Still Specifications

Kenneth Hickman, Ian White, and Egon Stark, in their article "A distilling system for purer water" (6 Apr., p. 15), make the important point that purer distilled water is necessary for scientific research and describe an elegant methodology for obtaining high-quality water. However, the solution is impractical for most of us because we are not in a position to construct or test such equipment. Having worked on the design of high-purity glass stills and other types of water purification equipment for many years, I would like to add a practical postscript to the article by Hickman *et al.*

An effective still cannot be constructed by simply linking a number of stages together. A still is a system in which many stages are interdependent, and a great deal of empirical testing and redesign lie between the best theoretical concept and an operating model. For example, a seemingly minor detail, such as selecting a vertical, rather than a horizontal, orientation of boiler heater elements, can dramatically alter the effectiveness of a still (*1*).

From a practical standpoint, the greatest potential for improving the quality of water purification equipment no longer lies with the inventor or engineer, but with those leaders in the scientific community who are contemplating means of specifying performance. Still specifications must reflect the broad spectrum of still performance, and they must permit duplication and verification under controlled conditions, or no amount of innovation will cut through the current stagnation resulting from an uninformed market. The widely accepted "tap water" test is no test at all, since tap water represents such a hopelessly complex and variable matrix that duplication of test conditions is impossible, and specifications cannot be challenged in a scientific manner. The use of standards which cannot be verified and the use of vague expressions such as *triple distilled, pyrogen-free, ultrapure*, and so forth has led to widespread product misrepresentation.

Water purification equipment should be tested with a set of binary solutions made from carefully defined pure water and containing sufficient solute to swamp background effects. The impurities should be selected so that information is obtained about the weaknesses as well as the strengths of a given type of equipment, and they should be amenable to convenient measurement. Ideally, a broad set of tests could be established which would also permit comparison of the relative efficacies of differing methods of water purification, that is, deionization versus distillation, or versus reverse osmosis. I have applied this type of testing in a comparison of six popular, commercial, all-glass laboratory water stills, and the results showed extraordinary, and often unexpected, differences between the designs (*2*). Obviously, this type of testing may not always tell the whole story, but it would represent a first step.

The burden of developing meaningful specifications lies with the scientific community, not with the industrial community. Industry has long been aware that the profit margins for establishing pioneering standards in the absence of consumer demand are slim. Standards acceptable to an industry are very likely to reflect an element of "standards fixing."

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References

1. E. L. Gibbs, *Glass Laboratory Water Stills (Design and Performance)*, part A, *Introduction and Discussion of Design Features* (Ultrascience, Evanston, Ill., 1972).
2. ——, *In Vitro* **8**, 37 (1972).

Gibbs's letter treats two related subjects: the alleged impracticality of our prototype still and the present state of the art of testing and appraising water stills and the products thereof. We concur with most of his suggestions as well as others in the literature (*1*) for improving the latter but do not feel competent to offer additions or corrections.

Concerning the prototype still, we wrote in the last sentence of the caption for our figure 4, "Our purpose has been less to provide an engineered design of *commercial proportions* than to demonstrate the utility of a *system* for providing improved water" (italics added). Our reasons for offering it in that state of development were linked to our interpretation of the applicable patent regulations ". . . that all information, uses, products, processes, patents, and other developments resulting from such research developed by Government expenditure will . . . be available to the general public" (*2*).

One can scarcely quarrel with the application of such a ruling to public funds and the world's chief operating fluid. Unfortunately, the common good is not always best served by this arrangement. If proprietary rights may not be acquired, there ensues little protection for a firm otherwise willing to market an invention.

With this opinion in mind, we pursued two interrelated themes: one, some suggestions to manufacturers and installers of distilling equipment; the other, the prototype still which a handyman-mechanic, "Admirable Crichton" of many laboratories, could put together from common bits and pieces (that is how we made ours). Since describing the still in *Science*, we have added four thermal switches (*3*) which allow the still to operate without attention. This it has done for the past 6 months, with the specific resistance of the product water hovering between 93 and 97 percent of the calculated specific resistance of pure water. The prototype still is thus eminently practical for any laboratory that cares to put it together. The main purpose of our article—to outline a methodology for producing purer water—appears to have been served, if we judge by the letters and requests for reprints received (from 16 countries and 31 American states) in the past 2 months.

Now, for two further disclaimers; in figure 12 of our article there are four points, Δ, which lie above the calculated curve for pure water. The points, selected from the literature, are to show how admittedly impure water would compare with our results. We have apologized to C. G. Malmberg (*4*) for omitting mention that the preparation of ultrapure water was not the prime concern of his work.

The second disclaimer concerns a recheck of sterility done in May 1973. Bacterial contamination was found in 13 of 40 tubes of Trypticase soy broth inoculated with product water and incubated at 37°C for 48 hours. Reference to the daily log showed that air had entered on three occasions when power failure (endemic) had shut down the still, and, during one such failure, a glassblowing adjustment had been made. Although the still restarted without aid upon restoration of current, it is evident that a means for instant in-process resterilization should now be devised.

Perhaps the most important point, as Gibbs observes, and our inquirers have emphasized, is the worldwide need for convenient sources of highest-quality water that has been exposed. Credit for ventilating the matter remains with M. S. Favero, L. A. Carson, W. W. Bond, and N. J. Petersen (*5*).

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References and Notes

1. R. C. Hughes, P. C. Murau, G. Gundersen, *Anal. Chem.* **43**, 691 (1971).
2. *Saline Water Conversion Act of 1971* (PL 92-60, 92nd Congress, 1971), section 6(d).
3. Details can be supplied upon request with a stamped, self-addressed envelope.
4. C. G. Malmberg, *J. Res. Nat. Bur. Stand. Sect. A* **69**, 39 (1965).
5. M. S. Favero, L. A. Carson, W. W. Bond, N. J. Petersen, *Science* **173**, 836 (1971).
6. This work was supported by the Office of Saline Water under grants 14-30-2572 and 14-30-2964.

The Case of Nina Strokata

At the 1973 annual meetings of the American Society for Microbiology, held during the second week of May in Miami Beach, Florida, hundreds of American microbiologists signed a petition in defense of Nina Strokata, a Ukrainian microbiologist who has been sentenced to 4 years imprisonment because of her refusal to denounce her husband, a writer. Among the signers of the petition were university department chairmen, heads of medical, industrial, and governmental laboratories, university professors, clinicians, scientists from various laboratories, and students. Also among the signers were scientists from Belgium, Canada, France, Germany, India, Iran, Israel, Pakistan, Portugal, and Sweden.

The petition was presented to the Commission of Human Rights of the United Nations on 17 May 1973. Addressed to the Honorable Kurt Waldheim, Secretary-General of the United Nations, the petition describes the plight of Nina Strokata and states

> We microbiologists are compelled to urge the government of the USSR, a signatory of the Universal Declaration of Human Rights, to review the case of Nina Strokata immediately. We request that the Soviet government allow the presence of representatives of international microbiologists, journalists and the United Nations at an open trial where Nina Strokata would have a chance to defend herself according to Articles 10 and 11 of the Universal Declaration of Human Rights.
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> We urge, therefore, that the Commission of Human Rights of the United Nations demand the implementation of these rights in the case of Nina Strokata.

This petition was not sponsored by any scientific or political organization, but was initiated by a handful of microbiologists who were familiar with Nina Strokata's case. It may be of interest to all scientists, not just to microbiologists, that international cooperation among scientific groups is a fact and entails many aspects of their professional lives.

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Postscript

B. Grzimek (Letters, 22 June, p. 1232) rightfully condemns the crew of R.V. *Searcher* for writing the ship's name on the rocks of Tagus Cove in Galápagos National Park, but their adolescent action is far from the only example of a scientific expedition's failure to respect the beauty and wildness of these islands. Scientists, although seemingly in the best position to recognize the importance and vulnerability of the Galápagos Islands, have often set a poor example of behavior there. Grzimek does not point out, however, that the *Searcher* sank to the bottom of the sea (with no loss of life) shortly after leaving her graffiti at Tagus Cove. Vessels bound for Galápagos in the future are invited to draw a moral from this tale.

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