Editorial

Exploiting biodiversity in the marine environment: a personal perspective

A few years ago, I had the opportunity to visit Tribhuvan University, outside Katmandu. I had been invited to visit the Department of Chemistry, and to talk with some of the scientists about potential biotechnological development. During the course of my visit, I was taken to visit a laboratory housed in a small building at the edge of a forest. The building had two entrances, one of which was padlocked. The other entrance led into a small laboratory. As might be expected, the laboratory I saw was rather sparsely stocked with some glassware, boxes, an oven, a small incubator and a rather primitive autoclave. The shelves had a few bottles of various solutions. There was one person in the laboratory washing glassware. On the opposite side of the room was a small door which was also padlocked, and a couple of signs in Newar, Hindi and English. One sign said. 'No Entrance Without Permission'. The other sign said 'Danger Keep Out!!' The response to my question as to what went on in the padlocked section of the field laboratory was not surprising, 'I don't know' was the response of my host. 'Why can't we go inside?' I asked, rather naively. 'The lab' is run by a team from – (*and he named another country*). 'Part of the contract states clearly that we are not allowed inside without permission'. 'Does the university receive anything for allowing a foreign company to set up a facility on its campus?' I asked. 'Of course', my host replied. He then went to a wooden crate which was also locked, asked for the key and took out a small colorimeter often used in student laboratories in the West. 'Where is the team now?' I asked. 'Can I meet them?' 'They are away in the South in the jungles of the Terai region collecting samples.' I later learned that the company was looking for new plant varieties in various jungles and forests, which might yield extracts with activities similar to the anticancer drug Taxol.

Needless to say, I was outraged by the obvious exploitation of the naivety of the Nepalese. Why should a foreign or even a domestic company be allowed to get away with this takeover of someone else's resource? The event described above took place just before the Rio Conference of 1992, which resulted in the establishment of the landmark Convention of Biodiversity (CBD). The CBD was ratified by most of the world at the time; the US a notable exception. One of the key objectives of the CBD

is to ensure an equitable sharing in the benefits arising from the industrial and commercial development of a genetic resource. Despite the ambiguities arising from an unclear definition of 'equitable', the spirit of the CBD offers an ethical framework in which the parties can negotiate. The outcome of such an exercise is anticipated to generate a 'win-win' result. Implicit in this assumption is that the negotiator on behalf of the suppliers of the genetic resource, have sufficient knowledge and understanding to bargain successfully.

In open systems such as marine environments the situation can be even more complicated. As an example, consider the effect of metagenomics on modern marine biotechnology. Since only about 0.05%–0.1% of the total population of bacteria in the oceans are culturable, a large-scale screening program designed to survey the microbial diversity in the world's oceans is not realistic unless there is a high-throughput system for screening and subsequently identifying organisms that does not depend on their culturability. Metagenomics provides just such a solution (see other articles in this volume) without the need to culture any organisms in the sample. In this approach, samples are collected at sea and brought to a laboratory where millions of small fragments of DNA are sequenced at random and the genome sequences assembled using the most sophisticated computer technology available. The sequences are published along with the precise geographical location of the sampling. The biotechnological implications result from the possibility of recognizing new and heretofore undescribed genes, gene products and processes suggested from the sequence. Once identified, the 'lead genes' can be isolated, cloned and expressed in suitable microbial hosts using existing molecular tools. This enables the production and the characterization of particular products, which might yield a unique energy source such as a novel hydrogenase, a new biopolymer or perhaps a component of a unique pathway to be incorporated into a scheme for synthesis of high value precursors for subsequent chemical synthesis. Comparative genomics can be used to screen genome libraries from other geographical areas. Little wonder then, that in many cases a large-scale screening program of this magnitude is often funded by private investment money.

How can samples isolated from the open sea be considered a genetic resource owned by a specific entity? Moreover, if sequences are published, what makes them valuable? The sequences themselves are important if they can be patented as proprietary intellectual property. There is nothing to prevent the company from simply submitting the patent application before publishing the sequence. In addition, once the lead genes and products are isolated and identified, their precise origin is very difficult to trace. The samples themselves are the genetic resources that are now owned by the company.

As regards ownership of genetic resources from the open sea, the fact is that many of these screens involve sampling of coastal waters, which come under the jurisdiction of a specific country, necessitating a negotiation. The Mediterranean region is a case in point. The countries in this region are diverse and represent a broad range of experience and accomplishments in biotechnology.

One wonders, therefore, how negotiations might proceed, and what might be the criteria for 'equitable sharing of benefits'. Clearly, one might settle on the size of the royalty check along with a token cash advance. A second possibility could be to simply reject the deal altogether. However, as in the case of the Nepali program, omitting a specific region from a global screening program, particularly for new microbial species, is simply 'throwing out the baby with the sea water'.

A third option is to establish a system for collective bargaining, in which the relevant countries in the coastal areas, form a strategic alliance for the purpose of negotiating with the company interested in acquiring the genetic resource(s). In the case of the Mediterranean region this could be handled through the aegis of the International Commission for the Scientific Investigation of the Mediterranean Sea (CIESM). Since CIESM member States include all the countries surrounding the

Mediterranean Sea, the negotiating body could include a select group of scientists, business people and government representatives with broad perspective and insight. Such negotiations could then be conducted on a more 'level' playing field. It is likely that the companies acquiring the rights to collect samples, from coastal waters will not want to negotiate in this fashion. They are likely to prefer to deal with each party separately, particularly if they are not interested in revealing their real motivation for continuing the screening. In addition, much will depend on the demands of the country, the source of the genetic resource.

The benefits from a successful conclusion to such a negotiation are not necessarily limited to a royalty check. The collective negotiations may result in some useful trade-offs, which could include training grants to graduate students and/or junior faculty interested in specializing in marine biotechnology. Another form of compensation could include the endowment of a chair in the name of the company in a local University, and a third alternative might involve sponsoring of a permanent Workshop series in which members of the company might also participate as instructors. In the case of the company, the opportunity to make a positive contribution to the advancement of less developed countries in the region, while at the same time promoting their own reputation as a positive force for progress and reserving the rights to produce novel marine products resulting from the screen may be tempting. Particularly if the cost of this form of compensation is actually less than a 'cash pay off'. Certainly this mode of negotiation can inspire confidence and is in line with the spirit of the CBD.

David Gutnick

*Department of Molecular Microbiology and
Biotechnology, Tel-Aviv University, Tel-Aviv, Israel.*