IUPAC and Chemistry in Developing Countries

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IUPAC's International Role: A Scientific and Moral Responsibility.

The International Union of Pure and Applied Chemistry (IUPAC) is a scientific international, nongovernmental, objective and authoritative body which addresses global issues involving the chemical sciences. IUPAC is unique in that it is both a scientific and a mission-oriented international union. In keeping with present trends, IUPAC's mission and functions will increasingly involve, among other things, responses to:

- The globalization of the scientific-technological endeavor
- Recent advances and changes in science and technology
- The challenges of the mission-oriented service of chemistry to meet mankind's needs.

I welcome this opportunity to take a broad view, probing the goals, objectives, long-term strategies and activities of IUPAC as presented in the **IUPAC Strategic Plan for 1998**. One of its overarching issues is rooted in a single word in our Union's title: "**International**." In particular, what joint scientific, mission-oriented and moral commitments does IUPAC have to ensure that all the members of the world chemistry community and their countrymen, share in the knowledge, excitement, contributions and benefits of the modern chemical sciences?

This question assumes particular importance when addressing the special problems and opportunities of chemistry in developing countries (DCs), where the needs are most critical, but local chemistry research capacity and infrastructure are most constrained. Thus, the **IUPAC Strategic Plan for 1998** explicitly states, as Long-Range Goal 5:

> IUPAC will promote the service of chemistry to society in both developed and developing countries.

The strategic thrusts designed to achieve these goals specifically include as an example, IUPAC's series of international conferences on Chemical Research Applied to World Needs Conferences (CHEMRAWN), which make a central contribution to the global issues of chemistry and society. Since 1971, these conferences have provided IUPAC an important mechanism for transcending pure science to address issues with important socio-political components. The next CHEMRAWN XII CONFERENCE ON AFRICAN FOOD SECURITY AND NATURAL RESOURCE MANAGEMENT - NEW SCIENTIFIC FRONTIERS, to be held in Nairobi, Kenya in 1999, pertains to these central issues.

IUPAC can also make a major contribution to DC education in the chemical sciences, as stated in IUPAC's long-range goals:

> IUPAC will utilize its global perspectives to contribute towards the enhancement of education in chemistry.

Indeed, the developed world has a major responsibility to help develop the scientific, educational and professional training infrastructure in DCs. IUPAC already pursues professional training programs in chemistry in developing countries, in fruitful collaboration with UNESCO.

IUPAC also seeks to directly foster the development of the chemical sciences in DCs. In many cases, IUPAC's initiative and scientific expertise have been leveraged with outside financial resources to produce valuable results. UNESCO's support of the UNESCO-UNIDO-IUPAC Program in Chemical Safety is one recent example.

The global progress of the chemical sciences and their future practical contributions to society depend on harnessing the best minds and efforts mankind can provide in both the developed and the developing world. We cannot afford to squander the human intellectual resources lost in nations which can not themselves provide the means, environment and richness of domestic and international contacts required for the full realization of their scientists' talents and their service to society.

Scientific Development: New Opportunities, Old Challenges.

Those of you with experience in countless past efforts to promote chemistry-related development in DCs will be quick to remind me that these ideas are not new, neither to the world development agencies nor to IUPAC, which has often been a true pioneer. Yet I posit that the current rapid pace of:

- Globalization,
- Scientific and technological advances,
- Information technology
- Population growth

raises both the urgency of longstanding DC problems and the feasibility of their solution to a new, unprecedented level.

For example, revolutions in electronic communication, data access and networking, intelligently used and consistently supported (in an area where long-term maintenance is as vital as it is difficult), can dramatically reduce the geographical barriers, political barriers, isolation and fragmentation that have hampered DC scientists in the past. Today many chemists in developed countries prefer to do their literature searches automatically from their office PC, via the Internet, rather than scurrying about the subterranean caverns of their local university library, manually flipping the pages of dusty indices and bound journal volumes. Indeed, if they want to get fresher information, they will search their electronic bulletin boards, subspecialty networks and e-mail contacts, all of which transcend national boundaries. The same can now be done, with equal – indeed greater impact, in DCs, for what developed-country scientists do as a matter of convenience, scientists in DCs must do as a matter of necessity. The provision and maintenance of information technology infrastructure is a clear prerequisite for optimal benefit of this opportunity.

The keys are equipment (modest), training, initial contacts, functioning access to electronic networks, databases and publications, and long-term maintenance and support. "Long-term" is the most challenging operative phrase here. Progress by Brownian motion – short, random leaps – is slow at best. Research collaborations and equipment that disappear or fall into disuse every two to three years with the conclusion, successful or not, of yet another touted but effervescent short-term "initiative" can't replace lasting, long-term relationships. Similarly, interactive CD texts and simulations – on both the macroscopic, microscopic and molecular level – can revolutionize our ideas about intellectually stimulating, high-quality training and its near universal availability.

This picture of change and new opportunities for intervention and growth must, however, be balanced by an honest account of what has not changed in developing countries, or has changed more slowly. No organization, no matter how well-meaning, can overlook the crucial fact that

research and development work – anything beyond communication and information exchange – is still very, very difficult in DCs. Broad generalizations will not suffice, because ultimate success is often in the details.

For example, a U.S. scientist may simply order advanced equipment and have it installed and running on the day of delivery a week later. A developing country scientist may have problems with locating and evaluating equipment, local currency controls and fluctuations, customs controls, uncertain or spotty delivery, "siphonage" of funds or other resources at various levels, institutional politics, training operators, maintaining contamination-free environments, obtaining high-grade supplies, water and electricity (of appropriate phase, voltage, stability, continuity, etc.), compatibility with domestic and international communications systems and existing equipment (often from a hodge-podge of donors of different nations and eras), and a host of other difficulties undreamed of by his OECD colleagues. As a friend of mine, who regularly visited both European expert meetings and remote LDC laboratories for the USAID, once wryly noted, "It is definitely easier doing research and development work in Switzerland."

Advanced technology will not obviate the need for more widespread and detailed understanding of :

- Needs
- Conditions
- Preconditions

Of DCs for active scientific progress.

So while some aspects have suddenly become radically more easy and effective, others remain difficult. To intelligently use technically based approaches to help ameliorate the latter remains part of our challenge, and, always, we must not lose sight of the correspondingly high stakes involved. On the technical front: better science, better distribution of the benefits of science, better adaptation and use of new scientific advances to accommodate expanding world populations, and the food/energy/environment pressures they create. On the social side: increased scientific activity, contact and cooperation, which can help "open up" societies in DCs to international trends and norms, preventing their stagnation and helping integrate them into an increasingly interdependent world.

A Five-Point Plan for IUPAC.

The central role of chemistry in many recent scientific, technological, economic, and food/health/energy/environment-related developments enables IUPAC, its constituent organizations and their members to make significant intellectual and practical contributions towards five important goals:

- Strengthening access in DCs to international information and research networks in chemistry and related fields.
- Strengthening capacity of DCs for chemical research.
- Strengthening human chemistry-related resources in DCs, particularly in chemical education.

- Strengthening the ability of DCs to adapt recent scientific and technological advances to local conditions and needs.
- Strengthening cooperation with Regional Academies in DCs.

Regarding the last point, perhaps because of my personal experience as President of the Israel Academy of Sciences and Humanities, I regard National Academies as a strong, often underutilized, force for wise policy-making. Regional Academies, where they exist, should be strengthened as useful catalysts for international cooperation.

The Case of Africa.

IUPAC strives towards the globalization of the activities of the world chemistry community for the sake of scientific progress and the service of chemistry. The broadening of the geographical base of IUPAC is imperative, particularly in Africa where currently only Egypt and South Africa are members of the Union. Both countries make central contributions to IUPAC, but this is not enough. I am calling for extensive future participation of African academic and industrial chemistry in the activities of IUPAC. I hope that more African countries will join IUPAC for the sake of the future of the chemical sciences and for chemistry in Africa.

Perhaps it might be useful to provide a few specific examples of what IUPAC has been doing, and could do in the future, in Africa. The African continent is home to 62% of the world's DCs. The distribution of what development there is, is highly non-homogeneous. The same is true of chemistry infrastructure and research. Over half, twenty-nine of Africa's 51 countries; published less than 10 journal articles (national total) in 1996, a year in which Egypt published 2,560 journal articles, conference papers and/or technical reports. Rising university enrollments (mostly in the Arts) and stagnant budgets have caused average per-student subsidies to plunge from $6,300 in 1970 to $1,500 by 1988. Falling staff salaries force potential researchers out of the laboratory into second or third jobs, or to temporary or permanent emigration ("brain drain").

IUPAC can learn much from decades of previous aid programs, their successes and their all too frequent failures. We can learn:

- The importance of allowing the scientists in the recipient countries themselves to formulate and prioritize their most critical needs.
- The need to emphasize long-term institution-based capacity, including management and maintenance capacity.
- The benefits of long-term institutional relationships and linkages, rather than "hit-and-run" short-term studies and assistance contracts.
- The potential for increased regional and subregional training and research cooperation.
- The need to increase the recipient institutions' ability to coordinate and integrate multiple donor inputs and to make meaningful strategic management decisions.
- The need for funds to support preliminary (pre-grant) exploration costs, grant preparation costs, returning (overseas-trained) scientist re-entry grants, etc.

IUPAC should not try to duplicate the work of others. Even 10 years ago the total annual resources for development-related research was $2 billion; and today the World Bank's expenditures on African training alone amounts to about $100 million a year (about half of

which is overseas training). Furthermore, the World Bank, the Association of African Universities (AAU) and the African Finance Ministers already consider research, including chemistry research, an integral part of their new initiative to revitalize African universities. Similarly, the World Bank is already working with 15 African countries (speaking three different languages) to develop a trans-national African Virtual University. So we must always remember, despite our enthusiasm, that IUPAC is neither a funding Agency with an operative infrastructure, nor can it match the massive financing of the World Bank, government agencies and large private donor organizations.

What then can IUPAC do? It could, and should launch an African initiative which exploits IUPAC's unique strengths, and which helps complement, inform, guide and/or coordinate – but not duplicate or compete with – the work of others. IUPAC's main commitment rests on its large body of chemical research, teaching and management expertise. The top-level expertise of its members is:

- Voluntary
- International
- Non-governmental
- Politically neutral.

Capacity Building and Research Support in African DCs.

Concerned by such circumstances and trends, in 1995, IUPAC strengthened its collaboration with UNESCO to help develop and foster chemistry, with an emphasis on capacity building and research, within the world's developing countries. Initially it was decided to focus on a small number of African countries with a demonstrated capacity to benefit from such an initiative. A twelve-person Task Team, composed of senior chemists from Sub-Saharan Africa and South Africa, was then convened by Dr. C. F. Garbers, a Member of the UNESCO/IUPAC International Chemistry Council. Approximately 40 African government departments and related foreign and international donor and development agencies were approached for information (not all have replied to date). This effort also sought to ensure IUPAC's full cognizance of, and coordination with, ongoing development efforts. An extensive literature search was undertaken and statistics on chemistry and science in Africa were also collected. IUPAC, and the entire world chemistry community, are grateful to Dr. Garbers and the members of the task team for their important contribution.

The first fruits of this ongoing effort was Dr. Garbers' 1997 report on: "**Chemistry in Africa's Least Developed Countries: An Overview of Capacity Building and Research Support**." The report concurred with the findings of others that the universities of Sub-Saharan Africa are already in crisis and that, without external funding, even the current research effort in most of these universities is not sustainable. Some universities already depend on foreign funds for over 50% of their total budgets, and chemistry research and teaching facilities have already "degenerated beyond belief."

Many national chemistry and science training efforts are limited in scope. Just five of Africa's 51 countries train approximately 76% of all post-secondary students in the natural sciences. Although a few chemistry departments are good, most need significant help in upgrading their facilities, staff and programs. Because of difficulties with maintenance, compatibility, spare

parts, etc., previous efforts to provide second-hand scientific equipment from abroad have generally been of only marginal use. North-South scientific collaboration and donor agency financial support have been crucial to developing Africa's growing capacity in chemistry, but such aid has also often fostered economic, cultural and intellectual over-dependence. More regional "South-South" (not "North-South") and "bottom-up" (not "top-down") collaboration is essential.

The Overview also notes many new international efforts to revitalize African universities and increase donor coordination, efforts which IUPAC supports and with which it must coordinate its own future efforts. The participation of so many chemists from DCs at this IUPAC-sponsored International Chemistry Conference, and the unfortunately unrealized desire of so many others to attend, further demonstrates the potential and need for expanded regional cooperation. Such meetings can also help provide a forum for the formal and informal discussions required for its implementation.

The International Council for Chemistry, established by IUPAC and UNESCO, is a significant step in this direction; but IUPAC could greatly expand its work with groups of experts from all stakeholders to elaborate an integrated regional plan for promoting chemistry-for-development, and then seek to define and coordinate the required international and local inputs as part of a single, rational plan. This program's overall goal should be to combine IUPAC/UNESCO/African analyses and planning with donor-community and African capacity building and research support to strengthen chemistry's pervasive role in meeting the needs of government, communities and industry in African countries.

IUPAC and UNESCO, as the preeminent international organizations in their respective fields, could, and in the view of the Task Team should, invite the countries of Africa to conduct needs assessments for chemistry research and teaching at their universities. UNESCO and IUPAC should also help provide them with the human and, if necessary, the financial assistance to do so. IUPAC would review, strengthen and integrate the national reports into an overall regional strategy, one which, as far as possible, links weak departments to stronger institutions in the same or neighboring countries. Special attention should be given to opportunities and proposals for subregional or regional initiatives.

The Task Team proposed that IUPAC ask UNESCO to allocate sufficient financial resources in 1999 to help fund IUPAC-organized regional workshops to study, prioritize and integrate the various subprojects and budgets into a single long-term plan, and to fund other African chemistry-related activities. Thereafter, UNESCO would probably have to solicit the larger amounts of funds needed to implement such a plan from sponsoring governments, both within and outside of the region. IUPAC should appoint a task group of outstanding African chemists to help coordinate such regional initiatives and actions regarding the central issues of capacity building and scientific-professional training infrastructure.

These efforts must also be closely monitored; and IUPAC's commitment to longer-term support must be linked to demonstrable progress. This follows from both the seriousness of the problem and our global approach. If successful, IUPAC's African Chemistry Initiative could be a useful model for similar initiatives in other regions of the developing world. If unsuccessful, limited – perhaps irreplaceable – resources and opportunities will have been squandered.

I, for one, am confident that, with our joint effort and goodwill, this bold initiative in chemistry for the benefit of all mankind will succeed. Indeed, considering mankind's future basic needs, it *must* succeed.