



FEATURED ARTICLE

Weathered Lignite Deposits and Balkan Endemic Nephropathy

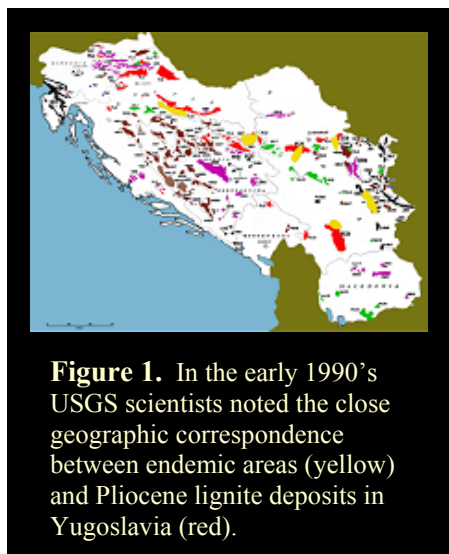
Gerald L. Feder

Balkan endemic nephropathy (BEN) is a fatal kidney disease that is known to occur only in geographically discrete areas of the Balkan Peninsula in Eastern Europe. The disease was first described in 1956, but may have existed for many centuries. The disease seems to occur only in rural villages located on alluvial valleys of tributaries of the lower Danube River (Figure 1). Although the disease is apparently geographically restricted to a relatively small area, BEN is a significant public health problem. At least 25,000 people are believed to be suffering from BEN, and over 100,000 people may be at risk. Researchers have been trying to determine the cause(s) of BEN for almost half a century, but there is still no consensus among the scientific community as to its etiology. Some local villagers feel that mysterious cosmic powers are responsible, and wear protective amulets or pendants and perform ritual prayers to ward off the disease. Western medicine generally opines that certain environmental exposures, genetic predisposition, and/or an infectious agent is the more likely cause. *(Continued on page 2)*

EDITORIAL COLUMN

An estimated 300 to 500 million cases of malaria each year cause 1.5 to 2.7 million deaths, more than 90% of those in children under 5 years of age. Malaria accounts for about 2.5% of all global disease. The estimated annual direct and indirect costs of malaria are on the order of US\$1.8 billion. Because we thought that we had eradicated malaria from this country, those staggering statistics don't have much of an impact on many of us. But they probably do to a 15-year-old young man and a 19-year-old woman in Loudon County, about 10 miles from Reston, Virginia. These two teenagers contracted malaria about two months ago. Unlike the 60 or so cases of malaria reported to the Virginia Department of Health annually, or the approximately 1,200 cases reported to the Centers for Disease Control and Prevention (CDC) for the whole country every year, these two individuals seem to have been infected by local mosquitoes. Most Americans that get malaria acquire the infection while on travel in a part of the world where malaria is endemic. But now we face the prospect that malaria is back, or that it never even went away. As if we didn't have enough to worry about in the metropolitan Washington, D.C. area, what with snipers, West Nile virus, and anthrax letters.

Since August, mosquitoes in Virginia and on a Maryland island on the Potomac River have been tested and found to be carrying the malaria parasite. There are two kinds of malaria, falciparum and vivax. Fortunately, the generally non-lethal vivax form is the only one that has been found here so far. The most likely explanation for how these mosquitoes became infected is that an infected traveller or immigrant came to the area, possibly flying into nearby Dulles International Airport, and was bitten by mosquitoes while still having sufficient parasites in their blood. Not all mosquitoes are competent vectors, but as luck would have it, we have two species of anopheline mosquitoes that are. Some have suggested that malaria was never completely eliminated from this area, and that perhaps it has been hiding in some non-human reservoir. It is not uncommon for zoos to have occasional cases of bird malaria, and perhaps the parasite has mutated to become infective to humans. There have been three other instances of probable mosquito-transmitted, locally-acquired malaria in the US since 1999: one in Georgia, one in New York, and one here in Virginia. If nothing else, this experience reminds us that we ought not ignore health problems of the developing world.



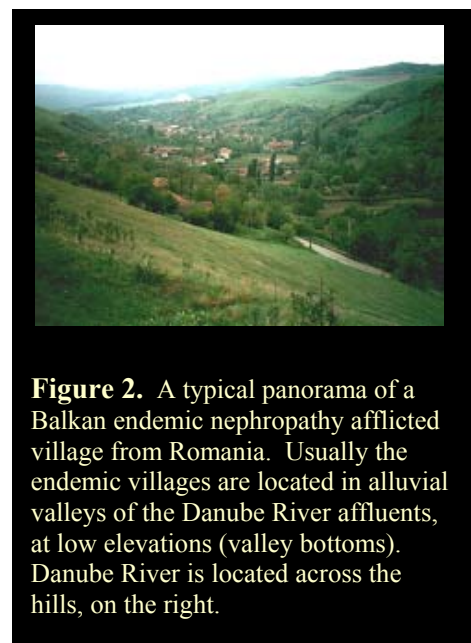
A common geologic feature of endemic villages is the proximity to distinctive low rank Pliocene lignite deposits and lignitic shales that were deposited about 5.3 to about 1.6 million years ago. Researchers at USGS hypothesize that weathering of the lignites and associated shales yield toxic soluble organic compounds, and that these toxins are transported by the local ground water flow system to the shallow water wells used by the villagers. Figure 2 shows an alluvial valley typifying the geologic and hydrologic setting of endemic home sites.

Laboratory analysis at USGS of water samples from endemic and non-endemic villages indicate the presence of potentially carcinogenic and nephrotoxic organic compounds (Figure 3). These include naphthylamines, aniline, aminophenols, alkyl phenols, biphenyls, and heterocyclic (N-, O-, and S-containing) compounds in much higher concentrations in the endemic villages than nearby non-endemic villages.

The disease has several features that characterize it as a distinct clinical entity. Unlike the case with many other kidney disorders, BEN patients do not, as a rule, have high blood pressure. And a significant number of BEN patients also

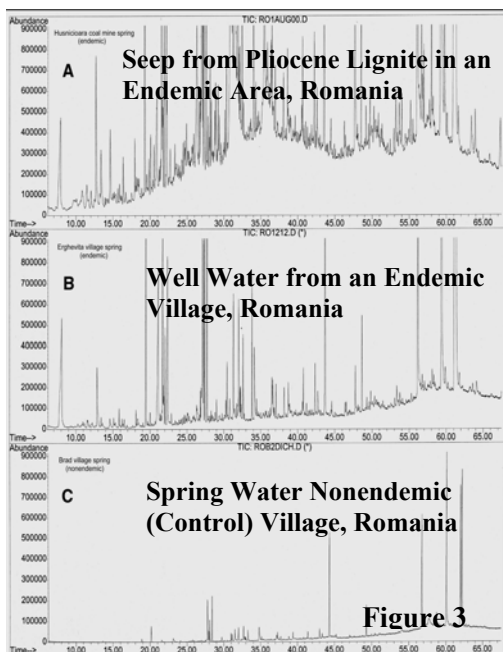
have an otherwise unusual type of upper urinary tract cancer. Only stable, rural populations of people seem to get BEN. The stability implies a long "incubation period" for the disease, consistent with ingesting low levels of toxic compounds from rural water wells over decades. There are no known cases of BEN among people living in cities and drinking water from a municipal supply. Making the diagnosis of BEN is made challenging by the lack of any specific sign, or marker of the disease. Only when the particular constellation of symptoms and the patient's history are in keeping with BEN is the diagnosis made. Thus there could be many more people suffering from BEN than is currently recognized. Autopsies are not routinely performed in this region, and only a post-mortem examination can confirm BEN as the cause of death. The kidneys are shrunken to about 30% their normal size. BEN patients in some areas now undergo new sophisticated ultrasound procedures to help confirm the presence of shrunken kidneys, and the proper diagnosis of BEN.

The clinical and pathological characterization of the disease has been followed by a sustained search for its causative factors, involving international teams and multidisciplinary approaches. At present, fatalities from BEN still occur in the same regions, and the etiology of the disease is still not known. The main fruits of BEN research, up to the present, have come mostly from excluding some fruitless hypotheses, and to redirect future investigations and hypotheses. A currently accepted concept is that BEN is an environmentally induced disease, and some of the most consistently incriminated agents are toxic organic compounds present in the drinking water from shallow wells in the endemic areas. Researchers at USGS hypothesize that these compounds may be leached by groundwater flowing through the nearby low rank Pliocene coal (lignite) deposits, and transported into shallow household wells dug into the alluvium. Until the past decade, most people in the endemic villages used water from these shallow hand dug household wells, for drinking and other purposes. Over the past decade an increasing number of endemic villages are getting public surface water supplies, piped in to household faucets from regional surface water reservoirs. These reservoirs are quite distant from the endemic villages, and are filled by surface water runoff that is independent of the ground water system supplying the wells in the endemic villages. Moreover, the treatment process for this water renders formerly toxic compounds harmless. It will be very useful to study the people in these villages to see if the people raised from childhood using piped-in water no longer develop BEN.



One of the characteristics of BEN is that people generally don't develop the disease unless they have lived in an endemic village for the first 15-20 years of their life. They then generally won't develop the disease until they are about 40 to 50 years old. Once they develop the disease, it is fatal, unless they go on dialysis, or get a kidney transplant. Due to

the high cost of kidney transplants, and the low economic status of most villagers in the endemic areas, most patients must spend the rest of their lives on dialysis. Many BEN cases are reported where a person moves out of an endemic village at about 20 years of age, and they are later diagnosed with the disease when they are about 40 or 50 years old. Though the



correlation between endemic villages and the proximity to Pliocene lignite deposits seems to be established, many researchers believe BEN may be a multicausal disease. For example, genetic factors may predispose a person to develop BEN if they are exposed to certain toxic organic compounds early in their lives, or even prenatally. Similarly, it is possible that childhood exposure to fungal toxins known to damage the kidneys or infection with bacteria that attack the kidneys sets one up for developing BEN. Subsequent long term exposure to low levels of toxic organic lignite-derived compounds may then seal the person's fate, leaving unharmed someone with no such history.

While BEN is not known to occur in the United States, it is curious that this country's lignite deposits occur in states with the highest rates of cancers of the renal pelvis (RPC). Louisiana has the sixth highest Renal Pelvic Cancer (RPC) mortality rate in the United States. Other states with major lignite deposits are Wyoming and the Dakotas; Wyoming ranks first in the USA for RPC, and North and South Dakota rank third and fourth, respectively. All of these states have large rural populations that obtain drinking water from wells. A team of scientists from USGS, the Louisiana Geological Survey, the Centers for Disease Control and Prevention, and the Louisiana State University Medical School have begun investigations

designed to see if a BEN-like syndrome exists in this country. It will also be instructive to look closely at countries with large lignite deposits like Greece and Turkey. However, health data from these nations are sometimes unreliable, and are often difficult to obtain.

While a clear understanding of the cause(s) of BEN remains elusive, there is good reason to be hopeful that we will soon identify the risk factors, and enable preventative measures that will protect large numbers of people from this illness. This issue represents an example of how geoscience experts and the public health and biomedical community need to communicate, cooperate, and collaborate to untangle the intricacies of complex disease etiologies having an environmental component. That is to say, for all of the misery it brings, BEN does seem to be a valuable mechanism for Epidemioecologists to demonstrate their worth.

Jerry Feder, one of the world's foremost BEN investigators and has retired from the USGS, but may still be contacted at glfeder@tu.infi.net or gl9202@aol.com. A fact sheet summarizing BEN may be found at <http://pubs.usgs.gov/fs/fs004-01>.

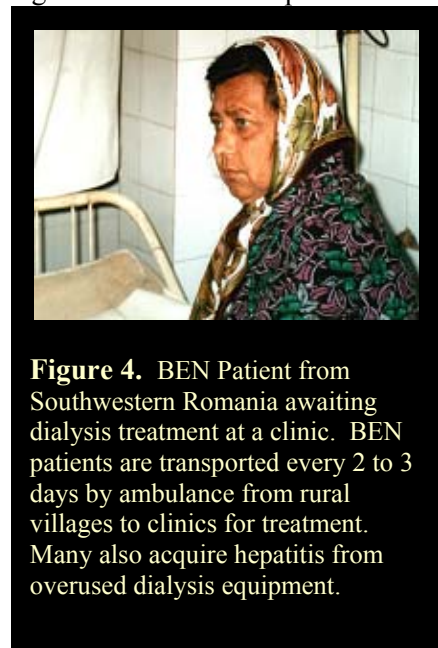


Figure 4. BEN Patient from Southwestern Romania awaiting dialysis treatment at a clinic. BEN patients are transported every 2 to 3 days by ambulance from rural villages to clinics for treatment. Many also acquire hepatitis from overused dialysis equipment.

UPCOMING EVENTS

- A Medical Geology textbook being edited by Olle Selinus of the Swedish Geological Survey is making progress. Several USGS scientists are participating in this groundbreaking publication, scheduled date for publication in early 2003.
- The American Society of Tropical Medicine and Hygiene, 51st Annual Meeting, will be held on November 10 – November 14, 2002 at the Adam's Mark Hotel in Denver, CO. For more information please visit their website at: www.astmh.org/

U.S. GEOLOGICAL SURVEY NEWS

USGS Health Conference

Plans for the USGS National Conference on Health-Related Research are moving forward. We have confirmed the exact dates which will be April 1 – April 3, 2003. The Call for Abstracts has been distributed and can be found on: http://health.usgs.gov/call_abs.html . The website has been developed for on-line submission of abstracts. The on-line registration and lodging is still being developed. Please let your colleagues that might be interested in this conference know the URL for this website.

Human Health web site:

The USGS human health web site has a new URL:

<http://health.usgs.gov>

Please visit the site and provide any updates to Jan Hren (jhren@usgs.gov)

New listings/links welcome!

Human Health Sciences and Geosciences: Bridging the Gap, a Topical Session at the annual meeting of the Geological Society of America, was held on Monday, October 28, 2002 in Denver, Colorado. The session featured a wide range of talks on water quality, dust exposure, biomedical perspectives on geological issues, and human health applications of remote sensing and vector ecology. Presenters' affiliations included USGS, US EPA, McGill University, and Purdue University. USGS Mendenhall postdoctoral fellows Joe Bunnell and Thomas Ziegler chaired the session. Abstracts may be viewed at: http://gsa.confex.com/gsa/2002AM/finalprogram/session_2960.htm.

EPIDEMIOECOLOGY IN THE MEDIA

(Click on the following logo's to link to the website. Also click on these to link to that article)



August 28, 2002

Hilary Heason

NEWS RELEASE: Bangladesh claims against the British Geological Survey

Abstract:

The Natural Environment Research Council (NERC) has received a writ concerning a claim being made against it by a number of Bangladeshi residents who allege that NERC was negligent in not testing for the presence of arsenic in groundwater while carrying out some research in 1992. The research was carried out by the British Geological Survey (BGS) and was funded by the British Government. http://www.bgs.ac.uk/scripts/news/view_news.cfm?id=116

The New York Times

ON THE WEB

July 14, 2002

Barry Bearak

Bangladeshis Sipping Arsenic as Plan for Safe Water Stalls

Abstract:

The arsenic, a slow, sadistic killer, has just about finished its work on Fazila Khatun. She teeters now. The fatigue is constant. Pain pulses through her limbs. Warts and sores cover the palms of her hands and the soles of her feet, telltale of the long years of creeping poison.

Mrs. Khatun is hardly alone in this suffering. Bangladesh is in the midst of what the World Health Organization calls the "largest mass poisoning of a population in history." Tens of thousands of Bangladeshis show the outward signs of the same decline. Some 35 million are drinking arsenic-contaminated water, the poison accumulating within them day-by-day, sip-by-sip. <http://query.nytimes.com/search/abstract?res=F30C10FB34540C778DDDAE0894DA404482>

- VITAL SIGNS: CAUSE AND EFFECT; Lessons From a Poisoned Coffeepot
- Air Testing After Sept. 11 Attack Is Both Perplexing and Reassuring
- U.S. to Test for Contaminants In 250 Downtown Apartments
- Lung Ailments May Force 500 Firefighters Off Job
- Uranium in Soil Found at Sites in Balkans
- Tainted Water Has Little Impact So Far



Kenneth R. Weiss

August 29, 2002

The World; Indoor Stoves Killing Millions in Third World, WHO Says; Health: Leaders at South Africa summit seek to end cooking and heating practices among the poor that unleash poisons in their homes.

Abstract:

More than half of the world's households cook or heat using unprocessed solid fuels such as wood and agricultural waste. In India, about 75% of households use these fuels. Typically they are burned in open fires or primitive stoves, mostly in rooms that lack adequate ventilation or chimneys. Without ventilation, women and children around the home are regularly exposed to high concentrations ... <http://pqasb.pqarchiver.com/latimes/>

- The State; Angry Town Rejects Taint of Uranium; Health: Idyllwild residents worry that their drinking water has been contaminated by naturally occurring radiation.
- Los Angeles; Chromium 6 Removal May Cost \$315 Million; Health: Supervisors asked for estimates on cleaning up wells in northern L.S. County after high levels of pollutants were detected.
- THE WORLD; Safety Rules Scarce in China's Factories; Asia: New protections will soon take effect for workers, thousands of whom are killed or maimed annually. The injured often cannot support themselves.



Eric Pianin

March 13, 2002

Drug Wastes Pollute Waterways; 80% of Streams Checked by USGS Contain Trace Amounts

Abstract:

The first nationwide study of pharmaceutical pollution of rivers and streams offers an unsettling picture of waterways contaminated with antibiotics, steroids, synthetic hormones and other commonly used drugs. Of the 139 streams analyzed by the U.S. Geological Survey in 30 states – including Maryland and Virginia – about 80 percent contained trace amounts of contaminants that are routinely discharged into the water in human and livestock waste and chemical plant refuse.

www.washingtonpost.com/wp-adv/archives

- Traffic Signal Re-Timing Approved to Help the Air
- Water, Water Some Place; Drought's Variations Causing Cracks in Regional Approach
- Study Says Long-Term Exposure Also Can Cause Respiratory Illnesses



Amanda Gardner

August 11, 2002

Some workers face higher asthma risk

Abstract:

Asthma is more than merely a genetic problem, a new study suggests. Workplace elements also matter: Entertainment-industry workers such as artists, designers and photographers have an asthma risk five times greater than average workers, and farmers, forestry workers, teachers, truckers and health-sector employees face double the risk.

<http://pqasb.pqarchiver.com/chicagotribune/>

- Waste facility opposed by Kirk; Mercury in lake near Waukegan a major concern
- EPA tests wells in Downers Grove

The editors of this newsletter welcome

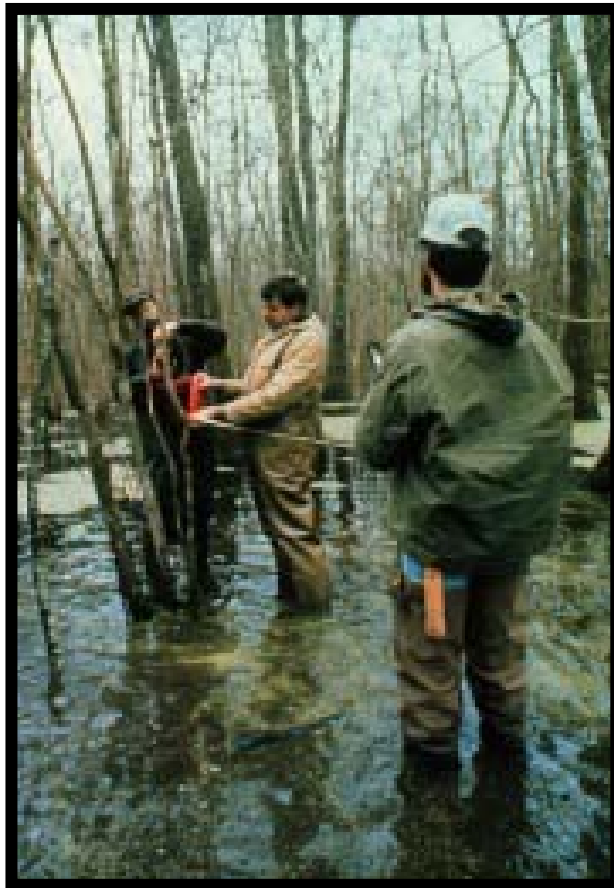
- Suggestions on what to include in future newsletters
- Suggestions on the newsletter format
- E-mail addresses of USGS people who may be interested in receiving copies of the newsletter. (Note: subscribers will receive e-mail notification of future editions of the newsletter that will be posted on a USGS website).
- Contributions toward Upcoming Events or U.S. Geological Survey News

For comments and feedback please contact Samara Holtzman: sholtzman@usgs.gov: 703-648-6479.

(The editors of the Epidemioecology Newsletter value any input through their readers.
Please don't hesitate to contact us at anytime and thank you for your replies.)

IN THE NEXT ISSUE

Just when you thought it was safe to go back in the water ...



Regulations for maximum contaminant levels in water supplies are based on toxicological studies of individual compounds. Now we are finding that most water contamination involves complex mixtures. Learn about this, what the USGS Toxic Substances Hydrology Program is doing about it, and other emerging water quality research issues.