

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/226317033>

Chemistry and Chemical Education as a Bridge to Peace

Chapter · July 2009

DOI: 10.1007/978-1-4020-9732-4_1

CITATIONS

6

READS

705

1 author:



[Zafra Margolin Lerman](#)

Malta Conferences Foundation

22 PUBLICATIONS 93 CITATIONS

SEE PROFILE

Chemistry and Chemical Education as a Bridge to Peace

Z. M. Lerman

Abstract Chemistry and chemical education can be important tools to advance the peace process, especially in the Middle East. The Middle East is a region in conflict for many years. This part of the world is of particular importance because it has a source of energy that is a strategic resource: fossil fuel. This nonrenewable source of energy not only fuels economic and political conflicts, but its worldwide use also places at risk the sustainability of life on Planet Earth, by polluting the environment and contributing to climate change. The Middle East also has major problems of air and water quality, which will require regional cooperation to solve. Geopolitical borders are only lines on a map; air and water do not recognize these lines. Therefore, any work concerning the environment - especially air and water quality - must be done in collaboration between nations. Chemistry is an international language. A chemist from Bethlehem, Pennsylvania in the USA, and a chemist from Bethlehem, Palestine, use the same chemical notations, and can communicate scientifically to one another without understanding each other's spoken language. Building on the international language of chemistry, three major international conferences called the "Malta Conferences" and formally titled "Frontiers of Chemical Science: Research and Education in the Middle East" were held in 2003 [1, 2, 3], in 2005 [4, 5, 6], and in 2007 [7, 8, 9]. In these conferences, chemists from 14 Middle East nations gathered to discuss solutions to the problems of air and water quality, energy resources, and chemical education in the Middle East. These collaborations between the chemists have yielded results that are a cornerstone for a bridge to peace.

1 Challenges Facing the Scientific Community

There are now over 6×10^9 people on Planet Earth consuming over 6×10^9 tons of fossil fuels each year; most of which is consumed by developed countries. With the expectation of 10×10^9 people by the year 2050 and with the increasing consumption

Z.M. Lerman (✉)

Columbia College Chicago, Institute for Science Education and Science Communication
600 S. Michigan Avenue, 60605, Chicago, Illinois, USA
e-mail: zafral@aol.com

of fossil fuels by developing countries, we will run out of these energy resources, cause irreversible environmental damage, adversely affect the food supply that depends on energy, and endanger the sustainability of life on Planet Earth.

We must develop new and clean energy resources. It is a simple fact that the amount of solar energy received by the surface of the Earth in 1 h is approximately equal to the total energy consumption of the entire planet in 1 year at present, and this is just **one** of the clean energy sources available to us.

The scientific community must promote the use of renewable sources of energy. In this way dependence on the energy resources in an unstable Middle East will be reduced. This will both decrease their contribution to detrimental climate change, as well as their value in the economic and political conflicts between countries.

Science is an international language. Borders are only lines on a map; nature and science do not recognize these lines. Therefore, any work concerning nature and the environment must be done in collaboration between nations. Science is probably the only field that contributes to the quality and longevity of life, but also has the ability to cut life short. Therefore, scientists are in a very special position compared to other professions. They have the responsibility to use their science and their status in society for the betterment of humankind and for all life on Earth. Specifically, I believe it is the responsibility of the scientific community:

- To promote the development and use of clean energy resources.
- To add the subject of sustainability to the curriculum to prepare future scientists with the background needed to preserve life on Planet Earth.
- To guarantee cross-border scientific collaboration and cooperation, even between countries whose governments are hostile toward each other.

Security is on the mind of every citizen of Planet Earth, and these concerns are closely tied to events in the Middle East. The political and economic climate currently shared by Middle Eastern nations is grave, and casts a shadow over the safety of everyone in the world. Events in the region burst into violence daily, consuming lives and resources while threatening a far wider conflagration.

Despite these unfortunate and tense circumstances, there is some light at the end of this dark tunnel [10].

We have learned from the past that scientists can continue to communicate with each other even when their respective governments are at odds. One example is the Pugwash conferences during the Cold War, which brought together scientists from the Soviet Union and from the USA.

I believe that scientists can again succeed where politicians have failed. In 2001 I decided that we chemists have an obligation to use our chemistry to solve the problems of the environment, water, energy, and education in the Middle East. Working together on problems will contribute to the peace process. I brought my idea of the conference “Frontiers of Chemical Sciences: Research and Education in the Middle East” to the board of the American Chemical Society (ACS) and received a go-ahead to organize a conference. An organizing committee was formed with representatives from ACS and from the following co-sponsoring organizations: the Royal Society of Chemistry (RSC), the International Union of

Pure and Applied Chemistry (IUPAC), and the German Chemical Society (GDCh). UNESCO became a co-sponsor in 2007. I traveled to the Middle East to recruit the participating chemists and personally persuaded the Nobel Laureates to join. In addition, various officials of the countries in the region had to be consulted; all of the negotiations and communications had to be carried out with sensitivity for and understanding of the cultures, religions, and the security issues involved [11].

2 Frontiers of Chemical Science: Research and Education in the Middle East

Three major international conferences titled “Frontiers of Chemical Science: Research and Education in the Middle East” have been held, with the fourth scheduled for 2009. The participating scientists came from 14 Middle East nations (Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Palestine, Qatar, Saudi Arabia, Turkey, and United Arab Emirates) to discuss issues of scientific cooperation and collaboration.

Intensive workshops covered the following topics: Environment: Air and Water Quality, Science Education and Green Chemistry, Medicinal and Natural Products, Nanotechnology and Materials Science and Alternative Energy Sources. Each of the workshops came up with Future Action Plans.

The **Workshop on Air and Water Quality** discussed in detail the deterioration of water quality in Gaza and the fact that there is no clean drinking water in Gaza (see Fig. 1). The primary issues addressed were salinity, nitrate content, and health.



Fig. 1 Pollution by leaching waste water (Gaza Valley)

Salinity and Health:

- The quality of Gaza's municipal water supply is not acceptable.
- The chloride content in most wells fluctuates from 400 to 1,000 mg/L, which is double the recommended value by the World Health Organization (WHO), which is 250 mg/L (see Fig. 2).

Nitrate Content:

- Nitrate content in well-water is used as indicator, especially when salinity is low. Nitrate level in most of the wells is around 100–150 mg/L. This value is three times the recommended WHO value, which is 50 mg/L.
- This was reflected in the diseases that Palestinians in Gaza suffer, such as blue babies and renal failure.

The Workshop on Air and Water Quality reached the following conclusions:

- The Middle East has severe, generally transboundary, air and water quality problems.
- Without regional collaboration and cooperation, Middle Eastern air and water quality will continue to degrade.
- Regional collaboration generally requires an international “umbrella” to enable quick communication, travel, and action.
- The “Malta Conferences” have catalyzed regional collaboration on environmental issues through the establishment of a Middle East Air and Water Quality Forum, with IUPAC support.

The Air and Water Quality workshop participants committed themselves to working together to solve the problem of drinking water in Gaza and to develop methods to



Fig. 2 Pollution by leaching solid waste disposal



Fig. 3 Cairo/Tebbin South Area: Black plumes are from Mazout burning brick kilns; white plumes are from lead smelters

guarantee water quality in the region. In this workshop, the quality of air was also discussed (see Fig. 3) and cross-border collaborations were formed.

The **Workshop on Alternative Energy Sources** concentrated on alternative energy sources for the Middle East, citing solar energy as an ideal resource of energy for the area. The use of renewable alternative energy sources is growing rapidly and offers the best chance to replace fossil fuels and to develop a sustainable energy policy. The workshop developed specific short-term and long-term recommendations.

2.1 Short Term - up to 2020

- Energy Conservation (must be taken into account during construction); solar heating (both for water and space); and the use of waste heat from power plants.
- Recycling.
- Optimize the use of existing renewable technologies: wind; waves; hydroelectric; geothermal; solar conversion solutions; and solar-assisted, sustainable, clean fuel cycles (including advanced biofuels and partial artificial photosynthesis).
- Development and use of: “Clean Coal” technology, advanced geothermal technology, clean(er) nuclear breeders, and more efficient power stations.

2.2 *Long Term*

- Development and use of technology that is already theoretically available: 50 TW wind power; 12 TW geothermal; nuclear fusion; and widespread, efficient, cheap solar cells, and artificial photosynthesis.

Significant policy issues are related to the future of alternative renewable energy. These include financing research and development, access to energy sources, **education**, and community involvement. Alternative Energy Sources workshop participants recommended:

- Vigorous pursuit of Solar Energy options.
- Annual workshops involved in research and development of Alternative Energy, for senior researchers from the region and for students and young scientists, to reflect the challenge of developing alternative energy resources to achieve sustainability.

2.3 *Energy, A Global Challenge*

- Meeting this challenge requires coordinated action of the regional and world scientific communities, governments, and industries. Finding ways for efficient, cost-effective production of clean fuels can be the most important breakthrough in science in the twenty-first century - but to help it happen, we need to start working NOW.

The **Workshop on Science Education and Green Chemistry** (see Fig. 4) discussed the need for workshops and other educational programs to foster: development of alternative energy; sustainability and Green Chemistry; disposal of chemical waste; discussion of scientific method and ethics of science in the Middle East; strategic plans to attract students to scientific careers; and to educate scientists from multiple disciplines in the fields of pharmacology, toxicology, pharmacy, and clinical chemistry.

Science Education and Green Chemistry workshop participants made the following recommendations:

- Centers of excellence should be developed for chemical analysis and structure determination of natural products. Programs should be instituted to enable short-term exchange visits by faculty and students.
- A Middle East Virtual Campus should be established to facilitate exchanges of ideas among Middle East scientists. Web-based resources are needed, including a directory of laboratory equipment and expertise plus weblinks connecting to freely available databases and software.
- Newly developed theories in chemical education should be integrated into Middle East curricula. Green Chemistry, energy, nanotechnology, medicinal chemistry should be combined with the Systematic Approach in Teaching and Learning Chemistry for assessing secondary and tertiary students' skills.



Fig. 4 Workshop on Chemical Education led by Nobel Laureate Roald Hoffmann



Fig. 5 A poster on Water Quality in Gaza

In addition to the workshops, the scientists presented their results in poster sessions that stimulated interaction between scientists from different countries (see Figs. 5 and 6).



Fig. 6 Scientists from 14 Middle Eastern countries participated in the poster sessions

3 Specific Outcomes from the “Malta Conferences”

As a result of the “Malta Conferences,” many concrete examples of cooperation among the various nations in the region have already taken place to address the recommendations of the different workshops [12]

- A research grant was received for participants from Bethlehem University (Palestine), from Bar Ilan University (Israel), and from the Weizmann Institute of Science (Israel) to work together on a joint water purification research project. This project is ongoing.
- Collaboration is underway between professors in Gaza and Israel for heavy metals analysis (ICP analysis) of water samples brought from Gaza to be analyzed at the Technion-Israel Institute of Technology.
- Samples of TiO_2 in different dimensions prepared in Bar Ilan University (Israel) are being used in Bethlehem University (Palestine) for the joint research between these universities.
- As a result of a question raised by a conference working group concerning training of scientists in the use of the synchrotron being built in Jordan with UNESCO support, Nobel Laureate Yuan T. Lee (Taiwan) offered six full 1-year scholarships for Middle Eastern scientists to train on the Taiwanese synchrotron facility; all six have completed the training and are now back in the Middle East.
- The Malta-III scientists from Iraq who work on water requested to visit the Water Center in the Technion - Israel Institute of Technology in order to work

with the Israelis and learn different techniques to solve the severe problems with water in the region.

- Improved communications between Palestinian and Israeli universities has led to an agreement between Palestinian institutions and the Weizmann Institute of Science (Israel). Palestinian students are now accepted to study for the M.Sc. and Ph.D. degrees in the Weizmann Institute's graduate school.
- The president of the Technion - Israel Institute of Technology offered to provide three full Technion scholarships for students from an Arab country.
- Several collaborations began as a result of the "Malta Conferences" between two groups of scientists in Israel: Arabs who work in Arabic colleges, and Jewish scientists in Israeli universities. Scientists from the Weizmann Institute of Science are collaborating on environmental issues with scientists from the Arab Academic College for Education.
- As a result of the "Malta Conferences," the National Science Foundation made a grant of \$134,000 to Nobel Laureate Professor Roald Hoffmann to hold workshops for Middle Eastern graduate students and young chemists under 35. Two workshops were held in Jordan, and the third was held in Egypt.
- Numerous ongoing collaborations are occurring between scientists in Palestine, Israel, Kuwait, Iran, Jordan, and Egypt, especially in producing a database for water purification.
- The participants of Malta-III unanimously adopted a resolution calling on world governments to address the critical shortage of clean water in the Gaza strip (see box for full text of the Resolution).

Resolution on water in the Gaza Strip from the Conference on "Frontiers of Chemical Sciences III: Research and Education in the Middle East"

As scientists from throughout the Middle East, with some of their colleagues from other parts of the world, we wish to draw immediate and urgent attention to one such issue. Water is of central importance to human life; water in the Gaza Strip is of particular concern in terms of quantity and quality, threatening the health of every inhabitant regardless of their political inclination.

We urge governments to look beyond the present conflicts and disagreements that afflict the region. As with some other treaties, where difficult conflicts are set aside for future consideration, we urge that the interested governments and agencies ignore their current disagreements and, by drawing on scientific expertise, urgently address the issue of water in the Gaza Strip, taking into account the whole cycle from collection to reuse [13].

Scientists and governments alike have recognized the uniqueness and effectiveness of this conference. The National Science Foundation recognized the "Malta Conferences" as one of the ten best examples of "thinking outside the box." United States Senator

Richard Durbin made a speech on the “Malta Conferences” from the floor of the US Senate, in which he labeled the conferences as “truly historic” [10].

Nobel Laureate Walter Kohn wrote: “Our great Middle East chemistry meeting in Istanbul ... was for me - an elderly ‘freshman’ - a thrilling experience. The unfailingly friendly and cooperative tone; the excellent presentations, from basic science to urgent local and regional problems; the enjoyable banquets with opportunities for informally meeting colleagues with very different backgrounds and perspectives - yet all of us united by our love of science and commitment to its use for the benefit of mankind.”

The opinions of the participants, however, matter most. The general consensus among attendees in each of the conferences has been that the achievements of the conference far exceeded all expectations, prompting Malta-III participants to vote unanimously to hold a Malta-IV conference in 2009 in Jordan. For the first time since the inception of the “Malta Conferences,” ten Middle Eastern chemists have agreed to serve on the conference organizing committee, in addition to the existing international organizing committee. The convictions of the conference attendees and the concrete results of these conferences have borne out my initial vision: collaborations between scientists of the region will be the bridge to peace in the Middle East.

References

1. Freemantle, M. (2004) “Rendezvous in the Mediterranean” *Chemical and Engineering News*, 82, 2, pp. 36–39.
2. Langer, S. (2004) “Middle East talks hailed as ‘Pugwash’ for chemical sciences at Malta convention” *Chemistry World*, 1, 1 January, p. 6.
3. Malin, J.M. (2004) “Frontiers of Chemical Sciences – Research and Education in the Middle East” *Chemistry International*, 26, 3, pp. 7–9.
4. Lerman, Z.M. and Wade, J.S. (2006) “Frontiers of Chemical Sciences II: Research and Education in the Middle East” *Chemistry in Israel: Bulletin of the Israel Chemical Society*, Issue 21, pp. 21–23.
5. Malin, J.M. (2006) “Frontier Science in the Middle East” *Chemistry International*, 28, 2, pp. 9–11.
6. Ritter, S.K. (2005) “Science for Peace in the Middle East” *Chemical and Engineering News*, 83, 46, p. 15.
7. Everts, S. (2008) “Middle East Connections” *Chemical and Engineering News*, 86, 4, pp. 59–61.
8. Everts, S. (2007) “Conference uses science to build bridges in the Middle East” *Chemical and Engineering News*, 85, 51, p. 10.
9. Begitt, K., HopfRingsdorf, H. and Ringsdorf Ringsdorf, H. (2008) “Schritte über Grenzen” *Nachrichten aus der Chemie* 56, February, pp. 201–202.
10. Durbin, R. (2004) “Chemists Working Cooperatively” *United States Congressional Record*, 150, 66, May 12.
11. Velasquez, R. (2006) “Middle Eastern Scientists Promote Peace at Malta Conference” *Washington Report on Middle East Affairs*, 25, 1, p. 71.
12. Malin, J. (2008) “Middle East Chemists Meet in Istanbul” *Chemistry International*, 30, 3, pp. 31–34.
13. (2008) “Water in the Gaza Strip” *Chemistry International*, 30, 2, p. 18.