Committee for the Evaluation of Biology/Life Sciences Study Programs

General Report

March 2011

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Chapter 1 - Background

At its meeting on October 23, 2007 the Council for Higher Education (CHE) decided to evaluate study programs in the field of Biology/Life Sciences during the academic year 2007-2008.

Following the decision of the CHE, the Minister of Education, who serves ex officio as the Chair of the CHE, appointed an Evaluation Committee for the evaluation of the academic quality of biology/Life Sciences studies in Israel. The Committee consists of:

- **Prof. Michael Levitt, Department of Structural Biology, School of Medicine, Stanford University, USA - Committee Chair**
- **Prof. Ueli Aebi, M.E. Muller Institute for Structural Biology Biozentrum, University of Basel, Switzerland**
- **Prof. Yigal Cohen, Faculty of Life Sciences, Bar Ilan University, Israel**
- **Prof. Nicole Le Douarin, Institute of Embryology, College de France, France**[1]
- **Prof. Shlomo Rotshenker, Department of Medical Neurobiology, The Hebrew University Medical School, Israel**
- **Prof. Daniel Simberloff, Department of Ecology and Evolutionary Biology, University of Tennessee, USA**

Ms. Marissa Gross- Coordinator of the Committee on behalf of the CHE.

Within the framework of its activity, the Committee was requested to submit the following documents to the CHE:

1. A final report for each of the institutions, which would include an evaluation of Life Sciences study programs, the Committee's findings and recommendations.
2. A general report regarding the status of the evaluated field of study in Israeli institutions of higher education.
3. Recommendations for standards in the evaluated field of study.

The Committee's letter of appointment is attached as **Appendix 1**.

The first stage of the quality assessment process consisted of self-evaluation, including the preparation of a self-evaluation report by the institutions under evaluation. This process was conducted in accordance with the CHE's guidelines as specified in the document entitled "The Self-Evaluation Process: Recommendations and Guidelines" (October 2007).

[1] Prof. Le Douarin was unable attend the second round of visits due to personal reasons.

Chapter 2 - Committee Procedures

The Committee held its first meetings on May 8, 2009. At this meeting committee members were given an overview of higher education in Israel and a description of the Israeli CHE. They also discussed Biology/Life Sciences study programs in Israel and fundamental issues concerning the Committee's quality assessment activity.

During May 2009 Committee members conducted full-day visits to two of the eight institutions whose Biology/Life Sciences study programs the Committee was requested to examine: Hebrew University in Jerusalem and Tel Aviv University. The Committee visited the remaining six institutions, Ariel University Center, Bar Ilan University, the Open University of Israel, the Weizmann Institute of Science, the Technion- Israel Institute of Technology, and Ben Gurion University during March 2010.

During these meetings, the Committee met with the relevant officials at each institution, as well as with faculty members, students, and also conducted a tour of the campus.

This report deals with the general state of Biology/Life Sciences Programs in Israel.

Chapter 3 - Evaluation of Biology/Life Sciences Study Programs in Israel*

3.1 Introduction to General Report

This report discusses some general issues that arose as a result of our evaluations of the eight Life Sciences institutions listed above. These issues include: The Life Sciences Curriculum; Status of Education and Research in Ecology, Evolution, and Biodiversity in Israel's Universities; Academic Inbreeding; Financial Support for Students; and Objective Evaluation of Research Productivity.

3.2 The Life Sciences Curriculum as Taught in Israel

What is a good curriculum? This is a difficult issue that we did not deal with as such. Nevertheless, time and again our committee raised the issue of missing courses in one institute or another or expressed concern that there is too much emphasis on a specific discipline.

Our overall view is that:

(i) Undergraduates are supposed to get a broad view of the different disciplines in biology before they focus on one or another aspect. This grounding should be based on mandatory courses. We were also concerned about the real availability of electives.

(ii) Basic sciences such as chemistry, physics, math etc. must be based on mandatory courses.

(iii) Specialized tracks can be offered only after suitable background has been given (see (i) above) and they should be truly different (at least by 25%) thanks to a combination between mandatory and elective courses.

(iv) Wet labs for all are important.

(v) Individual research projects are to be encouraged.

With respect to points (ii) and (iii) Israeli universities are hamstrung by the fact that the typical undergraduate degree program leading to a BSc is 3 years, rather than 4 years as in the US and in many other nations (e.g., Canada). Typically, in the US, electives are a big part of the 4th year, and the 4th year increasingly includes some sort of capstone course or exercise integrating previous coursework and projects. Biology in particular, with its strong links to math, chemistry, physics, and statistics, tends to have more "general" prerequisites than many other subjects. How exactly Israeli universities can balance the 3-year BSc program with the need for adequate preparation for grad school, e.g via a MSc program that includes "tracks" and electives, is a

** This Report relates to the situation current at the time of the visit to the institution, and does not take account of any changes that may have occurred subsequently. The Report records the conclusions reached by the Evaluation Committee based on the documentation provided by the institution, information gained through interviews, discussion and observation as well as other information available to the Committee.*

real challenge.

Further, American and Canadian universities view the bachelor's degree as being a broad learning experience rather than just study of a particular major needed for graduate work. It is also supposed to represent the last time a student takes formal courses in a variety of fields (e.g., social sciences and humanities, for a science major) that will make her/him a well-informed, well-rounded citizen.

We do note that Israeli students beginning their first degree are older and consequently more mature than there American counterparts. They also likely had a better basis in the hard sciences than those from an average American high-school. Indeed, the Committee was very impressed by the enthusiasm for difficult and time-consuming research projects that undergraduates in Life Sciences undertake.

3.3 Status of Education and Research in Ecology, Evolution, and Biodiversity in Israel's Universities

This section is based on notes taken during our site visits, the self-studies provided by the universities, and a document presented to us by 2 faculty members during the site visit to Ben-Gurion University. The document was compiled by 15 faculty from Tel Aviv University, Hebrew University of Jerusalem, University of Haifa-Oranim, the Weizmann Institute of Science, and the Blaustein Center for Scientific Cooperation (associated with Ben-Gurion University) with additional input from faculty at Bar Ilan University, Ben-Gurion University, Israel Oceanographic & Limnological Research, and the Israel Academy of Sciences and Humanities.

With the single exception of one institution of the eight reviewed, the Committee found the status of education and research in ecology, evolution, and biodiversity to be at best in decline and at worst nearly non-existent in our site visits and perusal of the self-study reports. This is in stark contrast with global trends in science. Even at the one institution mentioned above, there are substantial gaps in these areas of research. This impression of the overall status of these fields in Israel was confirmed by general statistics presented in the document received at BGU (data from our visits and the self-evaluations were virtually identical to those presented in the document). However, the Committee did not visit those few institutions that contribute (or have contributed in the past) strength to these disciplines, most notably the University of Haifa, the HUJ Faculty of Agriculture at Rehovot, and the Blaustein Center of Ben-Gurion University.

Currently, approximately 87 researchers are employed in these fields in Israel, down from ca. 99 a decade ago. Many recent retirements of notable researchers in these areas have not led to replacements. Further, a large number of leaders in these fields will retire in the next 5 years (e.g., at two universities, at least 30% of the current biodiversity-related faculty will retire within this time frame). The document notes that the total number of faculty positions in Israeli research universities has increased whereas the number of

faculty working in biodiversity-related disciplines has declined. As another striking statistic, only 2 researchers in Israeli institutions focus on aquatic systems (including the only wetland ecologist), and both are scheduled to retire within 5 years. There are similarly only 2 researchers who focus on ecology, evolution, and related aspects of fish biology, also retiring within 5 years. The nation's only ecotoxicologist will retire within 3 years.

These are all fields in which great expertise is needed for effective environmental management, yet these and related fields are being phased out in Israel. Moreover, Israel has a modern, even model, agriculture, yet the decline or loss of expertise in insect and fungal populations and community ecology in the higher education system will surely hinder important training and development.

Particularly striking is the total or nearly total absence of research and instruction in Israel in certain areas of biodiversity research that are globally in the forefront today. Aspects of modern evolution and their relationship to ecology and biodiversity are barely present on the Israeli research scene. For instance, even at the one institution with a vigorous ecology program, there is only one evolution course, and no faculty there or elsewhere in Israel conduct research at the interface of phylogenetic systematics with various aspects of ecology, one of the main growing points in ecology and evolution. Graduate students we encountered during the review who were conducting research in this general area confirmed that they are to a large extent self-directed. Similarly, interactions between the below-ground and above-ground communities within ecosystems, probably the area of ecology that is globally exciting the most current interest (and that is of the utmost importance with respect to a myriad of environmental problems), is barely studied in Israel. Ecosystem ecology as a whole is quite poorly developed in Israel, and thus the intersection of ecosystem ecology with economics and sociology, a major current research thrust globally, is effectively absent.

At the universities that were historically the locus of these fields in Israel, that trained and continue to train most current faculty, and that still enroll the most students, these areas of research are currently in rapid decline. Although there are still important researchers and good graduate students, plus substantial undergraduate courses, the number of faculty and courses in ecology, evolution, biodiversity studies, and organismal biology in general are unsatisfactory if the Life Sciences programs aspire to compete with world-class institutions in these fields. Institutions that traditionally lacked strength in these areas have not improved. Only one institution with substantial strength in ecology, biodiversity, and related fields appears committed to maintaining this strength. Even in this program, there is a lack of ecosystem-level researchers and courses that typify leading programs in Europe and North America.

The Committee did not visit the University of Haifa, which has significant strength in these areas. The Biology Department at the Oranim campus has several researchers in the areas of ecology, evolution, and biodiversity, and numerous courses, including field courses. Graduate students are based

wholly or largely at the Mt. Carmel campus, however; the Department of Evolutionary and Environmental Biology there has several faculty in these areas. Thus, there are the makings of a substantial program in these disciplines at the University of Haifa. However, 5 faculty at the two campuses are scheduled to retire in the next 5 years. Further, the Biology Department at Oranim does not receive support from the CHE, and thus faculty suffer substantially in terms of teaching loads, lack of startup money and assistantships, and salary. The University of Haifa, as do the other institutions, lacks research and instructional strength in certain key areas of ecology and evolution (as noted above), but it is a potentially bright spot (albeit a tenuous one) in a generally depressing picture.

In sum, Israel still has strong ecologists and evolutionary biologists, but in spite of the marked upward global trajectory of growth in these fields, research and education in ecology, evolution, and biodiversity in Israel are not as strong as in the past. The nation as a whole will struggle to train the next generation of researchers and teachers in these fields of great societal relevance. In research in these disciplines, Israel lags behind Denmark, Sweden, Finland, New Zealand, South Africa, and Ireland/Northern Ireland. This situation puts into question Israel's ability to meet its national needs in research, conservation, and sustainable exploitation of its natural resources for the provision of ecosystem services, agriculture, biotechnology, and environmental health. It is still possible to strengthen these fields in Israel thanks to a core of scientists remaining in Israeli universities, but such a process would have to begin quickly.

3.4 Academic Inbreeding

"Academic inbreeding" refers to two phenomena in higher education: (i) a tendency for students to stay at the same institution for both undergraduate and graduate degrees, and (ii) a tendency for universities to hire their own doctoral graduates as faculty members. In general, it appears to the Committee that life sciences faculties in Israel are substantially inbred at both levels - some more than other, but all of them more than a Life Sciences department in a typical university in the United States. There are different perspectives on the causes and net effects of such inbreeding.

The potential harm of the second phenomenon, a university's hiring its own doctoral graduates as faculty, was first noted in 1908 by the most prominent university educator in the United States, President Charles Eliot of Harvard University. Since then, several studies have shown that, on average, "inbred" faculty have less recognition and are less productive scientifically than "outbred" faculty. We emphasize that this is an average tendency, and individual inbred faculty may be extremely productive. In addition to matters of productivity and recognition, it has also been suggested that inbred faculties may tend to become fossilized or narrowly canalized in their approaches to their field of study, or may tend to pursue directions that are "traditional" rather than growing points in the field.

Concern with faculty inbreeding is generally about initial hires, at the lecturer

or assistant professor level. It does not relate to hiring a more senior faculty member who has established a research program and reputation elsewhere but then returns to the institution at which he or she earned the PhD.

Academic inbreeding of the first type, students staying at the same university for both undergraduate and graduate degrees (see above), has been less well-studied than faculty inbreeding in the formal education literature, but it is generally frowned upon as not in the best interests of good undergraduates. The rationale is that it is healthy for a person intending to do graduate work in a discipline to be exposed to a new set of faculty members and different perspectives, and that such exposure will lead to greater creativity and productivity in later life. The stigma of having all one's degrees from a single institution, and especially from a single department, is greater for a student aiming for an academic position than for one planning a career in business (for instance, in a pharmaceutical firm). As with inbreeding at the faculty level, in individual instances it may be advantageous for a student to stay in the same institution. For instance, a person may plan to earn a graduate degree in a different field than that in which he or she earned a bachelor's degree. Or there may be compelling economic and/or geographic reasons to stay at one university (e.g., a spouse whose job or student position is at a local university, and there are no nearby universities with appropriate graduate programs). Or a university's graduate program in a particular field may be so far superior to that of any other university that the advantages of staying outweigh the disadvantages of inbreeding.

From the standpoint of the university, a high proportion of graduate students who were undergraduates in the same institution could be viewed as simply a reflection of an excellent program that students tend to be very satisfied with. On the other hand, it could reflect the inability of the program to attract good students from other universities. The assumption in the U.S. is that the latter is the case, and leading university graduate departments are loath to admit a large fraction of their students from among their own undergraduates.

Generalizing these concerns to Israel with its much smaller number of possible academic institutions must be done with due caution. Here students and postdocs at all levels return to their home institution for their academic career (which is why the Weizmann Institute needs a Graduate School). Under these circumstances, a student moving to a different place for the next rung of the ladder may be seen to reflect negatively on their home institute. Nevertheless, there seems to be an exception at the level of recruiting junior faculty. There is a common pool of applicants and every place tries to get the best possible junior faculty. Statistically, more of these must come from non-home institutes so that an institution that gets more non-home recruits is likely doing very well.

3.5 Financial Support for Students

For many students, the level of financial support is a major factor (sometimes the major factor) for making a decision in which institute they will enroll. The reason is that students in Israel are older than their counterparts world-wide.

A much higher proportion is married and may indeed support families. Clearly there is a need for Masters and PhD students to receive a reasonable level of financial support. In the life sciences, such support is taken for granted in the US and UK. In fact, in the US, the National Institutes of Health mandates a minimal level for such support irrespective of the local cost of living. During our evaluations of Life Sciences in Israel, we were surprised to see how different institutions have different levels of support and different rules associated with such support (see Table 1, below).

Financial support can include of (i) stipend (all institutions but level differs), (ii) a TA position (some institutions and always part time), and (iii) exemption from tuition (some institutions). Financial support comes from the PI and/or the institution. The relative contribution of each varies between institutions. Support by PIs is problematic for two reasons; first, it may involve a considerable fraction of the PI's budget, hindering research; second, PIs may not be able to sustain a constant research budget at all times, which, in turn, may cut or reduce support for students.

It is of national interest to ensure that students get basic financial support as otherwise students need to do jobs unrelated to their studies, which has a

Table 1. Support for MS and PhD Students

Institution	Student Stipend (NIS/month)		Comments
	MSc	PhD	
TAU	2,520	4,179	PHD students given a free choice of lab after a rotation. They get their own money at 175% of a normal stipend. The hosting lab pays 35 to 40% for a student. High costs of TAs that is between 500 NIS and 4000 NIS. Follows Weizmann scale of 175%. Normally [pay is] 125%. Only have to get part of TA money. 25% added. There are two systems running in parallel for PhD students: (i) The direct PhD students get fellowships form the Dean. They can choose any department and we compete for them. There are equal numbers in each department.
HUJI	3,089	3,202	The official teaching load of a full teaching assistant position is 22 weekly hours. PhD students are awarded a 40% position and MSc students a 25% position (4 and 2 hours respectively). Funding for the PhD is only for 4 years. Over 4 years, students must find their own funding.
BAR ILAN	2,080	3,333	70% of TAs have funding. Faculty do not take students who are not good enough to obtain Presidential scholarships. PhD students must finish in 4 years or there is a financial penalty. Students with full scholarships must sign a form committing all weekly hours to BIU. Students do not have to pay tuition fees with the scholarship. If advisors lose their funding, the student is safe.
Weizmann	4,600	6,890	All students receive full time scholarships. They all receive the same salary irrespective of the amount of funding a lab has.
Technion	3,911	5,063	Number of TAs is approx. the number of PhD students. There is a workshop for TAs on how to teach, and present. The university does not allow students with a scholarship to work anywhere else. Two and half students are free to each researcher. Every person who is accepted to the program will get a scholarship.
Ben Gurion	3,640	4,560	About 80% of MSc and PhD students are TAs. Almost all do some teaching in the beginning of the year. The other 20% are either supported by their PI or not supported. In order to get financial support from the university, they must work for it. Students do not have to pay tuition fees with the scholarship.

negative impact on studies and research. Our Committee maintains that research students need to receive sufficient funding to allow a basic standard of living taking into account their age and family situation. We also felt that in the absence of a sustainable level of financial support it is wrong to ask students to sign a statement agreeing not to earn additional sustenance. We recommend that the CHE examines this issue further.

3.6 Quality of PhD Students in Life Sciences in Israel

The Committee was unanimous in their praise for the exceptional level of Israeli PhD students. The many students we met (about one hundred) were enthusiastic, deeply involved and eloquent. They seem to be really excited both by their academic studies as well as their research projects. Overall, the PhD students here seem as good as or better than those at the best institutions worldwide. In fact, we concluded that in Israel the BS students are like MS students abroad, the MS students are like PhD students abroad and the PhD students are like postdocs abroad. This likely arises from the fact that almost all students are three years older, more experienced and more mature than their counterparts abroad. This unexpected consequence of military service in Israel provides a remarkably important boost to the level of Life Sciences in Israel.

3.7 Quality of Junior Faculty in Life Sciences in Israel

The Committee were exceptionally impressed by the many junior faculty we met (almost all faculty recruited in the past five years). Even more so than the exceptional BS, MS and PhD students in Israel, the newly recruited young faculty will decide the fate of Life Sciences in Israel. Somewhat unexpected is that the lack of sufficient positions to accommodate all the exceptionally talented young scientists who return to Israel after successful post doctoral studies abroad, has led to intense competition for the best people. It has also meant that institutions that have less strong records of research in Life Sciences are able to recruit young faculty who are the best in the world. In a situation where the best people are wanted by all, some institutions are able to make a huge difference by their aggressive recruiting policies that are often directed by powerful and enthusiastic Deans of Life Science faculties or even University Presidents. Incentives provided to these young super-stars include significant start-up funds, reduced teaching loads, housing in new buildings, etc. We applaud such efforts and are convinced that will lead to a leveling up of the quality of Life Sciences research in Israel.

It is essential that such outstanding recruiting efforts are not spoiled by existing, sometimes long-standing, practices for promotion to tenures faculty positions. Nowadays the competition for the best of the best is so fierce that even Harvard cannot afford the “Harvard Model” for tenure where several young faculty are hired with the expectation that only a third or so will make it. Instead, there is wide-spread adoption of the “Stanford-Model”, where junior faculty are hired with the expectation of getting tenure and that junior faculty are mentored as needed to insure that this happens. The Committee believes

that tenure decisions need to be made by a representative forum and that the ability to influence the outcome needs to be heavily weighted towards those tenured faculty closest academically to the candidates. We also note that aggressive recruiting of junior faculty who become tenured will help correct the top-heavy nature of some of the institutions with many Full Professors.

3.8 Objective Evaluation of Research Productivity

Objective, automated research evaluation is becoming a world-wide priority. Even at the US National Institutes of Health, where massive resources have traditionally been invested in careful, time-consuming peer review, there has been a recent focus on automated evaluation (see Fig. 1). Such evaluation is surprisingly difficult even though it is relatively easy to find the publications of a particular author as well as the number of citations to these papers. While Google Scholar is easy and freely accessible, it is not considered the most reliable source in that it finds many fewer papers than are found by commercial resources like the Web of Science or Scopus. Getting the publications for a particular individual usually at a particular institution and for a particular period of time is easy provided that family names are unique within that organization.

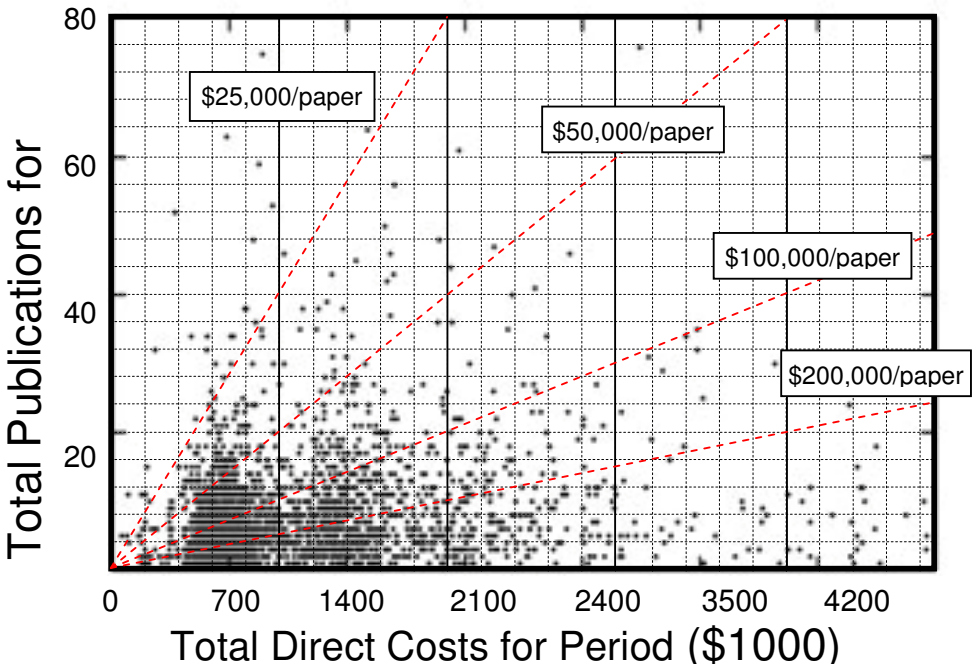

Figure 1. A plot of the number of grant-linked publications from 2007 to mid-2010 for 2,938 investigators who held at least one NIGMS R01 or P01 grant in Fiscal Year 2006 as a function of the total direct cost of their grants over the same period. (Dr. Jeremy Berg, Director National Institutes of General Medicine, https://loop.nigms.nih.gov/index.php/2010/11/22/another-look-at-measuring-the-scientific-output-and-impact-of-nigms-grants/ and http://www.nature.com/news/2010/101116/full/468356a.html)

Academic scholarship is often evaluated by the volume of the work (how many papers), but other measures include the impact of the journals (a journal's Impact Factor is the number of times an average article is cited

during the given year) and the significance of the work (how many times the actual papers are cited).

Each of these measures has its own shortcoming. (i) The number of papers ignores the fact that papers differ hugely in quality and journals differ as much in the rigor of their peer review. (ii) The number of citations depends on the time elapsed since a paper was published; if research is evaluated over a 5 year period, papers published early will have much greater exposure and likely be cited more often than papers published late in the period. (iii) The Impact Factor measures the average paper and not the paper under consideration. Only a small fraction of journals (about 25% of the total of almost 30,000) have Impact Factors assigned to them by the Web of Science.

These different measures are also more or less easy to find. (i) Counting papers is easiest. (ii) Looking up the impact factors for journals is relatively easy but care needs to be taken to use the most up-to-date lists and also to use the correct journal abbreviations. (iii) Summing citations and normalizing by years elapsed is most difficult and requires large volumes of data to be downloaded from the Web of Science or Scopus.

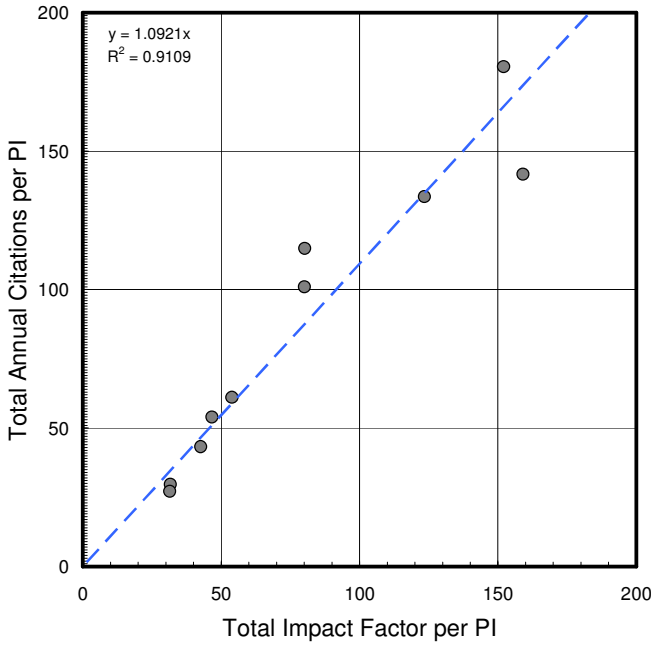

Figure 2. Relating Impact of Israeli Life Science to Top Life Science World-wide. Each point is for a particular Life Science institution in Israel or abroad. The Impact per PI in Life Science groups in the UK (MRC Cambridge) and the US (Harvard, Yale and Stanford) is better than that at all the Israeli institutions that we evaluated.

Relating Impact of Israeli Life Sciences to Top Life Sciences World-wide. In the analysis of research productivity done for Israeli Life Sciences, we looked at all three measures. Citations were normalized to an annual count by dividing by the number of years since publication. In Figure 2 we show that for a given institution, the Total Annual Citations per PI is almost the same as the total Impact Factor. It is also clear that while the best places in the world are better in terms of Impact than Life Sciences institutions in Israel, differences are small and uncertainties are large. The overall impact of Israeli research in the Life Sciences compares very favorably with that of most European countries, the UK and the US.

Cost of Scientific Research Output. In our analysis, we also calculated research productivity in terms of the cost per papers (total research dollars divided by number of papers) as well as the cost per annual citation count. Such quantization may seem out of line with the need to read papers carefully, be an expert in the field and evaluate work with all due attention (and subjectivity). That said, we live in the age of information and such measures will be used. It is interesting how the use of the h-index spread so rapidly after Hirsch's 2005 PNAS paper (itself cited over 1,300 times).

Recently, Dr. Jeremy Berg, the Director of the largest US National Institutes of Health Institute, General Medicine, surveyed the research output of the holders of almost 3,000 NIH grants (about half the total) and plotted the total number of papers in a three-and-a-half year period against the total direct NIH funding of each principal investigator for the same period (see Figure 1). The added red lines show different costs per paper of a particular investigator. The values we calculated for Israeli Life Sciences are between $60,000 and $140,000 in good agreement with the NIH data.

3.9 Electronic Journals

The Committee was surprised to learn that Israeli Life Sciences institutions do not have universal access to the top electronic journals in each field; some young faculty returning from abroad said that this inadequacy hampered their research. We know that there are national programs to provide such access at a cost that is not exorbitant hence our surprise. This is a difficult issue with almost 30,000 different journals (increasing at about a 1,000 new journals a year) and publishers charging as much as the market will bear. It may need to be re-examined at the national level.

Chapter 4 – Concluding Remarks

Our Committee is well-positioned to comment on the overall Council of Higher Educations review process as it applies to the Life Sciences. The initial self-evaluation involved a large amount of written material that we were given on paper and electronically. In general the institutions responded well to the requirements although formatting was inconsistent and made reading more difficult. Some of the larger Excel tables were also difficult to work with.

In our site visits we found a variable level of enthusiasm in the need for self-evaluation. Some places found that it had been enormously useful. As an activity that all faculty were involved in, it led to a greater self-awareness and group cohesion. Others regarded the process as unduly intrusive. US researchers on our Committee were surprised by the lack of appreciation for the value of self-evaluation.

Finally, it is hard to describe just how much work the Committee invested in this process with some three weeks of site visits and many, many hours of report reading, discussions, report writing, research productivity evaluation, responding to issues which arose, etc. We hope that we have been successful at this task which can never be perfect. The recommendations we have made have all been drafted with care and made with the best possible intentions.