NATIONAL WATER QUALITY LABORATORY
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Lab critical part in understanding the Nation's water quality—Hirsch

[**Editor's note**: Remarks of Robert M. Hirsch, Chief Hydrologist, at the dedication of the USGS National Water Quality Laboratory, June 9, 1999, Denver Federal Center.]

Water is our most precious and essential natural resource. The quality of that water, therefore, is of utmost importance to the Nation. Whether it is a water sample taken from a river or lake, from a reservoir, or drawn from a well drilled into a bedrock aquifer, chemical data on these water samples are essential building blocks in constructing a national story about our water quality. To be useful, the data must be accurate and they must be timely. Providing such data, to support our scientific studies, is what this state-of-the art facility is all about.

This Laboratory is an essential link in a continuum of steps that ensures that the story of our Nation's water quality is told, and is told accurately.

Picture if you will the many USGS hydrologists and technicians at work each day all across the Nation. These dedicated and trained individuals gather the environmental samples that are the building blocks of that national story of water quality.

What does it take to collect a valid water sample? It is not a simple matter of scooping up water into a bottle. We follow a carefully orchestrated protocol that ensures that the data are accurate and timely. Samples must be collected under conditions that keep the sample intact, identified, and uncontaminated. Samples must be treated on site and then quickly packed, chilled and sent immediately to this Laboratory for analysis.

Many chemicals are extremely time sensitive. They can change or disappear within hours. Thus, the efficient design of this Laboratory is critical to our ability to conduct the kind of rapid analyses that are needed to truly describe the water as it existed in the natural environment.

The sheer volume of work done at the NWQL is astounding. More than 30,000 individual samples from all over the Nation are received here each year and logged into the Laboratory's data base.

And from those 30,000 samples, more than 1.5 million analytical determinations are made. Being accurate with that volume of data is an astonishing accomplishment alone. Add to it the high degree of sensitivity required here, measuring substances to the part-per-billion level and even lower, and the speed with which analyses must be made and reported. It takes a world-class building to make all of that possible.

STANDING ON CEREMONY—Doug Posson (left to right), the USGS Regional Director, Robert M. Hirsch, Chief Hydrologist, Janice Ward, Acting Chief, Office of Water Quality, and Cindy Trevithick, staff assistant to Tom Tancredo, member of Congress representing the 6th District of Colorado, confer in the parking lot prior to dedicating the new Laboratory. (Dedication photos by Mars Harper)

Those 1.5 million analytical determinations are fed into a computer information system that can tell a researcher precisely when and where the sample was collected, as well as the precise amounts of the chemicals found in the sample. Each of those samples and its attendant analyses become part of a national data base which is used by USGS scientists, located in offices across the Nation, to tell a national story of water quality.

These data represent a national treasure trove of information, a treasure that is shared not only within the USGS, but is broadly available to scientists in universities, Federal, State, and local agencies, and with the private sector to help all of them work to solve often-vexing environmental problems and protect human health and environmental quality.

Let's take a look at the kinds of water- quality problems the USGS works on. The USGS has just completed a major interagency report on how nitrate borne downstream from the most remote reaches of the Mississippi River Basin are causing oxygen depletion in the Gulf of Mexico, a level of depletion that is so severe that it has created a dead zone in areas of the Gulf where aquatic animals literally are so starved for essential oxygen that they cannot survive.

Our study shows that human activities on the landscape can have far-reaching implications, hundreds and even thousands of miles away.

Right here in Denver, actions have an ultimate effect on the shrimp harvest in the Gulf of Mexico. Not too many miles from where we are standing, the USGS has a streamflow-gaging station on Clear Creek at Golden. What people do in the watershed of Clear Creek—fertilizing lawns or treating waste water—affects the quality at a local level. Clear Creek then flows into the South Platte River. What citizens and water managers do in the City of Denver—from handling waste water or keeping golf courses looking up-to-par—and what farmers and livestock growers downstream of Denver do with animal waste can affect the quality of the water in the South Platte.

The South Platte River flows into the Platte River, which flows into the Missouri River, which flows into the Mississippi River and then into the Gulf of Mexico. It is a sobering hydrologic reminder that actions of the citizens and businesses here in Colorado can affect the quality of water as far away as the Gulf of Mexico. The analysis of these long-distance effects depends on having a national system for collecting and analyzing water-quality samples, and then storing and disseminating the resulting data to users. This NWQL is a critical link in this important national process.

We are very proud of the contributions that our National Water Quality Laboratory has made in recent years to improve understanding of the Nation's water quality. We did it in an old facility a few miles from here—a facility that was never designed for the contemporary needs of a water laboratory. What we did there was to fight a constant up-hill battle against a building that was not designed for the task. But now we have a world-class facility to help us conduct world-class science.

One of the challenges we face in doing our studies of water quality is that our society creates thousands of new chemicals every year. Scientists have only limited knowledge of their behavior in the environment—for example, under what conditions do they break down and under what conditions do they persist? If they do break down, what are the daughter products? What are their potential effects on insects, algae, fish, or mammals, including people? Do they cause cancer or other diseases, do they cause reproductive or behavioral changes, or do they lower resistance to the effects of other chemicals or diseases?

To help the ecologists and toxicologists answer these questions, we need an ability to measure a vast array of new chemicals and measure them down to trace levels, well below official health or ecological standards. Without these low-level measurements, science will not be able to advance the knowledge of the effects of these chemicals. The NWQL runs highly sensitive analyses of 100 pesticides and 86 volatile organic compounds. The U.S. Environmental Protection Agency relies on these data as it carries out its responsibilities in regulating pesticides and gasoline fuel additives, such as MTBE. An ultraclean laboratory is critical to our ability to produce meaningful data on these compounds.

Of course it is not only human-created compounds that can have an effect on water quality. For example, most rocks and soils naturally contain some arsenic. The water that leaches through that soil or rock carries arsenic to our rivers and aquifers. Water-quality methods developed at the NWQL provided us with an extensive data base on the presence of arsenic at very low levels. This water-chemistry advancement came at an auspicious time, because medical science is finding that arsenic can be dangerous to human health at much lower levels than previously thought.

What is the future for the Nation's water quality? Tomorrow's environmental policies must reflect existing environmental conditions. We need to understand mixtures of trace compounds, chemical degradation products, and unintended environmental consequences (such as MTBE, which was developed to improve air quality but degrades water quality). To be effective, our Nation's water-quality strategies must be based on facts. This Laboratory is a critical link in the process of creating some of the facts that are needed.

VISITORS GATHER JUNE 9 FOR DEDICATION CEREMONY OF THE NATIONAL WATER QUALITY LABORATORY

I have visited this magnificent facility twice during the construction phase and once since its completion in March. I am so impressed at the thought and dedication that has gone into its design and construction, by so many parties: All of the firms that participated, by the General Services Administration, by the Small Business Administration, and by many dedicated individuals on the USGS staff.

This is no ordinary building, but a unique facility. It provides a working environment designed for efficient sample movement, ultraclean air and water, and a pleasant working space for the dedicated staff. This working environment is a critical complement to the scientific talent and expertise housed in the lab, and embodied in our entire workforce across the Nation.

This lab is a critical part of the complete process of measuring and understanding the Nation's water quality. All of nature is a continuum, and it is my honor to dedicate this facility as an essential link in that continuum of scientific monitoring, analysis, research, and understanding that is needed to safeguard our Nation's water resources.

The USGS motto of "science for a changing world" is truly embodied in the actions and the staff of this Laboratory, and none of this would have been possible without the funding provided to us by the Congress, and the dedication of the many public-sector and private-sector participants who have made this dreamed-of capability a reality. Thank you all for sharing in this historic moment with us.

Glodt named to handle customer support

Steve Glodt, NWQL computer specialist, has been assigned to provide internal and external customer support liaison. Debi Treseder, administrative officer and Acting Chief of Laboratory Operations, said the change in duties was effective June 21.

Treseder said that Glodt would head up a standing committee to identify customer issues. Glodt can be reached at 303-236-3721 in room 1437 or via E-mail to srglodt@usgs.gov.

Chemist Mary Cast takes on new duties

Chemist Mary Cast is coordinating all NWQL performance studies following Ann Watterson's retirement June 2 from the Quality Management Program. Cast also handles quality-control studies on the inorganic supplies used by the Districts (preservatives, bottles, and inorganic blank water) and reports her findings to the lab in Ocala, Florida.

Other duties include coordinating standard operating procedures for the Laboratory. Cast is the District contact if there are any questions concerning these projects. She can be reached by telephone at 303-236-3463 or via E-mail to mecast@usgs.gov.

Flagship facility for water chemistry dedicated June 9

The job of assessing the quality of the Nation's water just got a little bit easier with the construction and occupancy of a new laboratory at the Denver Federal Center. Managed by the U.S. General Services Administration, the new "building 95" houses the National Water Quality Laboratory — the flagship analytical facility for the U.S. Geological Survey of the U.S. Department of the Interior.

GSA and USGS dedicated the "world-class laboratory for 21st century science" on June 9. Building 95 is located at the intersection of 10th and Main Streets on the Denver Federal Center.

The National Water Quality Laboratory provides analytical services in support of the USGS mission to gather data for determining the location, amount, availability and quality of ground- and surface-water resources. The NWQL conducts environmental analyses that are geared to detect minute quantities of chemical constituents. These "trace" and "ultratrace" concentrations provide a level of analysis that is more stringent than that required for many existing standards of water quality. Detections of even trace amounts of contaminants can be important when classifying or defining the environment in which the water quality might be changing.

The highly automated, state-of-the-art capability of the NWQL and its high volume of analyses mark it as a unique facility. About 30,000 samples are sent to the NWQL each year, making it one of the largest environmental water-testing facilities in the United States. More than 1.5 million chemical determinations are made from these samples for USGS offices and cooperators with whom the USGS works. The stringent quality-control measures used by the NWQL ensure that the most rigorous standards are upheld. The NWQL has consistently performed at the highest levels of accuracy and reliability in comparability evaluations with other laboratories.

New methods and procedures, developed by the NWQL, have led to significant advances in the science of water chemistry and in knowledge about how water quality is affected by changes in the environment. Examples of these advances include the detection of airborne pesticide residues along the Mississippi River, characterization of hydrophobic (compounds that don't mix well with water) toxic organic compounds near Bemidji, Minn., determination of trace metals in arctic snow, and the first detections of MTBE (a gasoline additive) in water, which highlighted an environmental dilemma of air quality versus water quality.

The USGS relies on the NWQL to provide high-quality, low-detection level environmental data for samples that are collected as part of state-by-state investigations and assessments of the Nation's water resources. The USGS National Water-Quality Assessment Program, which is providing a vital understanding of the status and trends in water quality across the country, relies heavily on the NWQL for all of its analyses, as well as the development of new laboratory and field methods.

Holding the line on prices in FY 2000

In-house analytical-chemistry prices at the National Water Quality Laboratory (NWQL) will not be increased in fiscal year 2000, according to the Office of Water Quality (OWQ).

In the past, the OWQ has sent E-mail in May announcing NWQL prices for the upcoming fiscal year. The OWQ official memo will be sent later in the year because of issues related to Budget 2000 restructuring.

Depending on the outcome of the Budget 2000 restructuring, the prices for chemical-analytical services may even be reduced below FY99 levels. Prices for FY00 are available to USGS employees on the WWW NWQL Home Page at URL http://wwwnwql.cr.usgs.gov/USGS/pricelist_main.html.

Only in-house analytical-chemistry prices will remain at FY99 levels. Prices for all other analytical work, such as analyses offered by the Geologic Division, National Research Program laboratories, contract analyses for radiochemical parameters, and the Department of Defense Environmental Conservation Program contract will be announced as soon as they are available.

Bob Williams

Seminars listed

USGS visitors traveling in the Denver area are invited to stop by the Laboratory at the Denver Federal Center (building 95) and attend seminars in the main conference hall (room 1130). Scheduled seminars are listed as follows:

- David McCurdy, Duke Engineering and Services, Bolton, Massachusetts: "Basic Operational Considerations for a Commercial Radioanalytical Laboratory," 1:30 p.m. Tuesday, August 3.
- Pamela Greenlaw, Department of Energy Environmental Measurements Lab, New York: "Data Validation," 2:45 p.m. Tuesday, August 3.

Other seminars this year included the following:

- Bill Qualls, project manager/lead programmer, StarLIMS, Florida: "The New Commercial Laboratory Information System (StarLIMS)," January 6.

- E. Michael Thurman, USGS geochemist, Kansas District, Lawrence: "Analysis of Pesticide Metabolites by Liquid Chromatography/Mass Spectrometry," January 21.

- Brian Mader, graduate student at Oregon Graduate Institute, Portland, Oregon: "Controlled Field Experiments—A Method to Study the Gas-Particle Partitioning Behavior of Semivolatile Organic Compounds," May 20.

- Imma Ferrer, doctoral candidate, University of Barcelona, Spain: "Determination of Priority Pesticides and Metabolites in Water Matrices by Selective Solid-Phase Extraction Followed by LC/MS Using Atmospheric Pressure Ionization Techniques," June 7.

Patton, Ardourel attend Methods Board meeting

On May 10–13, 1999, Charles Patton and Harold Ardourel from the NWQL attended the Methods and Data Comparability Board (MDCB) meeting in Cincinatti, Ohio. Merle Shockey, the co-chair of the Board, was unable to attend the meeting. The MDCB is composed of members from Federal, State, and private agencies and organizations that are working on the means to ensure data comparability among the many users of water data collected by various agencies. The Board reports to the National Water-Quality Monitoring Council, which in turn is a part of the Advisory Committee on Water Information.

The Board has a number of workgroups studying various issues related to achieving data comparability among users. The current workgroups and their tasks are as follows:

Performance-Based Measurement System

Tasks: Define the dimensions of a performance-based measurement system for chemical, microbiological, and biological field and laboratory analyses. Prepare guidelines to implement the system in ambient and compliance- monitoring activities.

National Environmental Methods Index

Tasks: Prepare a compendium of chemical, physical, radiochemical, microbiological and biological field and laboratory methods and protocols that provides information regarding performance measures (for example, method accuracy, method detection limits, precision, bias, range of applicability, and matrix effects) that will allow users to determine the comparability of different methods.

Laboratory Accreditation and Field Certification

Tasks: Develop and promote a Board position on a national laboratory accreditation program and pre-laboratory certification program. Develop a Board position paper on accreditation of Federal laboratories.

Nutrient Measurement

Tasks: Conduct a review of nutrient sampling, analyses and nutrient strategy literature and determine the nutrient methods and data fields for inclusion in the National Environmental Methods Index.

Biology Measurement

Tasks: Identify, compile and develop a framework for characterizing and comparing water monitoring efforts that diagnose environmental conditions using either (a) whole organisms; (b) biomolecular materials; (c) populations in the field; or (d) microbiology.

Outreach and Publicity

Tasks: Develop and implement a process to inform and solicit input from the water-resources community regarding the efforts of the MDCB. Various media will be used, including the internet, brochures, fact sheets, reports, portable displays, and conference presentations.

Water-Quality Data Elements

Tasks: Develop and recommend a core set of data elements for reporting water- quality monitoring results, to be voluntarily implemented, that would allow data to be compared regardless of the purpose of the monitoring activity.

Ardourel is the acting chair of the accreditation workgroup and Patton is a member of the nutrients workgroup. More Board information will be available at a public website soon.

Harold Ardourel

New UV method added to the Organic Chemistry Program catalog

The Organic Chemistry Program has added a new method of analysis entitled "UV-absorbing Organic Constituents (UV 254/280)." This method is used to measure the ultraviolet (UV) absorption of a water sample at wavelengths of 254 and 280 nanometers (nm). The method is published in the nineteenth edition of Standard Methods for the Examination of Water and Wastewater.*

Some organic compounds in water absorb UV light at 254 and 280 nm. These compounds include humic substances, aromatic compounds, and tannins and lignins. Correlations may exist between UV absorbance at these wavelengths and organic carbon concentration, color, and individual compound concentrations that may form trihalomethanes or other disinfection by-products produced in water-treatment facilities. However, these correlations may vary from site to site, and they may vary seasonally at the same site.

The UV absorbances at 254 and 280 nm along with the dissolved organic carbon concentration can be used to produce the specific UV adsorption (SUVA). The SUVA is the ratio between UV absorption and the dissolved organic carbon in a water sample. SUVA can be used as a surrogate measurement to characterize the aromatic nature of the dissolved organic carbon. The SUVA can also be used in certain situations to demonstrate compliance with the U.S. Environmental Protection Agency's (USEPA) drinking-water regulations. For certain drinking-water treatment plants that cannot meet the overall Total Organic Carbon removal requirements, they may still be considered in compliance if the SUVA is equal to or less than 2.0 liters per milligram-meter. SUVA is UV absorbance normalized to the dissolved organic carbon concentration of the sample, and as such can be used to evaluate aromaticity in entire river basins.

A filtered water sample is used for the UV 254/280 analysis. Usually, the dissolved organic carbon sample can be used so there is no need for an additional sample to be taken. The UV absorbance is measured and the results are transmitted back to the customer electronically.

This analysis can be ordered for dissolved organic carbon samples by entering labcodes 2177 and 2178 in the add-on section of the Analytical Services Request form. If the analysis is in conjunction with a program regulated by USEPA, contact Ron Brenton at the NWQL (telephone 303-236-3210) because special arrangements must be made to comply with USEPA's required sample preservation and holding-time requirements.

Ron Brenton

*Eaton, A.D., Clesceri, L.S., and Greenberg, A.E., eds., 1995, Standard methods for the examination of water and wastewater: Washington, D.C., American Public Health Association, American Water Works Association, and Water Environment Federation, 19th edition.

What is SPiN and how do I use it?

The acronym SPiN, which stands for the Schedules, Parameters, and Network program, is the current version of the Web-accessible search program for analytical services offered by NWQL. SPiN began as a useful character-based tool on the PR1ME computer before it was moved to Unix. Its primary function is to provide customers with an easy way to get information about analytical services.

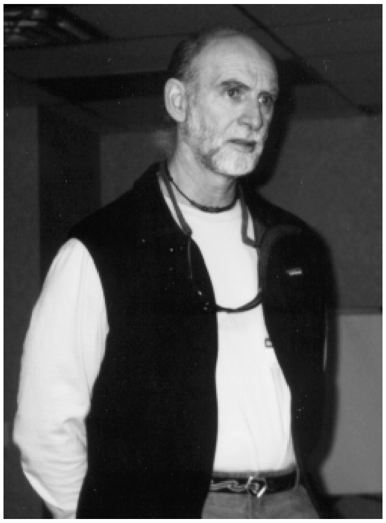
SPiN includes links to static pages from the NWQL catalog for descriptions of bottle types and preservatives, field supplies, and information on requesting analytical services. These links provide the user with information about current analytical procedures and constituents offered. SPiN is accessible to USGS employees through the NWQL home page at http://wwwnwql.cr.usgs.gov/USGS/.

The many options for searching analytical services include NWQL labcode, parameter code (also known as WATSTORE or STORET), Chemical Abstract Services (CAS) number, constituent name, schedule number, and a name fragment. The information obtained by the labcode search includes NWQL labcode, parameter code and method character, a description of the analytical technique and matrix, the CAS number if available, the quantity and type of sample required, a constituent name, the laboratory reporting level, reporting units, the method number as published, the reference where published, and the current fiscal-year price. Additionally, an option exists to help the user find a "best match" schedule.

The Laboratory is in the process of installing a commercial off-the-shelf Laboratory Information Management System (LIMS). As part of this new system, it is expected that the two separate applications, SPiN and the catalog, will be combined into a single customer-accessible application. Enhancements are expected to include the capability to list all time periods that LRLs (laboratory reporting levels) or LT-MDLs (long-term method detection levels) were effective, point to replacement procedures when an older one is invalidated, and the ability to create "custom" schedules for pricing.

Send comments or suggestions concerning SPiN needs or enhancements to Steve Glodt (srglodt@usgs.gov) or call Steve at 303-236-3721.

Steve Glodt



WATER-QUALITY ISSUES—E. Michael Thurman, USGS geochemist in the Organic Research Unit of the Kansas District Office, spoke at a seminar earlier in the year on the "Analysis of Pesticide Metabolites by Liquid Chromatography/Mass Spectrometry." Thurman was recently given the Department of the Interior's Distinguished Service Award for his pioneering research on the chemical and physical processes that determine the origin, movement, and fate of natural and contaminant organic substances in water. Thurman is collaborating with the Methods Research and Development Program in the study of contaminates.

Q & A for field-treatment protocols, bottle types for nutrients

Q. What bottle types are affected?
A. Only RCC bottles. Beginning January 1, 1999, whole-water nutrient samples should be collected in translucent ("natural"), 125-mL polyethylene bottles, amended with 1 mL of 4.5 normal sulfuric acid, and designated WCA. The RCC bottle code becomes invalid at the NWQL after a two-month grace period. Use only field supplies obtained from the USGS Quality Water Service Unit (QWSU) in Ocala (see table).

QWSU	Number	Item Description	Quantity
407FLD	Bottle, Poly	Plain, 4 oz (125 mL)	Case (100)
406FLD	Bottle, Poly	Plain, 4 oz (125 mL)	Case (500)
26FLD	Bottle, Cap	Plastic, 28 mm	Box (900)
417FLD	Bottle, Cap	Plastic, 28 mm	Pack (100)
438FLD	Vial (PP)	H_2SO_4, 4.5 N (1:7), 1 mL, whole-water (WCA) nutrient preservative	Box (24)

Q. Why can't I use the 125-mL brown bottles I currently use for the FCC analysis to offset some of the cost of this change?
A. The primary reason for the change to a translucent container for WCA samples is to enable laboratory analysts to estimate the quantity and settling rate of suspended solids in whole-water samples by visual inspection prior to analysis. With this change, the analysts' ability to obtain representative subsamples for whole-water digest preparation will improve. An added, anticipated benefit of using different bottles for collection and storage of dissolved and whole-water nutrient samples is reduced potential for collection-site and laboratory bottle mix-ups.

Q. Should FCC bottles be acidified also?
A. No. Do not acidify filtered (dissolved) nutrient samples. Continue to use brown, 125-mL polyethylene bottles for collection. Continue to use the FCC designation.

Q. Can I use sulfuric acid in glass ampoules in my current field-supply inventory to acidify WCA samples?
A. No. These ampoules typically contain concentrated sulfuric acid, which would greatly overacidify samples and degrade analytical results. Use only 1 mL of 4.5 normal sulfuric acid contained in screw-cap, polypropylene vials (QWSU #438FLD).

Q. Can I use half-filled, 250-mL translucent polyethylene bottles to submit acidified whole-water samples to the NWQL for nutrient analysis?
A. No. Over- or underfilling would be more difficult to recognize in 250-mL bottles. Over- or underfilling results in variation in acid concentration, which in turn could impact analytical results. Filling 125-mL bottles to the shoulder with sample will result in consistent volume of 120 mL ± 5 mL. Analysts at the NWQL will assume this volume when they matrix-match calibration and reference materials used during analysis of WCA samples.

Q. How do I process WCA samples at the collection site?
A. Field rinse clear, 125-mL polyethylene bottles with three 10- to 15-mL volumes of well-mixed, whole water dispensed from churn or cone splitters. Then fill bottles to the level of their shoulders (about 120 mL). Add 1 mL of 4.5 normal sulfuric acid solution (QWSU # 438FLD) to each WCA bottle and secure the cap. Immediately shake or swirl the bottle to mix the sulfuric acid solution with the sample. Pack processed sample bottles in ice and ship them with next-day priority to the NWQL for analyses.

Q. What if I sent an RCC sample to the NWQL after December 31, 1998?
A. Between January 1, 1999, and February 28, 1999, RCC samples inadvertantly sent to the NWQL were amended with sulfuric acid and designated as WCA samples prior to analyses. After this grace period, all RCC bottles received at the NWQL were returned at submitters' expense or discarded.

Q. What if I submit FCA and RCA bottles to the NWQL for analysis of samples collected in compliance with USEPA protocols?
A. Use the WCA sulfuric acid amendment solution (1 mL of 4.5 N H2SO4 per 125 mL of sample, QWSU #438FLD) to acidify FCA (filtered, chilled, acidified) samples. Beginning January 1, 1999, submit a WCA bottle for any whole-water nutrient analysis that required a RCA bottle. Using QWSU #438FLD sulfuric acid solution for all acidified nutrient samples will provide the NWQL with a known and consistent analytical matrix, which in turn should improve the quality of analytical data. See Office of Water Quality technical memorandum 99.04 (http://water.usgs.gov/public/admin/memo/QW/qw99.04).

Charles J. Patton

FIELD SAMPLING — Mark Sandstrom, NWQL research chemist, demonstrates on-site solid-phase extraction of pesticides in water samples. Sandstrom was one of several instructors for a short course on Field Water-Quality Methods for Ground Water and Surface Water, presented April 26 to May 7 at the National Training Center in Denver and on Clear Creek, in Golden, Colo.

The course was coordinated by Kathy Fitzgerald, hydrologist in the Office of Water Quality, Reston.

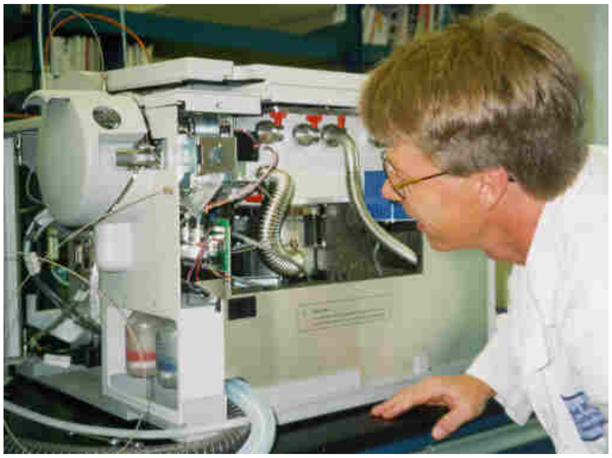
New titles in print

Moulton, S.R., II, Harris, S.C., and Slusark, J.P., 1999, The microcaddisfly genus Ithytrichia Eaton (Trichoptera: Hydroptilidae) in North America: Proceedings of the Entomological Society of Washington, v. 101, p. 233–241.

Moulton, S.R., II, Robison, H.W., and Crump, B.G., 1999, The female of Lepidostoma lescheni (Trichoptera: Lepidostomatidae), with new distributional records for the species: Entomological News, v. 110, p. 85–88.

Rose, D.L., Connor, B.F., Abney, S.R., and Raese, J.W., 1998, Laboratory method for analysis of small concentrations of methyl tert-butyl ether and other ether gasoline oxygenates in water: U.S. Geological Survey Fact Sheet 086–98, 6 p.

Copies of these publications are available from NWQL by contacting Cathryn (Cat) Martin by electronic mail (clmartin@usgs.gov) or by telephone (303-236-3459).



21ST CENTURY SCIENCE — Bruce Anderson, NWQL chemist, explains the operation of a high-performance liquid chromatographic mass spectrometer for visitors touring the new lab June 9 at the dedication ceremony.

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