education, administrators of the six major teaching hospitals, deans of medical schools, senior clinical researchers from a number of the hospitals, and some outstanding young clinical investigators and residents who are beginning their careers. We were impressed with the quality of the

research presented, which was primarily laboratory-based. The achievements they described included many of the major subjects in clinical research, notably oncology, cardiovascular medicine, pediatrics, imaging, and bioinformatics, but they referred to the whole span of contemporary medical research. Their enthusiasm and commitment were extremely encouraging despite the many practical difficulties they candidly described to us. It was evident to the committee that there is a core of talented medical investigators in Israel who are doing work that is competitive on an international scale. This outstanding group of physician scientists would be prime candidates for secure positions in the USA or UK.

In every case these physician scientists we met with are frustrated by the barriers which clinical researchers face in Israel, yet are committed to making the best of the resources and opportunities available to them. In every case they have availed themselves of extensive education and practical training in Israel and often in the USA. And they have been resourceful in finding champions within hospital administration who are willing to award them space and some infrastructure support, in capturing grants from agencies in Israel and abroad, and in patching together philanthropic funds (usually in modest amounts) from grateful patients or their hospital. Even highly successful physician scientists live every day with anxiety about future funding for their research.

In summary, the problems are: there are too few physician scientists, they must expend tremendous effort to support their salaries and research programs, they lack an appropriate career track and academic status within the medical schools, and they are forced to work excessive hours in the hospital and sacrifice time with their families because protected time for their research away from clinical duties is not forthcoming, and finally, the low salaries of all hospital-based physicians salaried by the Ministry of Health require them to obtain additional income through part-time positions providing care to private patients at HMOs.

The committee found that, in addition to these problems, an inadequate understanding of what clinical research really is and what it really aims to do permeates much of the system, from top to bottom. We perceive that at a number of levels there is a need to acknowledge that the goal of medical research – research in the laboratory or at the bedside, or both, conducted by PhDs or physicians – aims to improve the quality of patient care. It is entirely legitimate, indeed a necessity, to support physicians financially not only for the delivery of health care but also for the conduct of fundamental and applied medical research. Leaders of the medical and educational ministries in the government and leaders of medical schools and hospitals should act on the recognition that, today, a very large area of biomedical research is the logical concern of physicians who are based in hospitals, where they study humans to gain new knowledge and to design new therapeutic interventions. Collaborations between researchers in medical schools and hospitals must be as seamless as possible.

RECOMMENDATIONS

1. FUNDS TO SUPPORT CLINICAL RESEARCH

1a. Funding of research performed by physician scientists

We encourage the Ministry of Education to provide funds for clinical research (as defined above) in a manner comparable to the current support of basic research. The information provided to us indicates that the Israel Science Foundation is committed primarily to supporting basic laboratory research and this effort needs to be expanded (see Report from Visiting Committee on Basic Biomedical Research). The Visiting Committee proposes creation of a parallel Israel Biomedical Research Foundation charged with funding laboratory research and investigator-initiated clinical trials carried out by physician scientists and PhDs whose appointments are in hospitals. This foundation could also support grants in basic biomedical research, as proposed by the Visiting Committee on Basic Biomedical Research, provided that there is clear allocation of separate funds for basic and clinical research, and grant proposals are reviewed by separate peer review committees.

Funding from the Israel Biomedical Research Foundation should be adequate to support a meritorious research project for at least 3 years, based on the budget justification presented by the applicant. This typically will require \$50,000 or more per year. Physician scientists should be able to write fewer grants, in contrast to the current situation, in which many small grants must be patched together to create a research program. Funding should include technical support, necessary equipment at start-up, supplies, and support for special needs such as payments for the use of shared resources (e.g., flow cytometry, array analysis, experimental animals).

The Israel Biomedical Research Foundation should be free to indicate areas of research which they consider to be of special national importance, e.g., improved drug trials at all stages to speed up technology transfer, or epidemiological studies for planning national preventative health measures.

1b. Funds for research infrastructure in hospitals

Sophisticated laboratory-based clinical research requires shared core resources, which apparently are currently funded by the Ministry of Education primarily in medical schools and research universities. Grants to provide resources such as flow cytometry, confocal microscopy, animal imaging facilities, statistical analyses, bioinformatics, computing facilities, and new expensive technologies should be awarded to hospitals from Israel Biomedical Research Foundation funds based on competitive peer review. There could be minimum standards for applicants, for example, the presence at the hospital of at least four independent researchers funded by the Israel Biomedical Research Foundation. The Visiting Committee was presented with data showing that Israel has six hospitals which have on their staffs a number of physician scientists who are carrying out clinical research. Each of these hospitals is associated with a medical school, and each contains 900 or more beds. The hospitals are owned by the government, private non-for-

profit agencies, or health maintenance organizations. These six might be the hospitals initially eligible to compete for research infrastructure funds.

1c. Funding of Centers of Excellence in hospitals

Hospitals might also collect together a group of investigators to create a collaborative and interdisciplinary clinical research program within a special area of expertise, which could justify support from the Israel Biomedical Research Foundation. Typically the individual investigators in the collaboration would already be funded by their own research grants, and the Center of Excellence grant would support an innovative and interdisciplinary research project which they share. The existence of such centers would enable any Israeli hospital, not just the six most active teaching hospitals, to select a targeted area of research and compete for funding. We envision that these centers will bring together researchers in fields of established strength in Israel, such as, neuro-oncology, population genetics, informatics, and other disciplines. The centers will reinforce Israel's competitive position in biomedical research and attract industrial support.

2. FUNDED CAREER TRACK FOR PHYSICIAN SCIENTISTS, FULLY INTEGRATED INTO THE MEDICAL FACULTY

2a. Salary support providing protected time for physician scientists

As noted, the Visiting Committee learned that all physicians paid by the Ministry of Health need additional income to support their families. This is typically achieved by moonlighting at an HMO or in a private practice, which typically is not permitted to occur in the hospital in which they work. Clinical researchers must find time for their investigative activities after completing their patient care duties in the hospital and moonlighting. The situation is frustrating, and not conducive to attracting bright physicians into research careers at hospitals in Israel. We were greatly impressed by the determination of physician scientists at all stages in their career to make research their prime preoccupation outside normal working hours. However, for many physicians this state of affairs is untenable in the long term, especially when they compare their situation with that enjoyed by their colleagues of similar standing in other countries. Hence, our concern for a proper salary and career structure.

The most crying need, voiced repeatedly, is for protected time, in the form of salary support for physician scientists for research time, not tied to delivery of clinical care. Without these additional salary support funds from the Ministry of Health, hospital directors are often unable to allow clinical researchers time-off from full-time clinical obligations. The amount of salary support for research could cover 30-70% of a physician scientist's time, depending on the protected time he or she needs and can justify. This initiative would require recognition in the Ministries of Health and Education that optimal delivery of health care is enhanced by the presence of clinical research in the hospital and clinic environment, which the Visiting Committee believes to be the case. We propose a system of investigator-initiated competitive, peer-reviewed national five-year renewable physician scientist salary awards from the Ministry of Education, administered by the Israel Biomedical Research Foundation. Applications would require the endorsement of the director of the hospital where the applicant works and the dean of

the affiliated medical school, with a guarantee of matching support in the form of research space, research infrastructure and, possibly, a portion of the protected time salary support. We recommend that 30 such awards be funded during the first two years of the program. The candidates must have at least one peer-reviewed, substantial research grant. We also recommend a junior faculty track for physician scientists supported by national three-year salary awards, with the same hospital (or medical school) commitments. The total salary paid by the two ministries to hospital-based physician scientists would be commensurate with the salary paid to full-time clinicians of comparable status.

These awards will require review by selection committees composed of experts approved by the Ministry of Education, which should include both established physician scientists and basic scientists. The five-year award should require solicitation of external reviews.

The Visiting Committee was very sympathetic to the needs of all clinicians to supplement the total salary support provided by the Minister of Health. If moonlighting to provide care for paying or privately insured patients were permitted at all hospitals in which physician scientists work, it would save them precious time for research activities. Other mechanisms to supplement income such as performance of specialized laboratory tests on a fee-for-service basis were discussed by presenters and should be encouraged.

2b. Career Track for Clinical Researchers with Mentoring and Appropriate University Recognition

The Visiting Committee learned that in many cases, faculty working in hospitals did not receive the same benefits (e.g., sabbatical, travel allowance) as faculty with comparable academic rank working in the medical school. Teaching clinical medicine to students and carrying out clinical research are critical to the missions of the medical schools. If the proposed salary awards are given to selected physician scientists who have grant support and spend a substantial portion of their time in research, it would be fair to give them the “full rights” and benefits of their professional title, with full integration into the medical school faculty.

Since physician scientists are relatively few in numbers at the present time, efforts should be made by hospital directors and medical school deans to ensure that they receive mentoring and coaching from more senior researchers who also can serve as role models.

Clinical investigators who personally initiate trials of novel agents, which typically involves laboratory correlates and pharmacologic studies, can collaborate with laboratory investigators and lead important clinical research in the absence of a major personal laboratory program. In contrast to faculty who participate in multi-institutional trials designed by pharmaceutical companies, clinical investigators who initiate trials of new therapies, new diagnostic tests, or new devices are physician scientists, and they deserve protected time and career support comparable to physician scientists who carry out laboratory-based research. They should be eligible for salary support awards that create protected time and for research grants – subject to peer review by the same Israel Biomedical Research Foundation-sponsored committees that review laboratory-based physician scientists working in hospitals. This is a career path that seems to be the most neglected. A few well trained clinical trials specialists at each of the large hospitals could have a major impact on the quality of clinical research in Israel.

3. EXPANSION OF THE PIPELINE OF PHYSICIAN SCIENTISTS

In parallel with developing career pathways and funding mechanisms supporting salary and investigation for hospital-based physician scientists, we recommend that steps be taken to introduce medical students and residents to the availability and excitement of these career opportunities. Beginning early during medical school, students should be exposed to and receive instruction in the principles of medical research, and this should continue throughout the training of physicians. Physician scientists experienced in laboratory research and clinical trials should be invited to provide teaching and mentoring in the early years of medical school to students who express an interest in research. All medical students should receive enough experience in the laboratory in their curriculum to be well acquainted with laboratory practices as an integral component of medical care and research. The medical school thesis and the six-month period of research required during residency should be substantive research experiences, involving projects that are carefully supervised, and written or oral reports of results should be presented to faculty with relevant interests. A broad range of research opportunities should be offered, including computing, biomedical engineering, population sciences, etc., in addition to traditional laboratory research and clinical trials research.

Individual whose interests in academic research careers are stimulated should receive mentoring and encouragement to pursue fellowships following their residency training – in Israel or abroad. And when these highly trained individuals, many of whom complete fellowships in the USA or Europe, are ready to initiate academic careers, the best among them should be welcomed into Israeli hospitals and medical schools with start-up grants and partial salary support from the Israel Biomedical Research Foundation in a nurturing environment with one-on-one mentoring by senior faculty. The country cannot afford to lose these well trained physician scientists, who are welcomed into the USA and the UK.

CONCLUSION

The Visiting Committee cannot overstate the importance placed on long term support for salaries and research projects by the excellent physician scientists, hospital directors and medical school deans we met. Israel is at a critical juncture, when it can leverage the contributions of its intellectual manpower in the area of clinical medicine. We encourage the leaders of the governmental ministries and advisory groups involved in education and patient care to take action.

After meeting a number of Israel's bright, dedicated clinical researchers and learning about the innovative, exciting research programs they have succeeded in establishing in their hospitals, we are convinced that Israel has a largely untapped opportunity to make major contributions to clinical research in the future, to the betterment of medical knowledge, patient care and the growing biomedical component of Israel's knowledge-based economy.

We are very grateful for the immense effort made by the Academy and our hosts to ensure that we were able to talk with colleagues at all stages in their career. We were thereby given a frank and constructive insight into the challenges facing Israeli physician scientists. We appreciate

that their participation in our deliberations added greatly to the already heavy responsibilities with which they have to deal routinely. We are also very grateful that we were made so comfortable throughout the period of our visit.

Respectfully submitted,

A. Michael Denman, M.D.

John Mendelsohn, M.D.

Robert Schwartz, M.D.

**Report of the Visiting Committee for the Assessment of
the Interface between Biomedical Research and
Biotechnological Industry in Israel**

**Harvey V. Fineberg, Robert M. Califf,
and Michael Rosenblatt**

9-11 January 2008

Final Report

29 January 2008

Introduction

The interface between biomedical research and the biotechnology industry is complex. Any country desiring a vibrant life sciences enterprise, cutting-edge clinical medicine, and a prosperous biotechnology industry must actively attend to this interface. Thanks to an intense and informative set of presentations, the committee learned a great deal about this rapidly evolving and complex area of biomedical science in Israel. At the same time, our brief visit did not allow us to pursue in depth many of the critical issues that were raised during the visit, and we are mindful of our own limited understanding of many relevant circumstances and institutions in Israel.

The Visiting Committee was asked to consider the interface known as “translational science.” We take this charge to encompass the structures and functions that connect discovery research at the bench with applied research intended to develop effective technologies for society. Implicit in its name is the concept that translational science moves ideas along a continuum from an initial concept or discovery towards a technology that will have a direct societal benefit.

The Visiting Committee commends the Israel Academy and the country of Israel for making this issue a national priority as evidenced by the statement of Chief Scientist of the Ministry of Industry and Technology, Eli Opper, that biotechnology is one of the 3 top priorities of his organization. In this report we outline the key issues we identified and propose a set of activities that we believe could enhance the excellent systems and strategies already in place in Israel.

Assessment

1. Israel has assembled a mosaic of structures that together often serve to stimulate effective translational science:
 - A. The country has a deserved reputation for innovative and successful discovery science focused in its universities and major research institutes. We found that this mission now is jeopardized by funding cutbacks. The Visiting Committee knows of no country that has succeeded in the biomedical sphere while cutting back on the scientific enterprise that forms its foundation.
 - B. Each of the major research universities and research institutes has an experienced technology program. We found the “Technical Transfer Companies (TTC’s)” to be knowledgeable, aggressive about protecting discoveries of their faculty and active in attempting to commercialize discoveries and interfacing with both faculty and the external funding environment. Some highly creative approaches have been developed by the TTC’s: for example, the HBL (Hadasit Bioholdings Ltd.) as a means of raising capital from the public.
 - C. There is a very strong history of an incubator strategy for “high tech” industries which is evolving in biotechnology. The philosophy of

- providing both funding and a nurturing environment to develop a scientific concept into a potentially viable business remains a forward-thinking strategy quite relevant for many biotechnology and pharmaceutical projects.
- D. A series of government programs have been created to produce additional interfaces between industry and academia (Consortia, Magnetron, NoFar) and between Israel and other nations, including the US, Singapore, and Germany.
2. The Visiting Committee finds these activities would be enhanced and made more coherent by a realistic national strategy that focused on results. Biotechnology can no longer be regarded mainly as an emerging sector with amorphous possibilities. Success in achieving results will depend on the execution of a carefully crafted strategy.
- A. The strategy must include actions with measurable goals, time frames and performance indicators. Delineating these actions will create the necessary sense of urgency and orientation to results that will be required to compete on an international scale.
- B. A foundation for a successful national strategy is a reinvestment in infrastructure and human capacity. In this respect, the Visiting Committee aligns its position with the recommendation of the Visiting Committee on basic research, recognizing that money alone will not solve the problem.
- C. Because this effort is inherently multidisciplinary and multisectoral, at the least government, industry, academia and health professionals must all be at the table in crafting this strategy.
3. The Visiting Committee identifies significant concerns about the core values, mission and attitudes of both the universities and hospitals. Traditional, and in the Committee's view, overly restrictive concepts of mission and purpose, may impede the implementation of a biotechnology strategy unless effective approaches are developed to overcome these embedded ideas.
- A. Some faculty and leaders in Universities are reluctant to extend beyond the traditional dual mission of education and research. Today, the Committee believes, universities need also to play a larger role as engines for progress in society, including the creation of economic value. This requires extending of mission to applied research that can lead to useful technologies. In today's society, a commitment to applied research actually enhances the core research and educational missions.* Other countries are making investments in their

* As an example, this view was articulated by Richard Brodhead when he became President of Duke University (inaugural address, September 18, 2004): "The other thing I'm struck by virtually every day is that the balance between theory and practice has been struck in a somewhat different way at Duke. In the modern state of things, no school can be expected to produce much new understanding that does not give free rein to highly

universities as a competitive strategy for the creation of knowledge-based economies and in order to strengthen the confidence and trust from the public in continuing support.

- B. The Committee is under the impression that medical care institutions have been so focused on clinical services that the opportunity for physicians and other health professionals to engage significantly in clinical innovation and research has been severely limited. Hospitals, health systems, and practitioners need to play a critical role in biomedical research and development in addition to their responsibilities for clinical service. In alignment with the Visiting Committee on Clinical Research, we agree that there is a need to fund and nurture both physician-scientists and clinical investigators.
4. The Committee found widespread agreement that the lack of incentives and the ambiguity about the ownership of intellectual property (IP) for inventors based in government hospitals needs to be rectified. This situation deters innovation and commitment to product development in these hospitals, which play a major role in other societies in biomedical research. This results in a major loss of competitive talent. The Committee believes that an enlightened government policy would clearly lodge IP ownership in these institutions and would encourage financial incentives to the successful inventors.
5. There appears to be a severe shortage of national capacity to enhance biomedical translation in terms of human talent (physician-scientists, clinical investigators, and evaluative scientists), local resources and large-scale technologies. Some of these elements should be present in all university/medical center environments when a contribution to translational research is a key mission. Other elements are either very expensive (*e.g.* large-scale genomic technologies) or not needed in large quantity (*e.g.* animal toxicology) so that they should not be replicated at each institution, although they need to be available to translational investigators in a consortium arrangement. For such large-scale, shared resources, an evaluation should be done to inform decisions about what should be done in Israel and what can be accomplished more efficiently and effectively through external alliances.
- A. A series of functional capacities is required for pharmaceutical, biological and device development including facilities and procedures for “Good Laboratory Practices” (GLP) and “Good Manufacturing Practices” (GMP), chemical synthesis capacity, toxicology, measurement of Pharmacokinetics and Pharmacodynamics (PK/PD),

specialized research. But at this school, such study does not enclose itself within the intramural exchange among specialists that characterizes much modern academic life. At Duke it forms the research end of an arc that extends from inquiry through discovery to translation into practice, a continuum that links the most abstruse research with practical improvements to actual lives.”

- and modeling and cell culture assays. These functions are typically not rewarded in academia and may be provided by contract research organizations.
- B. Increasingly, preclinical and early clinical work will include integration of genomic and functional imaging data into a “systems biology” approach to human pharmacology. The large technologies needed to be competitive in this arena are very expensive and need not be replicated in each research center.
 - C. Facilities for early phase human studies require special environments and staff with extensive professional training and expertise in clinical pharmacology.
 - D. A talented pool of physician investigators is needed to provide insight into the applications of discoveries based on clinical evaluation and predictive assessments in early phase human studies. In an increasing number of cases, these early human studies reveal problems that require more extensive preclinical work. This type of research cannot be done in spare time; instead, it requires high level clinical skills coupled with scientific expertise in a supportive environment with appropriate resources.
 - E. A pool of clinical investigators is also needed. These experts have skills in research design, biostatistics and epidemiology, ethics of human studies, health services research, health economics and health policy. Their dual mission includes the design, analysis and presentation of clinical research studies intended to develop new technologies and the evaluation of technologies to determine their value in practice. Without insight from this group from the beginning, drug and device development is at significant risk of failure if clinical benefits cannot be documented through unassailable clinical trials and outcomes studies.

One of the reasons that biotechnology is so expensive is that the development of successful therapies involves coordination of all of these elements. Often the one weak link in the chain of activity leads to a setback that can destroy a potentially useful technology or cause a prolonged delay in the development process.

6. There is a perceived shortage of funding for the translation that extends from the stage of discovery and target validation to the point at which “proof of principle” studies have been completed. These phases require investments in the millions of dollars as opposed to the hundreds of thousands. Depending on the situation, “proof of principle” studies are typically needed either in animal models or early phase human studies in order to attract adequate capital to advance toward realization of a product.
7. Development of a sufficient, risk-tolerant, and patient source of capital would give Israeli scientists and institutions a competitive advantage in the international arena.

While we do not have adequate information to specify the exact amount, this fund would need to be at level of at least several hundred million dollars.

- A. One model to achieve such a fund would involve a tripartite contribution from philanthropy, government and academic institutions. We understand that a similarly constituted fund has been established to advance nanotechnology in Israel.

- B. An alternative that the Visiting Committee believes warrants investigation would involve the creation of an Israel Biomedicine Development Fund (IBDF). The IBDF would accept funding from (and sell shares to) participating Israeli institutions and the Israeli government as well as from the public anywhere in the world. We believe that for many potential contributor-purchasers in Diaspora locations, the IBDF could appeal on 3 levels: 1) opportunity to contribute to Israel's progress and stability; 2) the opportunity to promote better health and human welfare; and 3) the possibility, over time, of a financial return on their investment. For such a fund to be successful it would need to bring managerial expertise, developmental mentoring and institutional development to inventors and institutions that would promote the translational effort from discovery to product on the market. This approach would include the fundamentals of the impressive incubator strategy, but would bring much more money into play focused specifically on the needs and particular requirements for success in the biomedical sector, it would be more integrated across the translational continuum, it would take calculated risks, and it would have the possibility for sustained support.

Recommendations

1. The government priority on biotechnology should be elaborated with specific goals, time frames and performance measures to stimulate the necessary urgency and orientation toward results.
2. The government investment in basic biomedical research needs to be augmented in line with the recommendations of the basic research committee to provide the foundation for the translational research enterprise.
3. University leadership and faculty should embrace an enlarged mission of the university to include a direct contribution to progress in society, *i.e.*, by valuing the translation of knowledge into technologies that are useful to society. This will require the expansion of the criteria for academic advancement and recognition that provides evidence of the value of this activity.
4. Hospitals, health systems and practitioners should expand the expectations of a subset of clinicians to include support and time devoted to advancing knowledge in addition to delivering health care. Facilities and technologies should be developed to support the needs of clinical research.

5. The government should revise its approach to intellectual property to lodge ownership of inventions in government hospitals and provide incentives to inventors who are employed by government hospitals. The Bayh-Dole legislation in the US is one potential model.
6. A national investment is needed in a translational research infrastructure to support the transition between discovery and the completion of early clinical trials. This infrastructure would include process chemistry, formulation sciences, informatics, animal facilities, genomic technologies (genotyping, gene expression analysis, proteomics, metabolomics) and animal model expertise, among other capacities. We believe that the most efficient and sensible approach would be to centralize much of this effort rather than to create redundant infrastructure at multiple institutions. Components of this effort also may be outsourced beyond Israel.
7. We believe that a consortium should be developed at the major universities and hospitals to support clinical and translational research. This should be carefully planned in a progressive manner, perhaps in collaboration with international colleagues. While many countries (UK, Canada, Germany, Singapore) are developing models, the Clinical and Translational Science Award (CTSA) Program at the NIH may be the most comprehensive (see the most recent RFA at <http://grants.nih.gov/grants/guide/rfa-files/RFA-RM-08-002.html>).
8. Establish a national biomedicine investment fund on the order of \$200-500 million after assessing alternative mechanisms to put the fund into place.

If Israel supports and nurtures its scientific talent and adopts a strategic approach to translational research, we believe Israel has every potential to become a global leader in biotechnology.

Annex E. List of members of the Committee and short biographical sketches

Members of the Steering Committee for Biomedical Research

(In alphabetical order)

- 1. Prof. Ruth Arnon, Chairman**
- 2. Prof. Alex Keynan, Deputy Chair**
- 3. Dr. Dudu Friedman, Co-Ordinator**
- 4. Prof. Oded Abramsky**
- 5. Prof. Gabi Barbash**
- 6. Dr. Ora Dar,**
- 7. Prof. Avraham Hershko**
- 8. Prof. Yossi Klafter**
- 9. Prof. Yossi Mekori**
- 10. Dr. Irit Pinchasi**
- 11. Prof. Rami Rachamimoff**
- 12. Prof. Bracha Rager**
- 13. Prof. Michael Sela**
- 14. Prof. Uri Seligsohn**
- 15. Prof. Giora Simchen**
- 16. Prof. Karl Skorecki**
- 17. Prof. Mona Soreq**

ODED ABRAMSKY, MD, PhD, FRCP

January 2008

CURRICULUM VITAE

Born: November 2, 1940

- 1969 - Graduated from the Hebrew University Hadassah Medical School; M.D. degree.
- 1969-2008 - Resident and Staff Neurologist, Department of Neurology, Hadassah University Hospital, Jerusalem.
- 1974 - Board Certified in Neurology
- 1973-1974 - Postgraduate in Immunology and Neuroimmunology at the Department of Chemical Immunology, The Weizmann Institute Of Science, Rehovot.
- 1974-1976 - Studied Neurobiology (Immunology) at the Hebrew University Hadassah Medical School; Ph.D. degree.
- 1976-1978 - Advanced Postgraduate in Neuroimmunology, Department of Neurology, University of Pennsylvania School of Medicine, Philadelphia.
- 1978-1988 - Head, Neuroimmunology Unit, Hadassah University Hospital.
- 1981-1987 - Chairman, Division of Neurology and Neurosurgery, Hebrew University Hadassah Medical School, Jerusalem.
- 1982 - Professor of Neurology, The Hebrew University, Jerusalem.
- 1988-1992 - The Chief Scientist, Israel Ministry of Health
- Chairman, National Medical Research Organization.
- 1988- 2005- Head, Department of Neurology, Hadassah University Hospital, Jerusalem.
- 1988-1992 - Member, Board of Governors, United States-Israel Binational Science Foundation (BSF) (Chairman – 1989-1990)
- 1989-1997 - Member, European Committee for Treatment and Research in Multiple Sclerosis (ECTRIMS) (President – 1994-1995).
- 1991 - Israel S. Wechsler Chair in Neurology, The Hebrew University, Jerusalem.
- 1992-1996 - Dean, Faculty of Medicine, The Hebrew University, Jerusalem.
- 2000- - Director, The Agnes Ginges Center for Human Neurogenetics, Hadassah Medical Organization
- 2000- - Honorary President, Israel Society of Neuroimmunology.
- 2000 - "Lions" Israel Award of Distinction in Medicine.
- 2004 - Foreign Associate Member, Institute of Medicine of the National Academy of Sciences, USA.
- 2006 - Fellow (Hon.), Royal College of Physicians (FRCP), U.K.
- 2006-2007 - Chairman, the Advisory Committee of the Ministry of Health for Medical Technologies and Drugs Registration in the State of Israel.
- 2007- - Chairman, Israel National Council for Research and Development
In Israel.
- 2007- Establishment of The Oded Abramsky Chair in Neuroimmunology
By Biogen-USA, in Hadassah Hebrew University Medical Center.
- Military Service:
Regular
1959-1961 - Paratroops – the Israel Defense Forces (I.D.F.)
Reserve
1980-1984 – Lieut. Colonel: Divisional Staff Medical Commander, Armored Division.
1985-1989 - colonel: Assistant Commander of Research and Development. I.D.F. and Ministry of Defense, Director of "Man in Combat" Project.

PROF. RUTH ARNON, Formerly Vice-President of the Weizmann Institute of

Science (1988-1997), Prof. Arnon is a noted immunologist. Prof. Arnon joined the Institute in 1960. Prior to her appointment as Vice-President, she served as Head of the Department of Chemical Immunology, and as Dean of the Faculty of Biology. From 1985 to 1994, she was Director of the Institute's MacArthur Center for Molecular Biology of Tropical Diseases. Prof. Arnon has made significant contributions to the fields of vaccine development, cancer research and to the study of parasitic diseases. Along with Prof. Michael Sela, she developed Copaxone® a drug for the treatment of multiple sclerosis which was approved by the U.S. Food and Drug Administration, and is presently marketed in the USA, Canada and many other countries worldwide.

Prof. Arnon is a member of the Israel Academy of Sciences, and presently chairs its Science Division. On the world scene, she is an elected member of the European Molecular Biology Organization (EMBO). She has served as President of the European Federation of Immunological Societies (EFIS), and

as Secretary-General of the International Union of Immunological Societies (IUIS). Her awards include the Robert Koch Prize in Medical Sciences, Spain's Jiminez Diaz Memorial Prize, France's Legion of Honor, the Hadassah

World Organization's Women of Distinction Award, the Wolf Prize for Medicine; the Rothschild Prize for Biology and the Israel Prize and the recipient of an Honorary Doctorate from Ben-Gurion University. The AESKU Prize for Life Contribution to Autoimmunity by the 6th International Congress on Autoimmunity, Yakir Tel-Hai, Tel-Hai College, Israel.

Prof. Arnon is also the Advisor for Science to the President of Israel.

Prof. Arnon is the incumbent of the Paul Ehrlich Chair in Immunochemistry.

Gabriel I. Barbash, MD, MPH - an abbreviated curriculum vitae

Dr. Gabriel Barbash is a graduate of the Hadassah Medical School of the Hebrew University, Jerusalem, and is board certified in Internal Medicine, Medical Management, and Occupational Medicine. In 1985 he received a master's degree in Public Health (MPH) specializing in Health Policy and Management from the School of Public Health of Harvard University.

Dr. Barbash has extensive experience in administration as a flight surgeon in the Israel Air Force, where he also served as Deputy Surgeon General and Physician of the Combined Air-ground Operations Command.

Since 1993 he has served as Director General of the Tel-Aviv Sourasky Medical Center, a major teaching hospital affiliated to the Tel Aviv University. From 1996 - 1999 he served as the Director General (Surgeon General) of the Ministry of Health, and From 1998 to 2000 has been the Chairman of the Israeli Transplant Center.

From 1989 through 2000 he was the National Coordinator and principal investigator in Israel of the **GISSI-II**, **GUSTO-I**, **TIMI-9**, **ASSENT II**, and **GUSTO-4** Multi center Multi national Studies.

In 2001 appointed Professor of Epidemiology and Preventive Medicine in the Sackler School of Medicine, Tel Aviv University.

Dr. Barbash has published more than 80 original papers mainly in the fields of diagnosis, risk

assessment and treatment of acute myocardial infarction

Dr. Ora Dar

Dr. Ora Dar is the Head of the Life Sciences Sector at the Office of the Chief Scientist at the Ministry of Industry & Trade, Israel, and is the Consultant for Biotechnology to the Chief Scientist. She is responsible for defining and implementing the support of R&D in Life Sciences companies and for enhancing the networking between Academia & Industry in this field.

Dr. Ora Dar has the experience of 16 years in academic research (mostly at the Weizmann Institute of science), several years in the Industry and 10 years as a consultant to VC and investment firms, and to foreign funds and international R&D programs. She is a graduate of the Hebrew University of Jerusalem in Medical Sciences and holds a Ph.D. degree from the University of London, UK (St. Mary's Hospital Medical School, Imperial College of Science, Technology and Medicine).

Avram Hershko was born in 1937 in Hungary and emigrated with his family to Israel in 1950. He gained his MD (1965) and PhD (1969) from the Hebrew University- Hadassah Medical School of Jerusalem. After a post-doctoral fellowship at the University of California of San Francisco (1969-72), he joined the faculty of the Haifa Technion becoming professor in 1980. He is now Distinguished Professor in the Unit of Biochemistry in the B. Rappaport Faculty of Medicine of the Technion. His main research interests concern the mechanisms by which cellular proteins are degraded, a formerly neglected field of study. Hershko and his colleagues showed that cellular proteins are degraded by a highly selective system. This system tags proteins for destruction by linkage a protein called ubiquitin, which had previously been identified in many tissues, as the name suggests, but whose function was previously unknown. Subsequent work in Hershko's and many other laboratories has shown that the ubiquitin system has a vital role in controlling a wide range of cellular processes, such as the regulation of cell division, signal transduction and DNA repair. Abnormalities in the ubiquitin system result in diseases such as certain types of cancer. The full range of functions of the ubiquitin system in health and disease has still to be elucidated. Hershko was awarded the Nobel Prize in Chemistry (2004) jointly with his former PhD student Aaron Ciechanover and his colleague Irwin Rose. His many other honors include the Israel Prize for Biochemistry (1994), the Gairdner Award (1999), The Alfred P. Sloan Prize of the General Motors Cancer Research Foundation (2000), the Lasker Prize for Basic Medical Research (2000), the Wolf Prize for Medicine (2001) and the Louisa Gross Horwitz Award (2001). Hershko is a member of the Israel Academy of Sciences (2000) and a Foreign Associate of the US Academy of Sciences (2003).

Summary Curriculum Vitae: Prof. Alex Keynan

Alex Keynan was born in Kiev, Russia in 1921 and immigrated with his parents to Palestine in 1932. He grew up in Tel Aviv, received his PhD. from the Hebrew University in 1950. Dr. Keynan is a Professor of Microbiology (Emeritus) at the Hebrew University of Jerusalem. Most of his research interests are; the process of germination of bacterial spores, spore forming bacteria as insecticides, and growth rate control in bacteria.

While teaching and doing research as a faculty member at the Hebrew University, he also taught in the Departments of Biology and Biochemistry at Harvard University, The Massachusetts Institute of Technology, Brandeis University, the University of Illinois, the University of Wisconsin, Oxford University in England, The Rockefeller University, and Memorial Sloan Kettering Cancer Research

Center in New York.

Positions and Achievements:

Alex Keynan served as Scientific Director of the Israeli Institute of Biological Research from 1952 to 1962.

He was Chairman of the Israel National Council for Research and Development in the Prime Minister's Office from 1963 to 1968.

He served as Advisor for International Scientific Relations to the Minister of Foreign Affairs of the Government of Israel from 1965 to 1974.

From 1967 to 1990, he served as Vice President for Research of the Hebrew University, and Chairman of the University's Research Authority from 1968 to 1972 and 1968 to 1988.

From 1979 to 1984, he was Chairman of the Committee for Scientific Cooperation between Israel and Egypt.

He has spent summers from 1961 to 2007 at the Marine Biological Laboratory in Woods Hole, Massachusetts.

He has been a member of the advisory board of the Pugwash Conference on Science and World Affairs (1964 to 1988); the Advisory Committee of Science and Technology for Development to the Secretary of the United Nations (1965 to 1979); The Max Planck Institute for Cell Biology in Heidelberg, Germany (1979 to 1988); and the World Health Organization from 1983 to 1986 and 1996 to 1999.

In 1997 - 98 he chaired the project "Scientific Cooperation and Conflict Resolution" of the Carnegie Corporation of NY, which was published by the New York Academy of Sciences in 1998.

Together with Ephraim Katzir, they founded the Board of the Bat Sheva de Rothschild Foundation, 1957 and which continues its work until today.

He is a founding member of EMBO.

He was a member of the founding committee of the Israel Science Foundation and of the BIKURA (FIRST) committee.

Since 1990, he has been serving as a Special Advisor to the President of the Israel Academy of Sciences and Humanities and to the President of the Hebrew University of Jerusalem.

JOSEPH KLAFTER, Ph.D.

Heinemann Chair of Physical Chemistry

Research Interests

Chemical Physics -Theoretical Condensed Matter -Nonequilibrium Statistical Mechanics

Anomalous Diffusion -Nanofriction -Molecular Motors -Single Molecules

Brief Biography:

BSc. Physics, Bar Ilan University (1967).

MSc. Physics Bar Ilan University (1969).

PhD. Chemistry Tel Aviv University (1978).

Postdoctoral Fellow, Chemistry MIT (1978-1980).

Exxon Research and Engineering (1980-1987).

Tel Aviv University from 1987.

Chair Professor of Chemistry from 1998.

Heinemann Professor of Physical Chemistry.

Representative at the European Science Foundation, PESC committee (from 2001).

Head of Exact Sciences and Technology, Israel Science Foundation (1996-2002).
Chairman of the Academic Board of the Israel Science Foundation, ISF, (from 2002).

Fellow American Physical Society (1993); Alexander von Humboldt Foundation Prize (1996);
Weizmann Prize for Sciences(1999); Kolthoff award of the Technion (2003); Rothschild Prize
in Chemistry (2004); Israel Chemical Society Prize (2005);

Born in Tel Aviv in 1948, **Dr. Yosef Mekori** received his medical education at the Sackler School of Medicine, earning the M.D. degree magna cum laude in 1975. He completed a residency in internal medicine in 1981 at the TAU-affiliated Meir General Hospital, Kfar Saba, Israel, and moved to Denevr CO for a clinical fellowship in allergy and clinical immunology at the University of Colorado Health Sciences Center, followed by a research fellowship in Pathology at the Beth Israel Hospital, Harvard Medical School, Boston, MA.

Dr. Mekori 's research focused on mast cell function in allergic and non-allergic inflammatory processes. In 1986, he established and headed the Division of Allergy and Clinical immunology at the Meir General Hospital and in 1990 was appointed Chairman of Medicine in that hospital. In 1993 he spent a year as a Visiting Scientist in the Laboratory of Allergic Diseases at the NIH, Bethesda, MD. Dr. Mekori is a former Chief Scientist of the Israeli Clalit Health Services.

A fellow of the American Academy of Asthma Allergy and Immunology Dr. Mekori maintains membership in numerous professional organizations, including the European Academy of Allergy and Immunology and the Collegium Internationale Allergologicum. He served as the President of the Israeli Society of Allergy and Immunology and member of several international committees in this field. At TAU, Dr. Mekori became Professor of Medicine in 1994, incumbent of the Reiss Chair in Dermatology, a former head of the TAU-affiliated Felsenstein Medical Research Center and since 2002 has been Vice Dean for research and development of the faculty. In 2006 Dr. Mekori was appointed as Dean of the Sackler Faculty of Medicine.

Main research interest:

Pathogenesis of the allergic inflammation; mast cell physiology; mast cell T-cell interaction; inflammatory markers in atherosclerotic cardio-vascular diseases.

Dr. Irit Pinchasi.

Irit holds a PhD degree in Neurochemistry (MSc. In Biochemistry, with distinction) from the Tel-Aviv University in Israel and did her post-doc in cell biology at the Weizmann Inst. of Science in Israel. She has been working in Teva since 1986, holding a variety of positions within the Innovative R&D organization, as a Project Leader (for Copaxone), Head of the Auto-Immune Section and deputy VP for Innovative R&D. In 2002 she has been nominated the VP, Head of the Global Innovative R&D Division, responsible for all aspects of research and development for innovative products, from the project sourcing stage, through all the pre-clinical and clinical development stages, the preparation of regulatory and marketing submissions and throughout the entire life-cycle of the product.

For the last 3 years Irit also served as the Teva representative in the National Biotechnology Committee, as well as on the Bloomfield Science Museum Board.

BRACHA RAGER - BIOGRAPHY

Bracha Rager, an immunovirologist is a Professor of Microbiology and Immunology, Faculty of Health Sciences, Ben Gurion University of the Negev, former President of Israel Society of Microbiology (2005-2007) and former Chief Scientist of the Israeli Ministry of Health (1997-2002). Prof. Rager was born in Tel Aviv, Israel and graduated from Tel Aviv University in 1963 and received her Ph.D. from the School of Hygiene and Tropical Medicine, London University, London, England. She was a postdoctoral research fellow in Dr. Barry Bloom's lab, Department of Microbiology and Immunology, Albert Einstein College of Medicine, New York, where later she was she was appointed Visiting Professor.

In 1976 Prof. Rager joined and was one of the founders of the Department of Microbiology and

Immunology, Faculty of Health Sciences, Ben Gurion University of the Negev. She is a recipient of many prestigious awards and grants, authored numerous scientific papers published in peer-reviewed journals, and published articles of medical research policy and of scientific interest in national newspapers. Her research is devoted to viral pathogenesis, vaccine development and biotechnology.

Prof. Rager has held and is holding many professional consulting appointments. She served and is serving on advisory boards of a long and prestigious list of scientific committees, was a member of the Board of Directors of Teva Pharmaceutical Industries and a member of the Higher Council of Education (MALAG), where she chaired the sub-committee of universities, colleges of education and the committee of biotechnology.

Curriculum Vitae

Name: Rami Rahamimoff, **Z”L**
Date of Birth: May 17, 1937
Place of Birth: Sofia, Bulgaria

PRESENT ACADEMIC POSITIONS

- Professor of Physiology, Department of Physiology, Hebrew University-Hadassah Medical School.
- Jacob Gitlin Chair of Physiology, Hebrew University-Hadassah Medical School.

EDUCATION

1954 Graduated Herzliya Gymnasium, Tel Aviv, Israel (Mathematical-Physical division).
1962 Graduated Hebrew University-Hadassah Medical School, Jerusalem, Israel.

POSITIONS HELD

1962-1963 Rotating Internship, Hadassah University Hospital (Electives in Neurology and Cardiology).
1965-1966 British Council Research Fellow, Department of Biophysics, University College London, England.
1966-1968 Lecturer of Biophysics, University College London, England.
1971 Associate Professor, Hebrew University-Hadassah Medical School, Jerusalem.
1972-1974 Visiting Associate Professor of Neurobiology, Harvard Medical School, Boston, Massachusetts, USA.
1975- Professor of Physiology, Hebrew University-Hadassah Medical School, Jerusalem, Israel.
1976 (summer) Guest Scientist, Cold Spring Harbor Laboratory, N.Y., U.S.A.
1977-1983 (summer) Co-Director, Course on The Synapse, Cellular and Molecular Neurobiology, Cold Spring Harbor Laboratory, N.Y., U.S.A.
1979-1980 Visiting Professor of Neurobiology, Stanford Medical School, Stanford, CA, U.S.A.
1981-1995 Visiting Professor Neurobiology, Harvard Medical School, Boston, MA, U.S.A.

(1-2 months/yr)	
1984	Course Co-director, Cellular and Molecular Biology of the Synapse, Stanford University.
1985-	Jacob Gitlin Chair of Physiology, Hebrew University-Hadassah Medical School, Jerusalem, Israel.
1986 (6 months)	Guest Scientist, Max Planck Institute for Biophysical Chemistry, Gottingen, F.R.G.
1986-1989	Chairman, Department of Physiology, Hebrew University-Hadassah Medical School.
1989 - 1992	Chairman, National Committee for Biomedical Research
1994 - 2007	Director, Bernard Katz Minerva Center for Cell Biophysics.

PUBLIC OFFICES

1960	Chairman, Israel Medical Students Association
1961	President, General Assembly, Hebrew University Students Organization.
1977-1980	President, Israel Physiological and Pharmacological Society
1981-1985	Dean, Hebrew University-Hadassah Medical School.
1983-1993	Council Member, International Union of Physiological Sciences
1984	President, 1984 European Regional Physiological Meeting, Jerusalem, Israel
1983-1985	Chairman, Association of Medical Schools in Israel
1985-1988	Director, Center for Medical Education. Hebrew University - Hadassah Medical School.
1986-1993	Chairman, International projects committee, International Union of Physiological Sciences
1988- 1992	Chairman, National Committee for Biomedical Research
1990- 1998	Council Member, Federation of Asian and Oceanian Physiological Societies.
1994-1996	President, Israeli Society for Neuroscience
1995-2000	Chairman, National Council for Animal Experimentation
1996-1998	Vice President and President-Elect of the Federation of Israel Societies for Experimental Biology
1998-2002	President of the Federation of Israel Societies for Experimental Biology
1999	Co-President, International Brain Research Organization, 5th Congress, Jerusalem
2000	Chairman , Committee of the 75 th Anniversary of The Hebrew University
2001-	Chief Scientist, Israel Ministry of Health
2002-	Chairman, Steering Committee for Medical Research Council. Israel Ministry of Health

PRIZES AND AWARDS

- Israel Prize in Life Sciences- 1998
- Outstanding Teacher of the Year Award- several times

Michael Sela Short Curriculum Vitae

Born 6 March 1924 - Tomaszow, Poland; **Married to** Sara; **Children** Irit, Orlee and Tamar; **Scientific discipline:** Immunologist and protein chemist; **Academic title:** Institute Professor.

Most important awards, prizes and academy memberships: Israel Prize in Natural Sciences (1959); Rothschild Prize in Chemistry (1968); Otto Warburg Medal, German Society of Biological Chemistry (1968); Emil von Behring Prize of the Phillips University (1973); Gairdner Foundation International Award, Toronto (1980); The Prize of the Institut de la Vie, Fondation Electricite de France (1984); Commander's Cross of the Order of Merit of the Federal Republic of Germany (1986); Officer of l'Ordre de la Legion d'Honneur, France (1987); Albert Einstein Golden Medal (UNESCO) (1995); Harnack Medal of Max-Planck Society (1996); Interbrew-Latour Health Prize, Belgium (1997); Caballero, Order de San Carlos, Colombia (1997); Wolf Prize in Medicine (1998).

Honorary Doctorates: Universite de Bordeaux II (1985); National Autonomous University of Mexico (1985); Tufts University, Medford MA (1989); Colby College, Maine (1989); Universite Louis Pasteur, Strasbourg (1990); Hebrew University, Jerusalem (1995); Tel Aviv University (1999); Ben-Gurion University of the Negev (2001).

Membership in: Israel Academy of Sciences and Humanities; American Academy of Arts and Sciences; Pontifical Academy of Sciences; U.S. National Academy of Sciences; Deutsche Akademie der Naturforscher Leopoldina; Russian Academy of Sciences; French Academy of Sciences; Italian Academy of Sciences; American Philosophical Society; Romanian Academy; Polish Academy of Arts and Sciences. Honorary Member: American Society of Immunologists; Gesellschaft fur Immunologie; Scandinavian, French, Chilean and Colombian Societies of Immunology.

Activities: Ph.D. from the Hebrew University, Jerusalem for research carried out at the Weizmann Institute of Science, continues until this day as a Professor from 1963, Head of the newly created Department of Chemical Immunology - 1963 - 1975, Dean of the Faculty of Biology -1970 - 1973, Vice-President in 1970-71, President from 1975 to 1985 and since then until now, Institute Professor and Deputy Chairman of the Board of Governors. Visiting scientist or professor at the NIH (1960-61, 1973-74), University of California in Berkeley (1967-68), College de France (1973 and 1986-87) and Tufts University,, MIT and Harvard University. Since 1967 - Foreign Member of the Max-Planck-Institute for Immunobiology in Freiburg. (1970 -1974) Vice-Chairman and Chairman of the Basel Institute of Immunology (1975 -1979) Chairman of the EMBO Council (1978 - 1981), Chairman of the Scientific Advisory Committee of EMBL (1977-1980), President of the International Union of Immunological Societies (1989-1996), President of the Pasteur-Weizmann Scientific Council, from 1998, Honorary President, Pasteur-Weizmann Council. Published more than 800 articles, chapters, books, in the fields of immunology, biochemistry and molecular biology.

Served in various capacities as a consultant to the World Health Organization, including as a Member of its Global Advisory Committee (1979-1982). Member of the Executive Committee of the International Council of Scientific Unions.(1984-1993) First President of the newly created FISEB (Federation of Israeli Societies of Experimental Biology) since 1996.

Also, Chairman of the Public Council of the Batsheva Company for Modern Dance, Honorary Vice-Chairman of the Arthur Rubinstein International Master Piano Competition, Marcus Sieff Prize for Outstanding Initiative in Improving Relations between Jews and Arabs, Chairman of the Presidium of the Movement for Quality Government in Israel, and Founding Member of the Itzhak Rabin Memorial Center for Israeli Studies.

Uri Seligsohn, MD
Professor of Hematology

- Uri Seligsohn was born in Tel Aviv, Israel and graduated Medical School at the Hebrew University and Hadassah, Jerusalem.
- Specialized in Hematology at Sheba Medical Center, Tel Hashomer, Israel and did a postdoctoral fellowship at the University of Southern California, Los Angeles
- Served as Chairman of the Department of Hematology at Sheba Medical Center, Israel, until 2002
- Since 2002 he is the Director of the Amalia Biron Research Institute of Thrombosis and Hemostasis at Sheba Medical Center and Sackler Faculty of Medicine, Tel Aviv University
- Uri Seligsohn authored more than 215 papers in leading peer reviewed Journals and 20 chapters in major textbooks in Hematology and Genetics.
- In the last 10 years he has been one of the Editors of Williams Textbook of Hematology.
- His major research interests are in molecular, genetic and clinical aspects of thrombosis and Hemostasis.
- Uri Seligsohn was the President of the 15th Congress of the International Society of Thrombosis and Hemostasis (ISTH) held in Jerusalem, 1995 with 3,500 participants. He was the Chairman of this Society between 2000-2002, and currently co-chairs with Professor Frits Rosendaal from the Netherlands the ISTH education committee
- Awards and honors:
 - 1991 Ham-Wasserman lecturer, American Society of Hematology
 - 1997 Distinguished Career Award, ISTH
 - 2001 Member of the Israel Academy of Sciences and Humanities
 - 2007 Robert Grant Medal, International Society of Thrombosis and Hemostasis

Giora Simchen – Scientific Biography

Born in Jerusalem, 1939. Military service 1957-59. Studies at the Hebrew University: BSc in Biology (1962), MSc in Genetics (1963). University of Birmingham (UK): PhD in Genetics (1965), DSc (1978). Academic appointments at the Hebrew University, Department of Genetics: Senior Lecturer (1967), Associate Professor (1972), Professor (1978). Appointments as Research Associate or Visiting Professor for various periods of time (mostly sabbaticals) at the University of Washington (Seattle), Harvard University, MIT and Whitehead Institute for Biomedical Research, University of Munich, University of Vienna, Johns Hopkins University Medical School, ICRF (London), Institut Curie (Paris), Faculté de Médecine Necker (Paris), National Centre for Biological Research (NCBS, Bangalore), University of British Columbia (Vancouver, Canada). Member of various scientific societies, including European Molecular Biology Organization (EMBO, member of Council 2000-2005).

Main field of research: Molecular genetics of meiosis in budding yeast. Emphasis has been on DNA repair and recombination, chromosome segregation, and whole-genome gene expression. Published more than 110 peer-reviewed papers. Served on editorial

boards of various scientific journals.

Karl Skorecki was born and educated in Toronto and received his MD degree in 1977 at the University of Toronto – where he was awarded the Gold Medal for first standing in this class and in all course throughout the curriculum. He pursued postgraduate clinical and research training in internal medicine, nephrology, and molecular biology at Harvard Medical School (Brigham and Women's Hospital and Massachusetts General Hospital) between 1977-1984. He returned to the University of Toronto as Assistant Professor in Medicine in 1984, and was promoted to Associate and Full Professor in Medicine, Pediatrics and Clinical Biochemistry by 1994, and also was appointed as Director of Nephrology for the University, Chief of Nephrology at the Hospital for Sick Children and Senior Research Scientist at the Hospital for Sick Children and Toronto General Hospital Research Institutes. In 1995, he moved to the Faculty of Medicine of the Technion – Israel Institute of Technology, where he is a chaired full professor in Nephrology, and also assumed the position of Director of Nephrology at the adjacent Rambam Medical Center and subsequently also Director of the Rappaport Medical Research Institute at the Technion. His research program has focused on the following areas: 1. Renal physiology. 2. Human genetics including population genetics. 3. Human embryonic stem cells. Among the research discoveries attributed to him and his laboratory team members over the years are the use of target analysis to demonstrate ligand induced dissociation of G-protein subunits in living kidney cells, regulation of cytosolic phospholipase A2 by tyrosine phosphorylation and its genomic localization and transcriptional regulation, the site of resistance to natriuretic peptides in salt retaining states, population genetic structures of uniparental genomic regions of Jewish and Near East origin communities, development of methods for genomic tracing of maternal and paternal lineages, establishment of novel experimental platforms using human embryonic stem cells, promoter analysis of the telomerase gene in embryonic stem cells and malignant cells. These and other projects have been carried out with numerous collaborators at academic institutions worldwide, and reflect the important placed on academic and scientific interaction and collaboration.

He has been primary supervisor for more than 20 graduate students who have received MSc or PhD degrees and numerous research fellows. He has been principal investigator on competitive research grants totaling several million dollars, including from the Medical Research Council, the US-Israel Binational Science Foundation, the Israel Science Foundation, and other granting agencies. His publication record, with more than 160 full entries (excluding abstracts, conference proceedings) includes more than 100 original peer-reviewed original scientific publications, as well as numerous invited reviews, and book chapters in the world's leading textbooks of medicine and nephrology and total citation record of several thousand citations. He has been an invited lecturer at numerous conference plenary sessions and an invited visiting professor at many of the world's leading academic institutions, with more than 100 such invitation or lectureships. He has won several national research prizes in Canada and Israel, including the Royal College of Physicians and Surgeons Research Medal in Medicine (1988), and the Elkeless Fund Prize for Research Excellence (2004), as well as institutional research and teaching prizes and awards. He serves on a large number of international and national research and health policy committees, scientific journal and professional textbook editorial boards, among other public and professional activities

SOREQ Hermona, Curriculum Vitae

Dept. of Biological Chemistry, Silberman Institute of Life Sciences, & the Interdisciplinary Center for Neural Computation, The Hebrew University. Tel: 972-2-6585109; Fax: 972-2-6520258; Email: soreq@cc.huji.ac.il
See Departmental website at <http://sites.huji.ac.il/biolchem/soreq.html>

Biography:

PhD in Biochemistry (Weizmann Institute, 1970-76) Thesis on: "Structure and Functions of Regions in mRNA as Probed by Purified Polynucleotide Phosphorylase"; Postdoctoral studies (Rockefeller University, 1977-79); Senior Scientist and Associate Professor (Weizmann Institute, 1979-83,1983-86); Associate Professor and Professor of

Molecular Biology (Hebrew University, 1986-89 and thereafter); Dept. Head 1989-94; Institute Head 1995-2000; Vice-Dean for R&D, Faculty of Science, 2002-2005; Non-Resident Research Professor, The Bio-Design Institute, Arizona State University, 2005-2006; Faculty of Science 2005-2008.

Participation in national and international programs:

President, The Israeli Society for Biochemistry and Molecular Biology (2000-2001); Consultant to the Israeli Ministers of Health, Commerce and Science (2002-); Head, Infrastructure Committee advising the Minister of Science (2001-2002); Member, Israel Council for R&D, 2004-; Member, Israel's Bioethics Committee, 2003-; Council member, International Societies of Neurochemistry and of Developmental Neuroscience (2002-2005); Member, European Molecular Biology Organization (EMBO), Human Genome Organization (HUGO), Federations of American and Israeli Societies for Experimental Biology (FASEB, FISEB), American Societies for Neuroscience & for Pharmaceutical & Experimental Therapeutics, Society of Controlled Release.

POSITIONS

2005 - 2008 Elected Dean, Faculty of Mathematics and Natural Sciences, The Hebrew University
2005 - 2007 Non-Resident Research Professor, The Bio-Design Institute, Arizona State University
2002 - 2005 Vice Dean for R & D, Faculty of Mathematics Natural Sciences, The Hebrew University
2000 - 2005 Head, The Eric Roland Center for Neurodegenerative Diseases, The Hebrew University
1995 - 1999 Head, the Alexander Silberman Institute of Life Sciences, The Hebrew University
1992 - 1995 Head, Dept. of Biological Chemistry, The Hebrew University
1989 - On Professor of Molecular Biology, Department of Biological Chemistry, The Hebrew University
1986 - 1988 Associate Professor of Molecular Biology, Department of Biological Chemistry
The Hebrew University of Jerusalem.
1983 - 1986 Associate Professor, Neurobiology Department, Weizmann Institute
1979 - 1983 Senior Scientist, Neurobiology Department, Weizmann Institute
1977 - 1979 Fogarty Fellow, Department of Molecular Cell Biology, The Rockefeller University.

HONORS AND AWARDS:

2007 Honorary Doctorate, Ben-Gurion University of the Negev
Honorary Doctorate, Medical Faculty, Friedrich-Alexander-University Erlangen- Nürnberg
Teva's Founders Award in Molecular Medicine
2005 Lilly Award in Molecular Psychiatry
2005 Landau Prize for Biomedical Research
2001 Honorary Professorship, The Maimonides University, Buenos Aires
2000 Research Prize by the Israeli Minister of Health
1999 Kay Prize for Innovative research, The Hebrew University
1996 Doctor of Philosophy *honoris causa* in Chemistry, University of Stockholm, Sweden.
1995 Visiting Professor, College de France, Paris.
1992 U.S. Army Science Award of excellence, Miami.
1990- The Charlotte Slesinger Chair on Cancer Studies, The Hebrew University.
1986 - 1989 Berman Fellowship, The Hebrew University.
1985 Chancellor's Distinguished Lectureship, The University of California, Berkeley.
1982 Honorary Guest Lectureship, The European Society for Neurochemistry, Katania.
1980 - 1983 Charles Revson Career Development Chair, The Weizmann Institute.

**Annex G. List of Members of Visiting Committees and
short biographical sketches**

March 2007

Members of the Visiting Committee for the Evaluation of
Basic Biomedical Research in Israel

William E. Paul, MD, former Director of the Office of AIDS Research (OAR) at the NIH and now Chief of the Laboratory of Immunology at the National Institute of Allergy and Infectious Diseases, with nine research groups investigating genetics, molecular biology, cell biology, and cellular immunology. Dr. Paul is a member of the U.S. National Academy of Science and of its Institute of Medicine. He is a fellow of the American Academy of Arts and Sciences.

Georg Klein, MD, PhD, Professor Emeritus and group research leader in the Microbiology & Tumor Biology Center of Karolinska Institutet, the world's largest biomedical research institution, located in Sweden. Having published more than 1200 papers in the fields of experimental cell research and cancer research, he is the recipient of countless prizes, awards, and honors for his work.

Eva Klein, MD, Head of the Virology Group of Tumorbiology at the Karolinska Institutet, Sweden where her research and more than 500 papers have focused on the immunobiology of cancer. The recipient of a number of honors and awards, Professor Klein is a member of the Research Council of the Swedish Cancer Society, the Nobel Assembly of the Karolinska Institute, and the Royal Swedish Academy of Sciences and the Hungarian Academy of Sciences.

Andrew Marks, MD, Chair, Department of Physiology & Cellular Biophysics, Columbia University; Director, Center for Molecular Cardiology; a member of the National Academy of Sciences of the United States of America and its Institute of Medicine; a fellow of the American Academy of Arts and Sciences; founder and president, International Academic Friends of Israel.

Visiting Committee Members :Clinical Research in Israel;

(2nd Visiting Committee) and Their Bio's

The University of Texas M. D. Anderson Cancer Center
1515 Holcombe Blvd, Houston, TX 77030
1-800-392-1611 (USA) / 1-713-792-6161

John Mendelsohn, M.D., combines experience in clinical and laboratory research with administrative expertise for guiding The University of Texas M. D. Anderson Cancer Center in the 21st century.

Since becoming president in 1996, he has recruited a visionary management team and implemented new priorities for integrated programs in patient care, research, education and cancer prevention. Under his direction, M. D. Anderson has been named the top cancer hospital in the nation five out of the past eight years in U.S. News & World Report's "[America's Best Hospitals](#)" survey.

For almost three decades, Mendelsohn has been at the forefront in understanding how growth factors regulate the proliferation of cancer cells by activating receptors on the surface of the cells. These receptors, when activated, control key cell signaling pathways. He developed a specific monoclonal antibody called [ErbixTM](#), which blocks the activity of the receptor for epidermal growth factor. Clinical research trials have demonstrated that therapy combining this antireceptor antibody with chemotherapy or radiation is effective treatment for patients with several forms of cancer. On February 12, 2004, the FDA approved ErbixTM for treatment of advanced [colorectal cancer](#).

Where it All Began

Mendelsohn was born in Cincinnati on Aug. 31, 1936, and earned his bachelor's degree in biochemical sciences magna cum laude from Harvard College in 1958. While there, he was the first undergraduate student of James D. Watson, Ph.D., who later won the Nobel Prize in Medicine for identifying the structure of DNA.

After spending a year in Scotland as a Fulbright Scholar, Mendelsohn received his medical degree cum laude from Harvard Medical School in 1963. Between 1963 and 1970, he took residency training in internal medicine at Brigham and Women's Hospital in Boston, completed a research fellowship at the National Institutes of Health and finished a fellowship in hematology-oncology at Washington University Medical School in St. Louis. From 1970 to 1985, he was on the University of California San Diego faculty, rising from assistant professor to professor of medicine at UCSD in less than nine years. He was instrumental in establishing and funding a National Cancer Institute-designated cancer center at UCSD, which he directed from its inception in 1976 until he went to Memorial Sloan-Kettering Cancer Center in 1985.

At Memorial Sloan-Kettering, Mendelsohn chaired, reorganized and expanded its Department of Medicine. He also extended the landmark research that he began at UCSD to clarify at the molecular level how monoclonal antibody 225 prevents activation of the growth-signaling pathway that is turned on in cells by tyrosine kinase in EGF receptors. His group's laboratory and pre-clinical studies initiated and advanced the concept of anti-receptor therapy and anti-tyrosine kinase therapy as new forms of cancer treatment.

Mendelsohn held the Winthrop Rockefeller Chair in Medical Oncology at Memorial Sloan-Kettering, where he also served for five years as co-head of the Program in Molecular Pharmacology and Therapeutics. In addition, he was professor and vice-chairman of medicine at Cornell University Medical College and an attending physician at both Memorial and New York

Hospitals. The first clinical trial in the world with an anti-receptor and an anti-tyrosine kinase treatment was carried out at Memorial Sloan-Kettering with monoclonal antibody 225.

M. D. Anderson's Third President

In July 1996, Mendelsohn assumed the presidency of M. D. Anderson, becoming only the third full-time president of the Houston-based institution that was established in 1941. He also is professor of cancer medicine, and a faculty member at The University of Texas Graduate School of Biomedical Sciences.

Mendelsohn served as the founding editor of *Clinical Cancer Research*, a bimonthly translational research journal published by the American Association for Cancer Research, and he has been a member of the editorial boards of numerous other leading scientific journals. He has authored more than 300 scientific papers and articles for journals and books, and serves as senior editor of the textbook, "The Molecular Basis of Cancer."

Honoring Career Achievements

Mendelsohn has received a number of national and international honors in recognition of his [career achievements](#). Among those are the Dan David Prize in Cancer Therapy (2006), Fulbright Lifetime Achievement Medal (2005), Bristol-Myers Squibb Freedom to Discover Award for Distinguished Achievement in Cancer Research (2004), David A. Karnofsky Memorial Award from the American Society of Clinical Oncology (2002), Joseph H. Burchenal Clinical Research Award from the American Association for Cancer Research (1999) and the Gold Medal of Paris (1997). For more information on Dr. Mendelsohn's achievements, please see the biography section.

Mendelsohn and his wife, Anne, have three sons and jointly participate in multiple civic activities. They were honored in 2001 by Leadership Houston with the Distinguished Leadership Award. Mendelsohn is an active member of the Greater Houston Partnership (Board), the Houston Technology Center (Board), BioHouston (Vice-Chairman), the Center for Houston's Future (Board) and the Houston Forum.

Biography – Dr Michael Denman

Born Liverpool, UK 05 June 1934

Graduated in medicine, University of London 1958

FRCP London 1975

Medical and scientific training: Charing Cross University Hospital; Queen Elizabeth Hospital, University of Birmingham, UK; Royal Postgraduate Medical School and Hammersmith Hospital, London; Medical Research Council Rheumatism Research Unit, Taplow UK

Fulbright Research Scholar, University of Texas Southwestern Medical School, USA

Research Fellow, Karolinska Institute, Stockholm

NATO Research Scholarship University of Washington, Seattle USA

Visiting Research Worker, Hadassah Hospital Jerusalem 1963

Head of Medical Research Council Connective Tissue Diseases Research Group, Clinical Research Centre, Northwick Park Hospital, Harrow, UK;

Consultant Physician (Rheumatology and Clinical Immunology), Northwick Park Hospital

Director of Clinical Studies, Northwick Park Campus, Imperial College School of Medicine, London

Current appointment: Emeritus Consultant in Clinical Immunology, Northwick Park Hospital.

Author of papers on basic and clinical immunology and rheumatology (including papers in Nature, Journal of Clinical Investigation, Cold Spring Harbor Proceedings, and Lancet); contributor and editor to books on immunology and rheumatology including co-editor (with Professors Cohen, Lewis and Alberti) 'The Metabolic and Molecular Basis of Acquired Disease' and the 'Oxford Textbook of the Rheumatic Diseases.

Past honorary appointments: include President, Clinical Immunology Section, Royal Society of Medicine; Meetings Secretary, British Society of Immunology; Senior Honorary Secretary, British Society of Rheumatology
Heberden Roundsman

Editor, associate editor and editorial board member numerous international and national medical and scientific journals including New England Journal of Medicine.

Scientific Editor Encyclopaedia Judaica

Member of numerous research advisory boards including the Medical Research Council (UK), the Arthritis Research Council and the Nuffield Foundation

Co-organiser and Trustee Board member the Gerald Loewi memorial meetings on the immunology of the rheumatic diseases held biennially at the Rambam Hospital, Haifa since 1998.

Married to Dr Evelyn Denman, two children.

Robert S. Schwartz, MD

Deputy Editor

New England Journal of Medicine

Dr. Robert S. Schwartz is a distinguished physician at the New England Medical Center and a Professor of Medicine at Tufts University School of Medicine in Boston. Since 1994, he has been a deputy editor for the New England Journal of Medicine where he also serves as the book review editor. In addition, Dr. Schwartz is a lecturer in medicine at Harvard University Medical School. He earned his medical degree from New York University School of Medicine, and completed his residency at Montefiore Hospital and Yale New Haven Hospital. Among his many honors, Dr. Schwartz has been awarded the Sandoz Prize For Immunology (1995), the Medawar Prize (2000), and the Thomas Starzl Prize (2003). He serves on the editorial board of Current Opinion in Immunology and has been published in over 300 medical journals and publications

Members of the Visiting Committee For the
Assessment of the Interface between Biomedical
Research and Biotechnological Industry in
Israel: Bio's

Robert Califf, MD, is the Donald F. Fortin, MD, Professor of Cardiology, Vice Chancellor for Clinical Research and Director of the Duke Translational Medicine Institute. He is also Professor of Medicine in the Division of Cardiology and remains a practicing cardiologist. Dr. Califf has led some of the best-known clinical trials and health outcomes studies in cardiovascular medicine and has published over 800 peer reviewed original articles in collaboration with his colleagues. He is currently the 7th most frequently cited author in the field of medicine globally. He is considered a leader in the fields of quality of care, technology development and health policy. He has served on numerous committees and panels assisting in the development of health policy including the Cardiorenal Panel of the FDA and multiple Institute of Medicine Committees, including the Committee on Identifying and Preventing Medication Errors, the Forum on Drug Discovery and Translation and the Science Board of the FDA. He was the founding Director of the Coordinating Center for the Centers for Education and Research in Therapeutics (CERTs), a public/private partnership focused on the safety of medical products. After 10 years as founding director of the DCRI he has founded the Duke Translational Medicine Institute, which encompasses the spectrum of translational research at Duke.

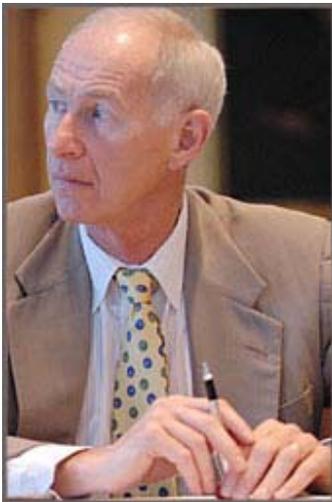


innovations.

Harvey V. Fineberg is President of the Institute of Medicine. He served as Provost of Harvard University from 1997 to 2001, following thirteen years as Dean of the Harvard School of Public Health. He has devoted most of his academic career to the fields of health policy and medical decision making. His past research has focused on the process of policy development and implementation, assessment of medical technology, evaluation and use of vaccines, and dissemination of medical

Dr. Fineberg helped found and served as president of the Society for Medical Decision Making and also served as consultant to the World Health Organization. At the Institute of Medicine, he has chaired and served on a number of panels dealing with health policy issues, ranging from AIDS to new medical technology. He also served as a member of the Public Health Council of Massachusetts (1976-1979), as chairman of the Health Care Technology Study Section of the National Center for Health Services Research (1982-1985), and as president of the Association of Schools of Public Health (1995-1996).

Dr. Fineberg is co-author of the books *Clinical Decision Analysis*, *Innovators in Physician Education*, and *The Epidemic that Never Was*, an analysis of the controversial federal immunization program against swine flu in 1976. He has co-edited several books on such diverse topics as AIDS prevention, vaccine safety, and understanding risk in society. He has also authored numerous articles published in professional journals. Dr. Fineberg is the recipient of several honorary degrees and the Joseph W. Mountin Prize from the US Centers for Disease Control. He earned his bachelor's and doctoral degrees from Harvard University.



Michael Rosenblatt
School of Medicine

Dr. Rosenblatt serves as Dean of Tufts University School of Medicine. He previously held the appointment of George R. Minot Professor of Medicine at Harvard Medical School and Chief of the Division of Bone and Mineral Metabolism Research at Beth Israel Deaconess Medical Center. He served as the President of Beth Israel Deaconess Medical Center from 1999-2001 and was previously the Harvard Faculty Dean and Senior Vice President for Academic Programs at CareGroup and Beth Israel Deaconess Medical Center. He was also a founder of the Carl J. Shapiro Institute for Education and Research at Harvard Medical School and Beth Israel Deaconess Medical Center, a joint venture whose mission is to manage the academic enterprise and promote academic innovation.

Dean Rosenblatt has served as Director of the Harvard-MIT Division of Health Sciences and Technology, during which time he led a

medical education organization for M.D., Ph.D., and M.D.-Ph.D. training jointly sponsored by Harvard and MIT. He was Senior Vice President for Research at Merck Sharp & Dohme Research Laboratories where he headed the worldwide development team for alendronate (FOSAMAX), Merck's bisphosphonate for osteoporosis and bone disorders. In addition, he directed drug discovery efforts in molecular biology, bone biology and calcium metabolism, virology, cancer research, lipid metabolism, and cardiovascular research in the United States, Japan, and Italy. In Japan, he had responsibility for clinical research and development. In leading most of Merck's international research efforts, he established two major basic research institutes, one in Tsukuba, Japan, and one near Rome, Italy. He also headed Merck Research's worldwide University and Industry Relations Department.

He is the recipient of the Fuller Albright Award for his work on parathyroid hormone and the Vincent du Vigneaud Award in peptide chemistry and biology, and the Chairman's Award from Merck. His research is in the field of hormonal regulation of calcium metabolism, osteoporosis, and cancer metastasis to bone. His major research projects are in the design of peptide hormone antagonists (especially parathyroid hormone), isolation/characterization of receptors and mapping hormone--receptor interactions, elucidating the mechanisms by which breast and prostate cancer "home" to bone, study of the tumor-secreted parathyroid hormone-like protein, and osteoporosis and bone biology.

Dean Rosenblatt has chaired the Gordon Conference on Chemistry and Biology of Peptides, and served on the NIH Physiological Chemistry Study Section and the Board of Scientific Counselors of the National Institute of Diabetes and Digestive and Kidney Diseases of the NIH. He has been elected to the American Society of Clinical Investigation, the Association of American Physicians, to Fellowship in the American Association for the Advancement of Science, and the presidency of the American Society of Bone and Mineral Research. He has testified before a Senate Hearing on U.S. biomedical research priorities in 1997.

From 1981 to 1984, Dean Rosenblatt served as Chief of the Endocrine Unit, Massachusetts General Hospital. He received his undergraduate degree summa cum laude from Columbia and his M.D. magna cum laude from Harvard. His internship, residency, and endocrinology training were all at the Massachusetts General Hospital.

Annexes H, I, J: Programs of Visiting Committees

Annex H. Program for the Visiting Committee for the Assessment of Basic Biomedical Research in Israel

Annex I. Program for the Visiting Committee for the Assessment of Clinical Research in Israel

Annex J. Program for the Visiting Committee for the Assessment of the Interface between Biomedical Research and Biotechnological Industry in Israel

Program for the Visiting Committee
For the Assessment of Basic Biomedical Research in Israel

March 24-28th 2007

Saturday, March 24th:

Arrival at Ben Gurion Airport. Will be received by Academy driver and escorted to “Misheknot Shenanaim” in Jerusalem.

Sunday, March 25th:

09.00 – 10.00 : Breakfast at the hotel and welcome; general briefing session with Ruth Arnon and Alex Keynan.

10.30 – 12.30: Briefing at the Israel Academy of Sciences and Humanities on background material:

- a) Israel Research System – Alex Keynan
- b) The funding of Biomedical Research in Israel – David Friedman
- c) Indicators – Irv Asher

12.30 – 13.30: Working lunch including a briefing by Prof. Yossi Klafter, Director of the Israel Science Foundation (the major funding organization of Israel’s basic research).

13.30 – 16.30: Meeting with Vice-Presidents of Israel’s Research Universities:

Prof. Arie Moran – Dean, Life Sciences - Ben-Gurion University

Prof. Haim Garti, Vice President – Weizmann Institute of Science

16.30 – 17.30: Closed meeting of the Visiting Committee.

17.30: Transfer to hotel.

19.00: Informal Dinner at a restaurant (Beit Anna Ticho) with Alex Keynan and Giora Simchen (member of the “Committee for State of Biomedical Research in Israel : Its Current Support and Future Needs”)

Monday 26th March:

08.00: Breakfast at the hotel with the President of the Hebrew University, Prof. Menachem Meggidor

09.30: Transfer to Givat Ram Campus, visit to the Institute of life Sciences, Hebrew University, hosted by Prof. Yoav Kabanchik, Chairman of the Institute.

10.00 – 12.30: Site visit to laboratories and meeting with scientists and graduate students.

12.30 -14.00: Lunch at Givat Ram campus of the Hebrew University, hosted by the Dean of Faculty of Sciences, Prof. Mona Soreq

14.30 – 17.00: At the Academy: Meeting with scientists:

Prof. Yehudit Bergman – Hadassah Hebrew University Medical School, Ein-Karem

Dr. Haim Cohen - Bar-Ilan University

Prof. Varda Rotter – Weizmann Institute

Dr. Yoram Raiter – Technion – Israel Institute of Technology

17.00 – 17.30: Transfer to hotel.

18.00: Transfer to restaurant in Tel Aviv.

19.00: Dinner hosted by Ruth Arnon at the Tel Aviv Hilton with members of the Israel Committee on “The State of Biomedical Research in Israel: Its Current Support and Future Needs”.

Tuesday, March 27th:

08.30 – 09.30: Breakfast at the hotel with Rami Rachamimoff, Chief Scientist,
Ministry of Health.

10.00 – 12.30: At the Academy. Meeting with 3 additional VP's of Israeli research
universities:

Prof. Hagit Messer-Yaron, Vice President for Research - Tel-Aviv
University

Prof. Eizenberg, Vice President for Research, – Technion Institute Of
Technology,

Prof. Haim Breitbart – Dean of Life Sciences - Bar-Ilan University

12.45 – 13.00: Meeting with the President of the Israel Academy of Sciences, Prof.

Menahem Yaari

13.00 – 14.30: Lunch hosted by President of the Israel Academy of Sciences, Prof.

Menaham Yaari (List of Attendees enclosed)

14.30 – 17.00: At the Academy: Meeting with scientists:

Dr. Dan Mishmar - Ben-Gurion University

Dr. Sigal Ben-Yehuda – Hebrew University, Hadassah Medical School, Ein-Karem

Dr. Dror Selektar – Technion, Israel Institute of Technology

17.00 – 17.30: Closed meeting of the visiting committee.

17.30: Transfer to hotel.

19.00: Informal dinner at the Arcadia Restaurant

Wednesday, March 28th:

08.30 – 09.30: Breakfast at the hotel with Prof. Bracha Rager

10.00 – 12.00 At the Academy; meeting with scientists:

Prof. Ehud Birk - Ben-Gurion University

Prof. Shulamit Michaeli - Bar-Ilan University

Dr. Yaniv Asaf - Tel-Aviv University

Prof. Keren Avraham - Tel-Aviv University

12.00 – 13.00: Light lunch with Ruth Arnon and Alex Keynan: general summary of visit

13.00 – 13.30: Meeting with Prof. Jacob Ziv, past President of the Israel Academy of Sciences and Chairman of the Israel R&D infrastructure forum, (TELEM).

13.30: Closed meeting of the committee and formulation of preliminary report.

Program for the Visiting Committee

For the Assessment of Clinical Research in Israel

June 24 - 26th 2007

Saturday, June 22-23 rd:

Arrival at Ben Gurion Airport. Will be received by Academy driver and escorted to “Dan Panorama Hotel” in Jerusalem.

Sunday, June 24th:

09.00 – 10.00 : Breakfast at the hotel and welcome; general briefing session with Ruth Arnon and Alex Keynan.

10.00 – 10.15 Transfer to the Israel Academy of Sciences and Humanities

10:15 - 12:30: Briefing at the Academy on the Background Material

a) Overview of Israeli Health Care System –Prof. Mordechai Shani, former General Director of Ministry Of Health (MOH)

b) Indicators : Irvin Asher

c) The Funding of Biomedical Research in Israel (Basic and Clinical) and research budgets in hospitals - David Friedman

12.30 – 13.30: Working lunch including a briefing by Prof. Yossi Klafter, Director of the Israel Science Foundation (the major funding organization of Israel’s basic research).

13.30 – 14.00: Meeting with Chief Scientist MOH, Prof. Rami Rachamimoff

14.00 -14.30: Ethical Aspects of Clinical Research in Israel: Prof. Avinoam Reches,
Hebrew University- Hadassah Medical School

14.30 – 17.00: Meeting with Directors of Medical Centers: Prof. Shlomo Mor-Yosef,
Hadassah Medical Center (Jerusalem); Dr. Ilan Zelinger, Soroka Medical Center
(Beer Sheva) and Prof. Gabi Barbash, Soraski Medical Center (Tel Aviv).

17.00- 17.30: Research as a Factor in Career Development of Physicians in Israel –
Prof. Ran Tur-Kaspa, Sackler Medical School, Tel Aviv University

17.30 -18.00: Closed meeting of the Committee

18.00: Transfer to Hotel

19.30: Transfer to Restaurant

20.00: Dinner hosted by Prof. Michael Sela; Arcadia Restaurant, Jerusalem

Monday 25th June:

08.30: Breakfast at the hotel with Prof. Yossi Mekori, Dean of Sackler Medical
School, Tel Aviv University

09.30: Transfer to The Academy.

09.45 – 12.30: Cont. meeting with Directors of Medical Centers; Prof. Raffi Beyar,
Rambam Medical Center, Haifa; Dr. Avi Treves, Sheba Medical Center, Tel
Hashomer

12.30 -13.30: Working lunch, including a briefing by Prof. Jacob Bar-Tana: Hebrew University Medical School, Chairman of the Selection Committee of the B. De Rothchild Foundation Grant Program for Young Physician-Researchers

13.30 -17.00: Meeting with physician-researchers: Dr. Benny Dekel, Sheba Medical Center; Dr. Shai Izraeli, Sheba Medical Center; Dr. Alon Hershko, Hadassah Medical Center; Dr. Nitza Cohen, Beilinson/Schneider Medical Center; Prof. Avi Or, Sorasky Medical Center

17.00 – 17.30: Closed meeting of the Committee

17.30 : Transfer to Hotel

18.30: Transfer to Tel Aviv

20.00: Dinner hosted by Prof. Ruth Arnon, with members of the Israel Committee for the Assessment of Biomedical Research in Israel (Hilton, Tel Aviv)

Tuesday, June 26th:

08.30 – 09.30: Breakfast at the hotel with Prof. Bracha Rager, Prof. of Microbiology and Immunology, Dept. of Microbiology and Immunology, Faculty of Health Sciences, Ben-Gurion University, Beer-Sheva, and former Chief Scientist of the Ministry of Health.

10.00 – 12.30: At the Academy. Meeting with additional Physician Researchers: Dr. Yair Bar, Sheba Medical Center; Dr. Talma Hendler, Sorasky Medical Center; Prof.

Nadir Arber, Sorasky Medical Center; Prof. Yaron Ilan, Hadassah Medical Center;
Prof. Eli Sprecher, Rambam Medical Center

12.30 - 13.30 - Lunch

13.30- 15.00: Meeting with members of the Israeli Committee: Prof. Uri Zeligsohn,
Sheba Medical Center; Prof. Hermona Soreq, Hebrew University, Jerusalem; Dr. Irit
Pinchasi, Teva, and Dr. Aharon Schwartz, Teva

15.00 – 16.00: Concluding meeting with Prof. Ruth Arnon and Prof. Alex Keynan

16.00 – 18.00: Concluding meeting of the Committee – preparation of the Report

18.00 : Transfer to the Hotel.

19.00: Informal Dinner with Prof. Alex Keynan

Program for the Visiting Committee
For the Assessment of the Interface between Biomedical
Research and Biotechnological Industry in Israel

January 9th -11th 2008

Wednesday, January 9th.

- 09.00** **Arrival at Ben Gurion Airport. Will be met by Academy driver and escorted to Mishkenot Shaananim.**
- 12.00 -13.30** **Lunch and briefing on the Visiting Committee mission, background material, and program, by Prof. Ruth Arnon and Prof. A. Keynan**
- 13.30 – 14.30** **Policy for national support for science-based industries: Prof. M. Trachtenberg, Head, National Economic Council, PMO**
- 14.30 -15.00** **Funding of Biomedical Research in Israel – Dr. David Friedman.**
- 15.00 – 15.30** **Organization of research management in universities, and the problems of applied research – Prof. Hermona Soreq, Dean of Natural Sciences, Hebrew University of Jerusalem.**
- 15.30 – 16.00** **Prof. Ya’acov Naparstek, Chair of Medicine Hadassah Medical Center, Jerusalem; and Entrepreneur in Biomedical Industry.**
- 16.00 – 16.30** **Prof. Rami Rachamimoff, Chief Scientist, Ministry of Health**

- 16.30 – 17.00** **University - industry relationships - Prof. Chanoch Gutfreund, Prof. of Physics, President (Emeritus) Hebrew University**
- 17.00 – 17.30** **Closed meeting of the committee**

Thursday, January 10th.

- 07.30- 08.15** **Breakfast at the hotel**
- 08.15 – 10.00** **Transfer to Tel Aviv.**
- 10.00 – 11.45** **National support for university originated R & D and innovation: Chief Scientist and assistants, Ministry of Industry and Trade: Dr. Eli Opper, Ms. Rina Pridor, Dr. Talia Ben-Neria.**
- **Policy of the office of the chief scientist of Trade and Industry, in support of industrial research and innovation.**
 - **Programs for frameworks to facilitate Technology Transfer from Academia to Industry – incubators, start-ups.**
 - **Programs for the encouragement of innovations in industry (MAGNET, MAGNETON, NOFAR).**
- 11.45 - 12.15** **Technology Transfer - "Hadasit" Jerusalem: Dr. Rafi Hofstein**
- 12.15** **Transfer to Weizmann Institute, Rehovot**
- 13.00 - 14.00** **Lunch.**
- 14.00 – 14.30** **Prof. Michael Sela, (President Emeritus), Weizmann Institute.**
- 14.30 – 15.00** **Organization of research management and problems of applied research. Prof. Haim Garty, VP for R&D, Weizmann Institute**
- 15.00 – 16.30** **Technology transfer - companies of the universities:**
- Dr. Amir Neiberg, "Yeda" Weizmann Institute, Ms. Tami Kfir "Yissum", Hebrew University;**

Dr. Yehuda Niv, "Ramot", Tel Aviv University.

16.30 – 17.00 Prof. Haim Aviv, CEO Pharmos Industries; "The State of Life Sciences Industries in Israel"

17.00 – 17.30 Closed meeting of the Committee

18.00 - Dinner hosted by Prof. Ruth Arnon, Rehovot

20.30 - Transfer to Mishkenot, Jerusalem

Friday 11th January 2008

- 07.45 - 08.30** **Breakfast at the Hotel**
- 08.30 – 09.15** **Prof. Chezy Barnholz, Prof. Biochemistry, Head Laboratory of Membrane and Liposome Research, Hebrew University Jerusalem; “From Basic Research to Successful and Productive Interaction with Industry”.**
- 09.15 – 10.00** **Dr. Aharon Schwartz, VP Innovative Ventures, Teva Industries; “Problems of Drug Development in Israel”.**
- 10.00 – 11.00** **Concluding meeting with Prof. Ruth Arnon and Prof. Alex Keynan.**
- 11.00 – 13.30** **Concluding meeting of the committee – preparation of the Draft Report.**
- 13.30 -** **Lunch**

Annexes K L M: Mission statements

Annex K. Mission statement for the Visiting Committee for the Assessment of Basic Biomedical Research in Israel

Annex L. Mission statement for the Visiting Committee for the Assessment of Clinical Research in Israel

Annex M. Mission statement for the Visiting Committee for the Assessment of the Interface between Biomedical Research and Biotechnological Industry in Israel

Mission Statement

The charge to the review committee from Chairperson Ruth Arnon, is to evaluate in general terms, the current state of basic Biomedical research in Israel, its degree of support, its comparison to the state of basic Biomedical research in other western industrialized countries, and recommend policies which have to be implemented by Israel to keep its basic Biomedical research effort competitive with that of other industrialized countries and mainly to maximize the potential human resources in this field.

Mission Statement

The charge to the review committee from Chairperson Ruth Arnon, is to evaluate in general terms, the current state of clinical research in Israel, its degree of support, its pattern of organization, its comparison to clinical research in other western industrialized countries, and recommend policies which have to be implemented by Israel to keep its clinical research effort competitive with that of other industrialized countries, to maximize its potential human and institutional resources in this field, with the long range goal of improving the quality of both clinical research and medical care.

Mission Statement for a Visiting Committee

The Interface between Biomedical Research and Industry in Israel

To advise the Israel Academy on organizational patterns and policies needed to assure the optimal utilization of innovation in biomedical research in Israeli universities and hospitals for future industrial utilization.

The mission includes the survey and evaluation of existing government and university institutions and policies intended to achieve the above-stated goal, and to advise on how to improve their effectiveness.

**Annex N. International comparison of funding for
academic R&D: insights from OECD data**

International Comparison of Funding
for Academic R&D: Insights from OECD Data

A Background Paper for the Visiting Committee
by Dr. I. M. Asher
Jerusalem
January 2007

1. Introduction

How much nationally sponsored R&D is enough? What does it take to stay competitive in today's world? These and many similar questions depend on just what one wants to (or has to) achieve and what resources and options are at one's disposal. These can differ dramatically between countries. Nonetheless, considerable insight can be derived from (cautiously) comparing various standard R&D funding indicators between countries, since:

- (1) the average performance of other leading countries, similar to yours, often helps pragmatically define what is meant by "competitive,"
- (2) certain common indicator profiles among "winners" are assumed to provide clues on what it takes to succeed.

To make sense of such comparisons one needs to have reasonably complete and complementary data, the latter implying common standards for data collection and reporting. The best known of these are the Frascati Manual (R&D funding) and Canberra Manual (R&D manpower) which are embodied in the OECD's excellent Main Science and Technology Indicators (MSTI) series. These reports provide comprehensive data for the U.S., U.K., Canada, Mexico, Australia and the EU-25 countries which form its membership. For comparison, it also reports selected data for nine non-member countries, including Israel, China and Russia. A list of the main abbreviations used (mostly indicator names) is attached as Appendix 1.

This preliminary report is based on MSTI/2006. The most recent data reported there and used here is typically 2004 (less often 2003 or 2005); the use of older 2002 data is noted. Residual incomparabilities in the data may prevent using them as more than well-informed estimates for

comparison; but they are the best data readily available. Israel's Frascati-type data are here compared to those of the U.S. and U.K., on one hand, and Sweden and Switzerland, whose populations (9.0 and 7.5 million respectively) more closely mirror Israel's (6.5 million), on the other.

Unfortunately, Israeli research manpower (Canberra-type) data is almost completely unavailable. This precludes comparing such indicators as [higher education R&D funding]/[researcher full-time equivalents] and other resources per researcher measures.

2. GERD and BERD

Below we show the total Gross Domestic Expenditures for R&D (GERD) and Business Expenditures for R&D (BERD) for our countries of comparison.

Indicator	U.S.	U.K.	Sweden	Switz.	Israel
GERD (\$ Billion)	312.5	33.2	10.4	7.6	8.7
% GERD coming from Government	31.0	31.4	23.5	22.7	23.3
% GERD used in Higher Education	13.6	21.4	22.0	22.9	16.8
GERD as % of GDP	2.68	1.88	3.95	2.94	4.69
BERD as % of GDP	1.88	1.16	2.93	2.17	3.59
BERD/GERD (%)	70.1	61.7	74.2	73.8	76.5

Israel, which relies heavily on its brainpower and high-tech industry, spends an inordinate amount of its GDP on R&D: 4.69% compared to 3.95% for Sweden and 2.94% for Switzerland, other highly regarded advanced countries of comparable size. All proportionally spend more than such large established countries as the U.S. and U.K. (2.68%, 1.88% respectively). As the corresponding figures for BERD show, most countries spend most of their GERD (about 60-75%) on industrial research and development, which yield more immediate profits than basic research. Israel's government contributes only about 23% of Israel's GERD (similar to Switzerland and Sweden); while the larger U.S. and U.K. are more generous (31%).

Since Israel spends more on R&D, normalized to GDP, than all the other countries in the entire OECD report, and since it spends a higher proportion of it on industrial R&D (76.5%) than most

of them do, its GDP-normalized BERD is easily the very highest around (3.59% of GDP). This can be compared with 2.68%, 1.88% for the U.S. and U.K. (respectively) and 2.93%, 2.17% for Sweden and Switzerland (respectively). On the other hand, Israeli industry contributes over two-thirds (64.4% in 2002) of Israel's total GERD and its emphasis on sponsoring industrial research is hardly unexpected.

So Israeli funding of total R&D and industrial R&D (which accounts for over 3/4 of the latter) are both doing exceptionally well. What about academic R&D and (not the same thing) basic research? Switzerland, Sweden and the U.K. all spend about 21-23% of their GERD in the Higher Education sector. In this, Israel is anomalously low, spending only about 16.8% of its GERD there, about halfway between them and the U.S. (13.6%). For more details, we turn to HERD.

3. HERD

The Higher Education Expenditures for R&D (HERD) for our comparison countries are shown below.

Indicator	U.S.	U.K.	Sweden	Switz.	Israel
HERD (\$ Billion)	42.43	7.10	2.30	1.75	1.34
HERD as % of GDP	0.36	0.40	0.87	0.67	0.72
HERD/GERD (%)	13.6	21.4	22.1	23.0	15.4
HERD/BERD (%)	19.1	34.5	29.7	30.9	20.0

Israel spends about the same % of its GDP on HERD as do its Swedish and Swiss counterparts, e.g., about twice that of the U.S. However, Israel's exceptional largesse to industrial R&D is not matched proportionally in its treatment of higher education. Israel spends only 15.4% of its total GERD on HERD. This is far below its Swedish and Swiss – and even British – counterparts (22.1%, 23.0%, 21.4% respectively), and is more like the U.S. ultra-low value of 13.6%. (The U.S. is obviously quite different in size, structure, economy and dynamics from Israel. For example, the U.S. can count on having someone active in almost every area of scientific interest. Without considerably more investment, Israel can not.) Similar results are obtained by comparing the relative sizes of Israel's business (BERD) and higher education (HERD) R&D expenditures. The BERD of the U.K., Sweden and Switzerland is about 3x its HERD; that of Israel and the U.S., about 5x its HERD.

Although the optimal ratios between basic (in Israel, largely academic), applied and industrial research are not known, the HERD/GERD ratios for Switzerland and Sweden might serve Israel

as a tentative, as yet unmet goal. Basic research is a major source of Israeli competitiveness. In general, Israel tends to excel in the initial (more basic) phases of a breakthrough and less so in the follow-up and development phases, when larger, better equipped and staffed foreign research teams have an edge.

Although most Israeli basic R&D is done in academia, some is done elsewhere. Conversely, considerable applied research and development work is done by Israeli academicians. That is, the actual figures for Israel's *basic* research are even smaller than its total HERD figures suggest.

4. BAORD

Government involvement in all this is most easily measured by the Government Budget Appropriations and Outlays for Civilian R&D (Civil GBAORD) indicator, which reflect the government's R&D funding intentions re a variety of socioeconomic objectives (health, space, basic research, etc.) at the time of budgeting.

Indicators	U.S.	U.K.	Sweden	Switz.	Israel
Total GBAORD (\$ Billion)	132.2	13.1	2.7	2.0	1.4
Civil GBAORD (% total)	43	68	83	99.5	-
Basic Research (\$ Billion)	7.35	2.0	0.36	0.19	-
General University Funds (\$ Billion)	-	2.6	1.24	1.16	-

Despite comparable populations, Israel's total GBAORD (\$1.4 billion) is smaller than Switzerland's (\$2.0 billion), even where corrected for population ($7.5/6.5 = 1.15$). Furthermore, although the % of GBAORD devoted to civilian R&D in Israel is unknown, it is almost certainly

much smaller than Switzerland's impressive 99.5%. Although no Israeli figures for basic research and general university funds from GBAORD are included in the OECD report (and thus the above table), these perhaps may be obtainable from the Israel Council for Higher Education.

The above comparisons, both positive and negative, should be viewed in the light of Israel's marked *dependence* on science and technology (S&T) to provide economic growth and security. In practice, it cannot rest content with parity with countries whose S&T needs are not quite as acute.

**Annex O. Outputs of Israeli clinical research and its
basic underpinnings; a bibliometric comparison**

Outputs of Israeli Biomedical Research:
A Bibliometric Comparison

A Background Paper for the Visiting Committee
by Dr. I. M. Asher
Jerusalem, February 2007

OUTPUTS OF ISRAELI BIOMEDICAL RESEARCH: A BIBLIOMETRIC COMPARISON

Introduction: Scientific publications are one easily measured output of scientific research. They are thus often used to provide – not without qualms, quibbles and controversy – insights into the research “health” of various fields, institutions and even whole countries. Widely used types of bibliometric measures, and selected examples, include:

quantity	number of papers published (in field, etc.) per capita
quality/impact	CAV = average number of citations per paper (in field, etc.)
leadership	percent of world’s top 1% most-cited papers (in field, etc.)
priority	percent of total papers devoted to a specific field/area/target
world ratio	ratio of a national measure to the world average for that measure
world rank	ordinal rankings of countries, etc. by a given measure (1 st , 2 nd , ...) Note: This highly non-quantitative measure ignores differences between widely and closely spaced entities.

Two recent reports by the S. Neaman Institute of the Technion – Israel Institute of Technology, a concise 16-page report by G. Czapski and Y. Ilan (October 2004, English) and a longer 202-page report by the same authors plus D. Getz and M. Shumaf - Tehawkho (August 2006, Hebrew), provide such bibliometric data for Israel, including the following areas of potential interest to biomedical research (the 2006 report includes only the first three):

- * Biology/Biochemistry
- * Molecular Biology/Genetics
- * Clinical Medicine
- * Immunology
- * Microbiology
- * Neurosciences/Behavior
- * Pharmacology
- * Plant/Animal Sciences

All data are from 1999-2003, unless otherwise noted. To provide a sense of scale, the populations and GDP's of selected countries (OECD data for 2005) are provided in Appendix A.

Overview. During 1999-2003, Israel published more papers per million population (about 800, all fields) than any of the 23 countries studied, except for Switzerland and Sweden. It also ranked among the five top publishers (in quantity) per capita in many specific fields, including: Biology/Biochemistry, Clinical Medicine, Immunology, Molecular Biology and Neurosciences. As the following table shows, this admirable propensity to publish was not always matched by equally admirable quality and impact as measured by citation (CAV) measures, except in Molecular Biology.

Field	CAV Israel*	CAV (Israel) ÷ CAV (World)*	Quality Rank	% Israel's Total Papers	% Israel's TOP Papers	<u>% TOP Pub.</u> <u>%Total Pub.</u>
Biology/ Biochemistry	7.41	1.02	10	7.3	5.3	0.73
Clinical Medicine	4.42	0.89	31	27.0**	19.2**	0.71
Immunology	9.22	0.91	15	1.9	1.0	0.52
Microbiology	6.11	0.93	17	1.7	0.4	0.24
Molecular Biology	16.80	1.33	4	3.2	3.1	0.97
Neurosciences	7.36	0.96	10	4.5	2.7	0.60
Pharmacology	4.57	1.00	14	1.3	1.0	0.77
Plants/Animals Science	3.38	1.21	10	5.5	5.6	1.02
Physics (for comparison)	4.79	1.34	9	14.8	18.9	1.28
Computers (for comparison)	1.62	1.29	3	2.2	4.5	2.05

* Data for longer period, 1993-2003

** About 25% of most countries' publications are in this field.

Quality does not always correlate with quantity, and Israel's CI = citation index = CAV (Israel)/CAV (World) quality measure (column 3) substantially exceeded world standards only in Molecular Biology (ranking 4th worldwide) and in Plant and Animal Sciences. Two other fields, Biology/Biochemistry (1.02) and Pharmacology (1.00), just barely met world standards. The rest were substantially *below* world standards, and even further behind Israeli "leadership" fields such as Computer Sciences and Physics (included for comparison).

"Leadership" can be (roughly) gauged by how many of the world's 1% most-cited ("TOP" papers Israel produces. This subset is presumed to be highly enriched in "hot" papers in "hot" fields. As a country, Israel published a respectable 1.161 such papers (1.42% of world total) during 1999-2003. The top ratings for the medical research-related fields studied are rather disappointing. Although 7.3% of all Israeli papers are in Biology/Biochemistry, only 5.3% of Israel's top papers were in those fields. Only Molecular Biology is about equally represented in Israel's TOP (3.1%) and all-papers (3.2%) databases. The easiest way to capture these comparisons is to define a new intra-national "Excellence" measure for each field, namely (% of Israel's TOP papers) / (% of all Israeli papers). As shown in the last column of the above table, this Excellence ratio is about 1.0 only for Molecular Biology and Plants/Animals Sciences. The other Excellence ratings range from disappointing (0.60-0.77) to disturbing (0.24-0.52). All contrast strongly with such Israeli "leadership" fields as Physics (1.28) and Computer Science (2.05). Thus biomedical research, as a whole, does not seem to be a prominent peak in Israel's Excellence landscape.

Since Israeli biomedical researchers are quite active, publish avidly, and are quite intelligent and highly trained, these bibliometric results suggest (with all the usual caveats) that we may need additional insights into the causes of this disparity to help more researchers in these fields achieve their full potential in the international arena.

International Comparisons. It is also instructive to (cautiously) compare Israel's bibliometric record and profile with that of other countries. Three fields of special interest are discussed below (based on the 2006 report). Data on additional fields can be found in the 2004 report, although they are hard to interpret in black-and-white.

Biology/Biochemistry represents the broadest, most basic scientific underpinning of biomedical research, and Israel published an impressive 1.23% of the world's publications in this area in 1999-2003, some 112.8 papers per million population. While ranked fifth in quantity (after Denmark, Sweden, Switzerland and Finland), it came in tenth only in CAV quality (7.41), barely exceeding the world average (7.26). However, after front-runner Switzerland (10.38), the next tier, led by Denmark/Sweden/Finland (7.65-7.85), clusters tightly (one problem with nonquantitative ordinal rankings). Thus, Israel's record here seems respectable, if not exciting.

Molecular Biology/Genetics is highly relevant to modern biomedical research and is Israel's best shot (along with Plant/Animal Sciences) in this general area. Israel published a dramatic 1.4% of the world's publications, some 50.1 per million population, a record exceeded only by Switzerland (80.3) and Sweden (53.26). In CAV quality measures, Israel (16.80) ranked a dramatic fourth, a record exceeded only by Ireland (23.16), Austria (17.58) and the USA (16.82).

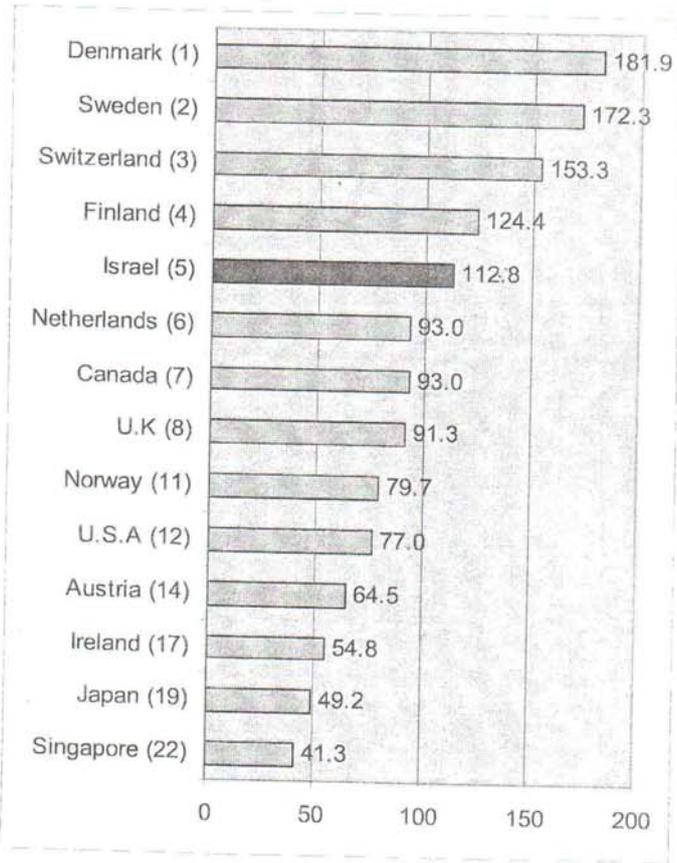
(Since intra-USA citations are a known anomaly, and since Ireland published only 310 papers in all, Israel's showing is even more impressive). This area has an outstanding citation index (CI) of 1.33, about the same as Physics (1.34), but comparatively fewer papers in the very highest (1% most cited) echelon, even when corrected for total papers published (see table).

Clinical Medicine accounts for 24% of all world scientific papers and 27% of all Israeli papers. In quantity, Israel ranks fourth, publishing 417.6 papers per million population, about 1.4% of the world's total. However, Israel's citation quality rankings in this area were quite low: 22nd place in CAV and 31st place in CI. Its CAV of 4.42 citations/paper contrasts rather starkly with Finland/Netherlands/Denmark (6.94-7.06) and is below the world average of 4.96. Clinical Medicine is, of course, unique in that much – indeed most – of it is done in a hospital, not university, setting. Some 70% of Israel's papers in this area originated in hospitals, and only 30% originated in universities (including the Weizmann Institute). In contrast, only 47% of Israel's 100 most cited papers in this area originated in hospitals (compared to 53% from universities). This suggests that the special challenges facing Israeli hospital research and researchers must also be taken into account.

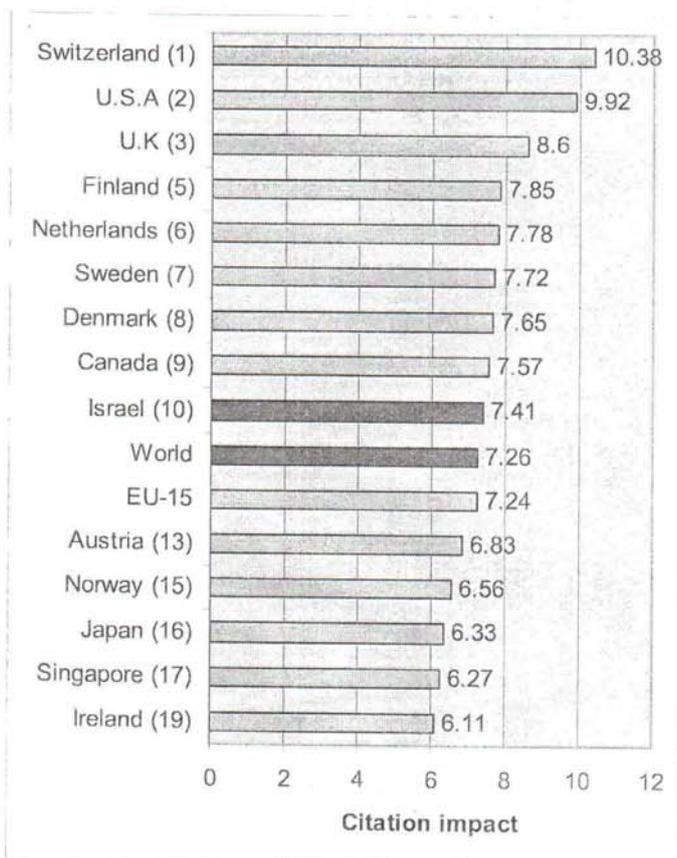
In conclusion, Israel's stellar record in several other research areas and, on the average, lackluster performance in the biomedical sciences (despite isolated peaks of excellence) suggests that much more can and should be done to realize Israel's full potential in this important area.

Tables IA, IB. Publications in Biology and Biochemistry (1999-2003)

IA. Quantity Indicator.
Number of papers in field
per one-million population

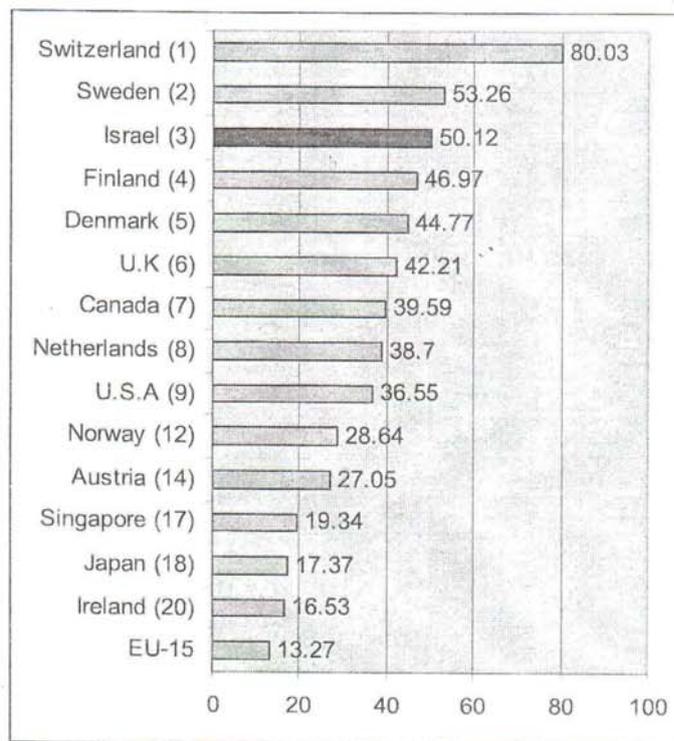


IB. Quality Indicator.
Average number of citations
per paper in field

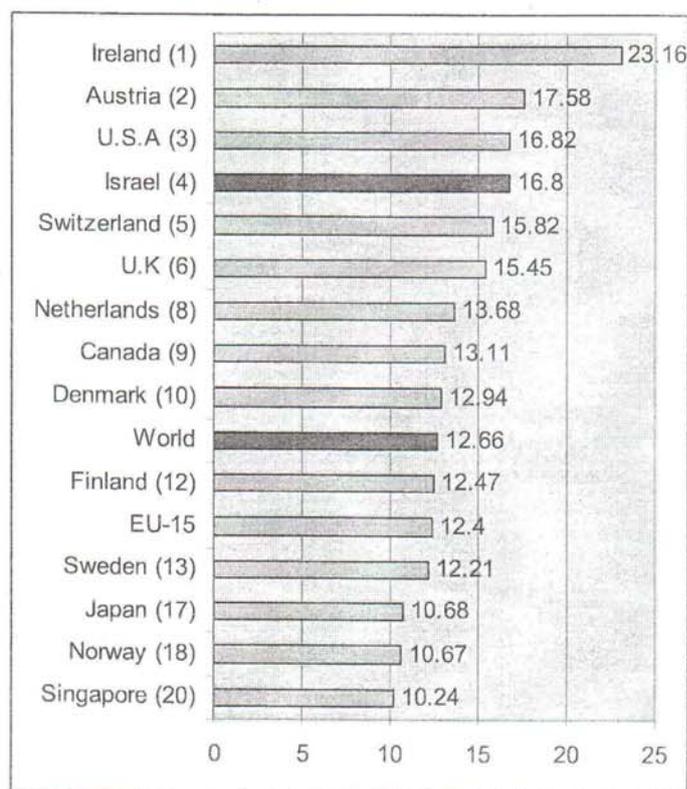


Tables 2A, 2B. Publications in Molecular Biology/Genetics (1999-2003)

2A. Quantity Indicator.
Number of papers in field
per one-million population

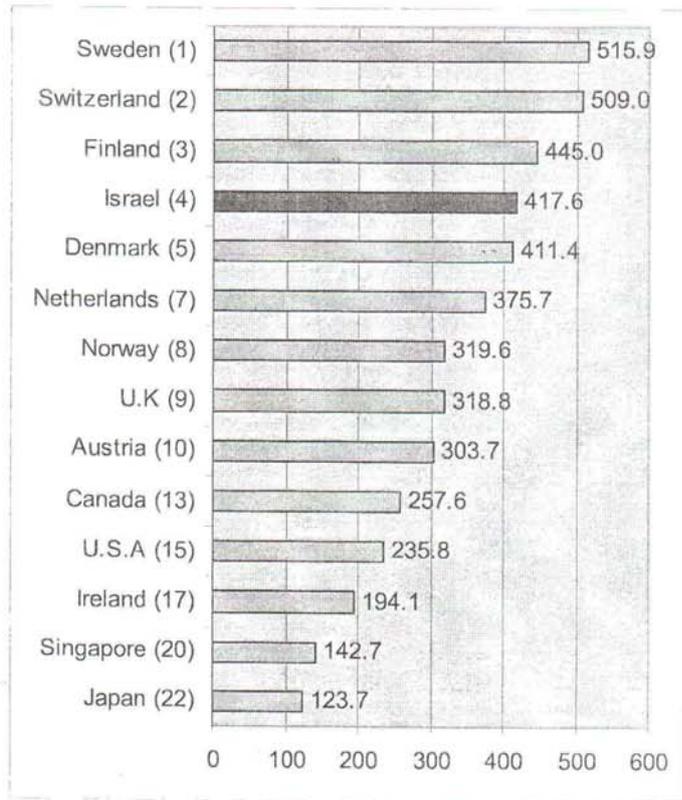


2B. Quality Indicator.
Average number of citations
per paper in field

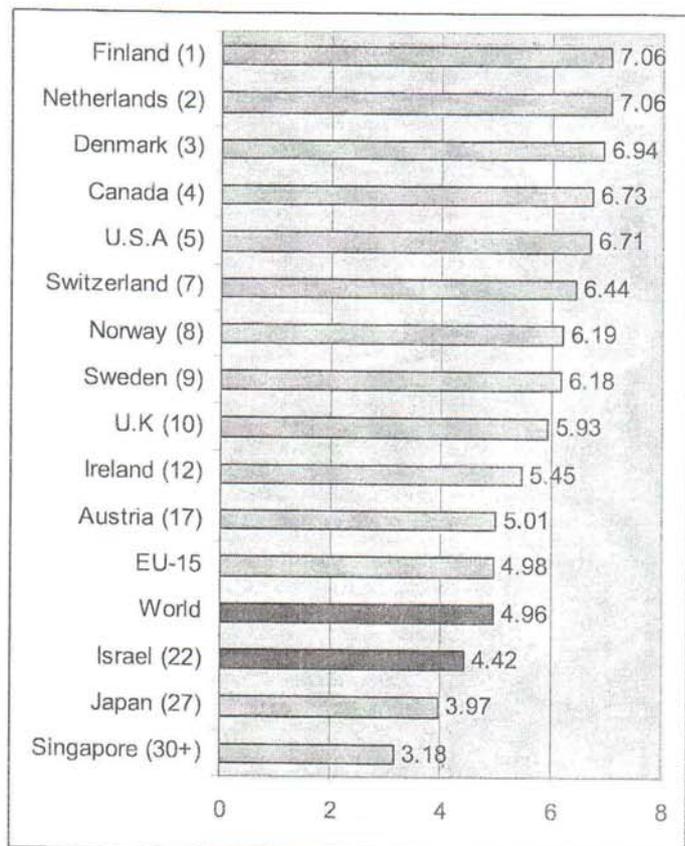


Tables 3A, 3B. Publications in Clinical Medicine (1999-2003)

3A. Quantity Indicator.
Number of papers in field
per one-million population



3B. Quality Indicator.
Average number of citations
per paper in field



Appendix A. Populations and GDP (2005) of Selected Countries

Country	Population (K)	GDP (\$M)
Israel	6,930	185,802
Austria	20,213	277,920
Canada	31,946	1,075,680
Denmark	5,403	184,638
Finland	5,227	162,485
Ireland	4,059	159,239
Japan	127,687	3,970,601
Netherlands	16,273	555,450
Norway	4,591	199,735
Sweden	8,994	295,139
Switzerland	7,483	269,971
U.K.	59,855	1,931,767
U.S.A.	293,951	12,431,882