

# Burning Issues

Tobacco's Hottest Topics

Tobacco-Related Disease Research Program Newsletter

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## Radioactivity in Cigarettes: Polonium-210

By Phillip Gardiner, Dr. P.H.

Just when you thought you knew everything about the deadly ingredients in cigarettes, up jumps another contender for the “most carcinogenic award”: polonium-210. Last November the news, splashed across the front pages of all major newspapers that ex-KGB agent Alexander V. Litvinenko had been killed by polonium poisoning set off a virtual investigative frenzy. News anchors, pundits and scientists alike all weighed in on the intrigue in London; however, it soon became clear that regardless of the particulars in the Litvinenko case, the predominant route of exposure to this radioactive, semi-metal in humans is from (you guessed it) smoking cigarettes and other tobacco products. If Litvinenko would have been shot, up-close and personal, as most “hits” are carried out, the news about polonium and radioactivity in cigarettes would have stayed on the back shelves of the tobacco libraries for the foreseeable future. However, although the murder of Litvinenko was certainly unfortunate for him and his family, it has been very fortunate for the tobacco control research community. His death has not only thrown a spotlight on another deadly aspect of smoking cigarettes but has also exposed what may be an important culprit in smoking-related lung cancers: radioactive polonium. So how does polonium get into cigarettes anyway? In this article, we’ll discuss this question along with polonium poisoning, polonium and lung cancer, and the role of the tobacco industry.

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### Polonium Poisoning: A vicious and tragic death

Litvinenko had several meetings on November 1, 2006 in downtown London, fell ill late in the day, was hospitalized on November 3rd and by November 23rd was pronounced dead. Alarming, it was only 20 minutes before his death that his doctors were able to make an accurate diagnosis — polonium poisoning. Polonium, atomic #84 (Po-210), is an extremely rare and extremely radioactive semi-metal. It is silvery grey in appearance and is very soluble so once in the body it has an impact on all tissues and organs.<sup>(1)</sup> Most importantly, the radioactive decay of polonium leads to the emission of alpha particles. Compared with beta or gamma particles, alpha particles are large and slow moving, making them unsuitable for radiation therapy since it's the alpha particles range is less than a tenth of a millimeter inside the body. However, alpha particles have great destructive power at short range, especially when they are ingested. Once in contact with fast-growing membranes, living cells, tissues, and organs, it is positioned for maximum damage, altering a person's DNA or killing the cells outright.<sup>(2)</sup>

Litvinenko, we now know, ingested his polonium with tea. Doctors hypothesize that this route of administration led to the immediate breakdown of cells and tissues in the intestine, appearing initially as food poisoning. The polonium then accumulated in the kidney and spleen, and Litvinenko experienced massive loss of hair, a characteristic side effect of radiation treatment for cancer. Finally, the polonium lodged in his bone marrow, releasing destructive and deadly alpha particles, severely reducing the white blood cell count and ultimately compromising the body's immune system as a whole.<sup>(2)</sup>

While Litvinenko's murder is a dramatic story, most people get their polonium the old-fashioned way: they inhale it with cigarette smoke.

### So how does radioactive polonium get into tobacco products?

The decay of radium in the soil leads to the uptake of polonium by the tobacco plant; however, the uptake does not occur mainly through the root system as one would suspect. Radium is a naturally occurring element that is present in most soil. As radium-226 decays, it pro-

duces other radioactive elements, among them radon-222. (Many of us are aware of radon, an odorless, colorless gas that is often trapped inside houses, increasing some people's exposure to radioactivity. Radon meters can be purchased at any hardware store, and some furnace companies install them in homes with basements.) Radon in turn decays and emits into the air what are called "radon daughters"; specifically polonium, or Po-210, and lead, Pb-210.<sup>(3)</sup>

Po-210 and Pb-210 are electrically charged radioactive particles. This property allows them to attach to dust particles in the air. These radioactive dust particles then attach themselves to the small sticky hairs of the tobacco leaves called trichomes. Hence, when tobacco plants are harvested and processed they contain radioactive polonium. And as if to add insult to injury, the phosphate ore used to make the fertilizers that are used by tobacco growers contains both Pb-210 and Po-210 in relatively high concentrations.<sup>(3)</sup>

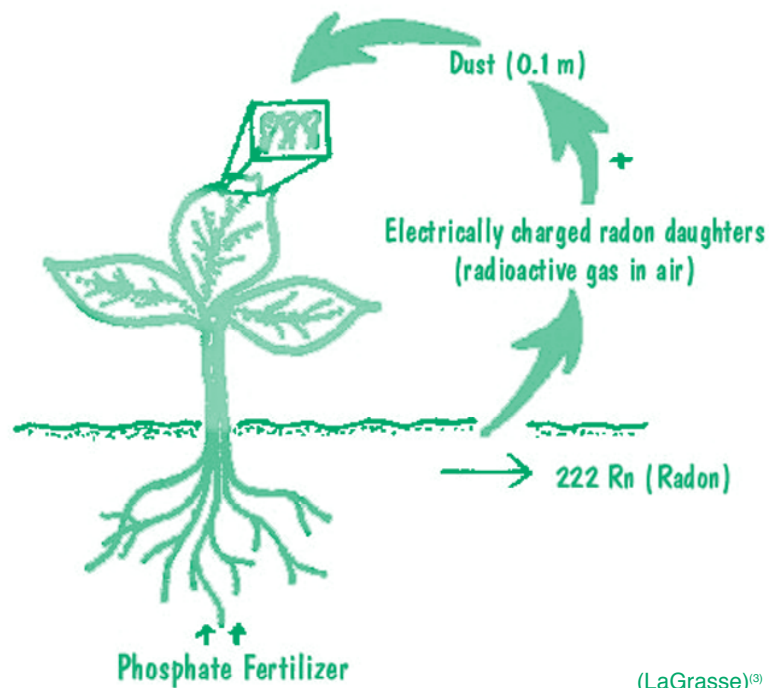
### Polonium and lung cancer

It is estimated that a person who smokes 11/2 packs of cigarettes a day receives an annual radiation dose equivalent

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**Figure 1: succinctly captures this process**

**Radioactivity in Phosphate Fertilizer Migration to Tobacco**  
Radioactive dust particles stick to trichomes (leaf hairs) of tobacco plants



(LaGrasse)<sup>(3)</sup>

## Polonium

Continued from page 2

to the dose the skin would receive if exposed to 300 chest x-rays per year.<sup>(4,5)</sup> In fact, former Surgeon General C. Everett Koop states that it isn't mainly tars that are responsible for lung cancer but the constant inhalation of radioactive particles in cigarettes by smokers.<sup>(6)</sup>

When a smoker inhales tobacco smoke (or any smoke for that matter), the lungs react by forming irritated areas in the bronchi. These irritated spots are referred to as "pre-cancerous" lesions, which serve as a perfectly natural defense system and usually go away with no adverse effects. However, insoluble tars in tobacco smoke can slow this healing process and allow other substances trapped in the tar such as radioactive polonium to adhere to lesions. These compromised areas of the lungs are at the bronchial bifurcations. Polonium 210 does its damage by emitting alpha particles, which have enough energy to tear apart the genetic machinery of cells, killing them outright or causing them to mutate into lesions and tumors.<sup>(7)</sup>

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At the bronchial bifurcations, radioactive hot spots develop ultimately compromising the molecular structure of the lungs cells and potentially precipitating lung cancer. Since the polonium-210 has a half life of 21.5 years (due to the presence of Pb-210), the slow deadly release of alpha particles can put an ex-smoker at risk for years after he or she quits. Experiments measuring the level of polonium-210 in victims of lung cancer found that the level of "hot-spot" activity was virtually the same in smokers and ex-smokers even though the ex-smokers had quit five years prior to death.<sup>(7)</sup>

It should be noted that compounding the problem is the fact that both Pb-210 and Po-210 in American tobacco has tripled since the 1940s. This has been occasioned by the increased use of phosphate fertilizers by the tobacco growers. Phosphate fertilizers already have substantial concentrations of lead and polonium.<sup>(3)</sup> One school thought even suggests that the removal of phosphates from fertilizers would drastically reduce the incidence of lung cancer.<sup>(8)</sup> The process of radioactive uptake described earlier occurs in most leafy plants, especially those being commercially produced where these types of fertilizers are used. The crit-

ical difference is that vast majority of these plants are not smoked. As for marijuana, which is smoked, there is some evidence that less polonium is inhaled by users.<sup>(9)</sup>

### Of course the tobacco industry knew

"When the former K.G.B. agent Alexander V. Litvinenko was found to have been poisoned by radioactive polonium 210 last week, there was one group that must have been particularly horrified: the tobacco industry."<sup>(10)</sup> This quote from Robert Proctor's Op Ed piece on December 1, 2006 in The New York Times cast a bright spotlight on polonium in cigarettes, introducing this subject to a wide audience. And as he astutely pointed out in his article, the tobacco industry had known about the existence of radioactive polonium in cigarettes at least since the 1960s.

Already in 1965, Philip Morris's scientists and executives were hot on the trail of polonium in tobacco. Letters, memos, and other correspondence among industry scientists and corporate administrators show that the tobacco industry knew of the radioactive danger posed by polonium in the mid-1960s. For example, in a letter dated December 1965, addressed to

Dr. Wakeman, another Philip Morris scientist, Dr. Seligman wrote: "In December of last year Sid Cantor called me concerning an AEC member who had been working on the accumulation of radio-active wastes in plants and who was seeking new employment.

"This man had isolated polonium-210 from tobacco and claimed that polonium-210 was a decay product of the radium (phosphate) found in tobacco. He also stated that polonium was volatile at the tobacco burning temperature and that polonium-210 should be filterable from the smoke stream."<sup>(11)</sup>

In another memorandum from December of 1965, R.D. Carpenter in speaking about polonium stated that "the levels in the lungs of cigarette smokers are about twice the levels in nonsmokers' lungs. . . . The current interest in polonium is due to the established fact that bronchogenic carcinomas have been produced in animals by the implantation of pellets of radioactive materials."<sup>(12)</sup> While Carpenter goes on to dismiss the possibility that polonium could be of harm to humans, he still concludes that: "Perhaps it is again time to discuss the polonium situation in light of the most recent developments."<sup>(12)</sup>

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# ***Policies Needed to Regulate Hookah Smoking and Hookah Bars in California***



By *\*Kamlesh Asotra, Ph.D.* and *\*\*Dian Kiser, Ph.D., C.F.R.E.*

## **Hookah Smoking and Hookah Bars – A Global Public Health Concern**

Hookah smoking has become very popular among youth and adults in North America, Europe, the Middle East and Asia, creating an urgent global public health concern for over 100 million Hookah smokers worldwide.<sup>(1)</sup> Since the article, “Hooked on Hookah”, was first published in “Burning Issues” in 2005, highlighting the dangers of Hookah smoking, it has been widely disseminated to college students in the USA<sup>(2)</sup> and distributed to public health personnel in California through CCAP-California’s Clean Air Project. Recognizing the ill effects of Hookah smoking and the looming global public health concerns, the

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World Health Organization issued an advisory note about Hookah use in 2005.<sup>(3)</sup> This year, the American Lung Association published a Tobacco Policy Trend Alert on the emerging trend and dangers of Hookah use.<sup>4</sup> In contrast to the widely held myth by Hookah smokers and also propagated by the Hookah bar operators that Hookah smoke is innocuous compared with cigarette smoking, recent biomedical and epidemiological research has demonstrated that the Hookah smoke is several times more injurious than cigarette smoke because of the significantly higher toxicants in Hookah smoke.<sup>(1-7)</sup> Although more data on the prevalence of Hookah use in the USA is needed, a recent study of 1671 mostly Arab-American 14-18-year-old teens in Michigan found that 27 percent had ever used Hookah. In addition, the risk of teens experimenting with cigarettes was found to be 8 times greater if they had used Hookah.<sup>(8)</sup> A recent internet search revealed that there are over 360 Hookah bars/cafes in 36 states in the US, with 98 in California alone, one-half of which opened just in the last 2 years. Hookah bars

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## Policies

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have also opened in several countries outside the Middle East including Canada, France, Hong Kong, India, Italy, Scotland and South Africa. While enforcement of clearly written anti-tobacco policies and public health advocacy efforts have resulted in a steady decline in cigarette consumption during the last decade, Hookah use is increasing alarmingly. Hookah businesses are mushrooming due to lack of stringent policies and insufficient awareness and enforcement across the USA.

### No Clear Policy for Hookah Bars

Currently, there are only a few local laws or policies to regulate Hookah bars in the US. California and Iowa have made efforts to regulate Hookah bars, while Massachusetts, Michigan and West Virginia are considering legal means to regulate these establishments.<sup>(9-11)</sup> The District of Columbia approved a ban on smoking in work places and restaurants in 2006 but gave an exemption to Hookah bars.<sup>(12)</sup> The state of California regulates Hookah venues under Labor Code 6404.5 (the California Smoke-free Workplace Act), and via Penal Code 308 and the nationwide Stop Tobacco Access to Kids Enforcement (STAKE) Act, both of which prohibit the sale of tobacco to minors. Also, since 2004 California requires that all tobacco retailers obtain a license to sell tobacco. The State's Food and Drug Branch conducts undercover buys at retail stores, but does not currently include Hookah bars/cafes for random check-ups.<sup>(9)</sup> Additionally, there are a handful of California jurisdictions that have addressed Hookah bars through smoking prohibitions in public places and fire and safety ordinances.<sup>(17)</sup>

### Legal Insights into California's Labor Code (6404.5)

A legal memo entitled the "Legal Parameters of the California Smoke-Free Workplace Law" (Labor Code Section 6404.5) was jointly written in 1998 by staff of the San Francisco, Los Angeles, and San Jose City Attorneys Offices which provides insight into this law.<sup>(13)</sup>

California's state smoke-free workplace law (Labor Code 6404.5) provides certain exemptions from the general smoking prohibitions. However, two main exemptions that should not be applicable to Hookah venues but are routinely exploited by them, include (i)

the business is solely operated by the owner (no employees), or (ii) it is a retail tobacco shop mainly selling Hookah tobacco or other tobacco. Most Hookah venues operating in California do not satisfy the above criteria, and therefore, should be deemed indoor workplaces like bars and restaurants where food and drinks are served by employees and smoking is prohibited.

While good profits may be one reason underscoring the rapid and unprecedented growth in the number of Hookah bars in California, another major reason is that the Hookah business operators have sought shelter from smoke-free workplace laws by unfairly exploiting exceptions found in the Labor Code.

### Needed Policy and Enforcement for Stringent Regulation of Hookah Bars

In July 2006, the California Air Resources Board (ARB), a department of the California Environmental Protection Agency, formally identified secondhand smoke (SHS) or environmental tobacco smoke (ETS) as an airborne toxic substance that may cause and contribute to death and serious illness.<sup>(14)</sup> Thus, California became the first state in the country to identify Secondhand Smoke as a Toxic Air Contaminant.<sup>(15)</sup> This decision of the California ARB could well have special policy implications for regulating businesses such as Hookah bars where Hookah smoking may occur not only indoors, but also outdoors.

In an effort to protect the public health, California can improve the language of the Labor Code 6404.5, and use the findings of the California ARB to ensure that customers are of legal age of 18 years and that Hookah smoking occur outdoors (if allowable under local law). Such a well-defined and enforceable policy to regulate Hookah businesses and Hookah smoking in California could also serve as a model for other states. It is quite gratifying that the publication, reprinting and dissemination of the *Burning Issues* article on "Hooked on Hookah" in 2005,<sup>(1)</sup> coincided with laudable efforts initiated at several colleges and universities in the USA to educate the youth about the dangers of Hookah smoking. Moreover, some colleges have clamped down on the student operators of Hookah clubs in their institutional dormitories, with subsequent disbanding of such activities altogether.<sup>(16)</sup> Hopefully, the efforts of Departments of Health in various states and those of the voluntary health agencies such as the ALA, AHA and ACS will also help

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## ***FILTERED TIPS***

By Teresa Johnson, B.A.

### ***Beyoncé's critics fired up; tour ads up in smoke***

Singer and actress Beyoncé Knowles is being criticized for tour ads showing her holding an old fashioned cigarette holder. Anti-smoking group Quit has written a petition to the U.S. Department of Health and Human Services stating that the tour ads could be in danger of violating the Tobacco Advertising Prohibition Act of the Master Settlement Agreement. The newspaper and billboard ads were recently released around the country to promote Knowles' upcoming tour.

Additionally, the National African American Tobacco Education Network and the National African American Tobacco Prevention Network have written a letter to Beyoncé and her management in protest of the tour ads. "With the power of this single image, it appears that you are glamorizing tobacco use and sending a message to your fans that tobacco use is safe and acceptable," states the two African American tobacco-control advocates.

The letter goes further to state "This is a devastating blow to all of the African American tobacco-control advocates and Elders, like us, that fight tirelessly against the tobacco industry's assault to entice our youth into smoking. The image you used plays right into the hands of the industry that continues to coerce, co-opt and lie about the harmful effects of their products. Ms. Knowles, you may not have known, but the tobacco industry was found guilty of racketeering by a Federal judge in 2006 for decades of deceiving the public."

*The tour ad was approved by her management and record company. [www.news.com.au/entertainment/story/0,23663,21255564-7484,00.html](http://www.news.com.au/entertainment/story/0,23663,21255564-7484,00.html)*

### ***Women's lung cancer rates higher than expected***

According to a recent lung cancer study nonsmoking females account for about 20% of lung cancer cases diagnosed every year in the U.S. The study asserts that lung cancer rates for nonsmoking females are higher than what was previously noted. Previous studies had speculated that lung cancer diagnosis for nonsmoking females were 10–15% per year. Lung cancer rates for nonsmoking females range from 14.4 to 20.8 cases per 100,000 persons per year. Secondhand smoke is a known cause of lung cancer in nonsmokers. In addition, other environmental toxins and hazards coupled with occupational exposures have been linked to increased incidents of lung cancer.

[http://www.mercurynews.com/search/ci\\_5191776](http://www.mercurynews.com/search/ci_5191776)

### ***The Marlboro Magician (Yikes!) Vanishing cigarettes anyone!?!***

Have you heard of the vanishing cigarette trick? How about the \$100 bill-to-cigarette routine? Well, these are just a few of the magical tricks that have been presented at upscale bars across the country under the Marlboro Magician Program. The Marlboro Magician show was created several years ago by the Philip Morris as a way of reaching out and giving back to their customers; giving back? How about a vanishing lung anyone?

<http://tobaccodocuments.org/landman/2083719682-9687.html>

### ***Smokers denied surgery***

In a recent British Medical Journal report experts debate whether smokers should be refused surgery. The issue gained publicity when a primary-care trust facility announced that it would be removing smokers from its waiting lists in an effort to contain health care costs: *BMJ, January 6, 2007, www.bmj.com.*

### ***Warning on warning labels: Do Cigarette warning labels work?***

A four-country survey has found that cigarette warning labels are more effective in influencing smokers' behaviors when the text warning messages are prominent. Even more effective than text warning messages were graphic messages. Compared to Australia, Canada, and the United Kingdom, warning labels in the U.S. have the least effective on smokers. It should be noted that U.S. warning labels have not been updated since 1984, nearly 25 years ago. Elsevier Health Sciences, February 7, 2007.

### ***Smoking and TB***

"Smoking is a major risk factor for tuberculosis (TB)," according to a recent U.C. Berkeley study. The study asserts that smokers have a 73% higher risk of becoming infected with TB than nonsmokers. Smokers who become infected with TB have a 50% chance greater than nonsmokers of developing active TB. It is estimated that half a million of the 1.7 million TB deaths each year are smoking related: University of California Berkeley News Release, February 26, 2007

### ***Statue of Limitations Overruled by Supreme Court***

In a unanimous decision, the California Supreme Court ruled that the statute of limitations begins when the smoker is diagnosed with a tobacco-related disease caused by cigarette smoking. The California Supreme Court overruled the 9th Circuit Court of Appeals' 2002 ruling that allowed the statute of limitations to begin when smokers discovered they were addicted to cigarettes: *The Recorder, February 21, 2007*

### ***Obama is calling it quits!***

Presidential candidate Barack Obama is attempting to kick his nicotine addiction. Obama has elected to stop smoking. After years of his wife's pleas to quit, could Obama's bid for the White House have played a role in his decision to quit? The votes are yet to be counted: [www.latimes.com/news/opinion/la-oe-brandt26feb26,-0,1513112.story?coll=la-opinion-righttrail](http://www.latimes.com/news/opinion/la-oe-brandt26feb26,-0,1513112.story?coll=la-opinion-righttrail)

### ***Pregnant Smokers Raise Their Child's Risk of Stroke, Heart Attack***

A Dutch study has found that pregnant women who smoke during gestation place their unborn child at high risk of developing stroke and heart attack later on in life. The findings were recently released at the American Heart Association's 47th conference.

### ***Slavery and cigarettes go hand-in-hand; back together again***

What do Philip Morris and the United States National Slavery Museum have in common? Can anyone say "slavery"? How ironic is it for Philip Morris USA to donate \$200,000 to the United States National Slavery Museum? The United States was built on the slave labor of Africans to grow and harvest tobacco. Today, Philip Morris is still involved in the enslavement of people with its addictive and deadly tobacco products. The Slavery Museum is dedicated to educating people about the history of American slavery. Maybe Philip Morris should take note of that and start telling the truth about the addiction and death associated with its products. First they made us pick it, now they make us smoke it! [www.globalink.com](http://www.globalink.com)

By Charles L. Gruder, Ph.D.

## **Grant proposals**

This year TRDRP will award new grants to start July 1, 2007. The 212 proposals received are undergoing peer review after which the Scientific Advisory Committee will recommend proposals to be funded. This is a 17.5% decrease from 2006. Although we anticipate having less money to fund new grants, fewer proposals may enable us to maintain last year's overall funding rate of 18%. If the budget increases (see next section), the Scientific Advisory Committee would have the option of funding more grants, depending on peer review assessments of quality and program priorities.

## **State appropriation in 2007-08 budget**

The governor's 2007-08 budget, which was released in January, includes an appropriation of \$14,553,000 for TRDRP. The Proposition 99 Research Account is TRDRP's sole funding source. At the January 23rd meeting of the state's Tobacco Education and Research Oversight Committee (TEROC), the California Department of Finance's figures revealed that the unrestricted reserve in the Research Account was disproportionately high compared with the other five Proposition 99 accounts. I noted at that meeting that the unrestricted reserve amount, \$2,700,000, had increased by 50% since the 2006-07 budget and urged the Department of Finance to release these funds to TRDRP in the next version of the state budget which the governor will release in May (the "May Revise").

TEROC voted to ask the governor to release these funds to TRDRP. The University of California has also asked the governor to augment TRDRP's 2007-08 appropriation by this \$2,700,000 and by the \$5,700,000 that is currently scheduled to go to the Department of Health Services for support of the California Cancer Registry. The Registry budget could be maintained if its funds were allocated instead from the Proposition 99 Unallocated Account. The rationale for this switch of funds is that the Research Account is limited, by constitution, statutes, and court rulings, to research on tobacco-related disease and TRDRP is the program designated by the state to carry out this mission.

If this \$8.4 million is not appropriated to TRDRP, we will be unable to fund a significant number of important scientific research projects on the prevention and treatment of tobacco-related heart and lung disease and cancer. The research program is an integral component of California's effective and internationally recognized effort to reduce the severe human and economic toll of tobacco use. TRDRP-funded research has contributed to the success of the state's tobacco control efforts by identifying more effective policies and strategies for tobacco use prevention and cessation, particularly among those of our state's diverse communities that are disproportionately affected by tobacco use and tobacco-related disease.

## **Strategic planning**

The TRDRP is preparing to launch a strategic planning process to address our continuing declining revenues. Unless TRDRP's budget is augmented it will be difficult to face the challenge over the next decade of continuing to have a significant impact on tobacco-related disease and tobacco control in California.

Over the past seven years, the program has made significant changes to accommodate to a declining budget, including the institution of hard caps on grant budgets and the designation of "Primary" areas for Research Project Awards. These changes were made on the recommendation of the Scientific Advisory Committee after obtaining input from program stakeholders. We are engaged in another strategic planning process to determine future changes that may be needed, including possible modifications in TRDRP's mission or goals.

The Scientific Advisory Committee will discuss the strategic planning process in June. We will be soliciting input from program stakeholders in the fall, beginning with a "TRDRP Listens" session at the biennial conference October 8-9 in Sacramento. We urge you to attend this session so we can hear your observations and suggestions.

## **Francisco Buchting is leaving TRDRP**

It is with mixed emotions that I announce that Francisco Buchting is leaving TRDRP after seven years of important contributions. He will become director of strategic development and knowledge transfer with ETR Associates in Santa Cruz.





## BELIEVE IT OR NOT!

**JOHNSON CITY, Tennessee (AP)** - Two inmates housed in a smoke-free prison traded a hostage for cigarettes after a six-hour standoff.

Billy Grubb, 32, and Bradley Johnson, 25, attacked the guard Monday night, said Howard Carlton, warden of the Northeast Correctional Complex.

"As the night progressed they started saying, 'Look, we'll give up if you let us have some tobacco. If you do that, we'll go back to our cell,'" Carlton said. "They got them some cigarettes, they smoked them and went back to their cell and locked themselves back in."

An investigation into how the inmates got out of their cell and their motive for attacking the guard continued Wednesday. Both are in prison for murder.

## Policies

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shape policy on regulating Hookah smoking and Hookah businesses in California and other states.

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## Polonium

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Those recent developments were the ongoing publication in the scientific literature by independent scientists that cigarettes contained radioactive Po-210 and that this could be a cause of the rise of lung cancer in Americans. There were at least eight peer-reviewed scientific papers published in the 1960s on polonium and tobacco, five in *Science*, two in *Nature*, and one in *Public Health Reports*. The industry followed these developments closely and by the mid-70s established a working bibliography that they shared with others on this issue.<sup>(13)</sup> However, it was Edward Radford's seminal piece in 1964 that touched a nerve in the tobacco industry. Dr Radford along with Vilma Hunt published in *Science*: "Polonium-210: A Volatile Radioelement in Cigarettes."<sup>(14)</sup> This paper asserted that polonium 210 found in the mainstream of cigarette smoke may initiate neoplasms in the bronchial epithelium of cigarette smokers.

It is important to note that Radford and another scientist, C.W. Francis, contacted the tobacco industry directly about their research findings. In both cases, these scientists wanted to "help" the tobacco industry remove polonium from tobacco. Looking for funding from Philip Morris to

definitely determine how Po-210 gets in to cigarettes, Francis suggested, somewhat naively that: "If Po-210 in tobacco causes lung cancer, it would be of great importance to produce a 'Po-210 free' cigarette tobacco."<sup>(15)</sup> The industry declined to take him up on his offer.

Although the industry may have turned a cold shoulder to Francis, they ramped up their own research, and things moved quickly. By January of 1966 Philip Morris had established a Radiochemistry Program for Po-210 in Tobacco:<sup>(16)</sup> "Alpha activity counting equipment has been ordered and will be available in our laboratory in the next 60 to 90 days. Some experimentation would provide information. . . would include the determination of Po-210 activity:

1. in bright, burley, and Turkish tobaccos, both green and after curing;
2. in tobacco at regular intervals during the aging process;
3. in the major domestic cigarette brands. . ."<sup>(16)</sup>

Did the industry know? Of course they knew. Just this cursory review of a few industry documents show that the tobacco industry was acutely aware that polonium was indeed present in tobacco and cigarette smoke. Moreover, the industry was aware that polonium was carcinogenic and a potential initiator of lung cancer. As usual, whether it concerns nicotine's addictive properties, the fraud of "light" cigarettes, or the presence of radioactive isotopes in tobacco products, the tobacco industry knew first; they have been and remain far ahead of the curve.

### TRDRP and polonium research

TRDRP is currently funding a grant that has polonium squarely in its bulls-eye: "Tobacco radioactivity & public policy" (14IT-0001), P.I. Hrayr S. Karagueuzian, Cedars Sinai Medical Center, Los Angeles. The specific aims of this project are:

1. to systematically retrieve, review, analyze, tabulate, and prepare a comprehensive data base from the declassified tobacco industry reports on radioactivity in tobacco smoke (main and side stream), the lungs of active and passive smokers, and nonsmokers and compare them with data published in the open literature;
2. to search and retrieve all relevant tobacco industry documents to determine the policy of the tobacco industry with respect to tobacco radioactivity and the actions taken to address the potential health consequences of

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## Polonium

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exposure to alpha irradiation both in active and passive smokers. The database resulting from this study is estimated to be used by investigators and policy makers and legislators to promote public awareness with respect to tobacco smoke radioactivity.

Clearly Dr. Karagueuzian has his work cut out for him. In my short review above, only six industry documents were cited. On the other hand Dr. Karagueuzian has already identified over 10,000 documents from various tobacco industry archives that mention polonium. He states in his most recent Scientific Progress Report that: "Most remarkable in our search was the findings that the industry hired a firm specializing in radiation biology to amass and tabulate world literature on tobacco radioactivity."<sup>(17)</sup>

If there is any solace to be taken from the tragic death of Alexander Litvinenko, it is the fact that his murder has cast a spotlight on radioactivity in cigarettes, possibly a key culprit in the tumorigenesis associated with lung cancer.

TRDRP wants to encourage investigators to actively pursue this topic and other studies on the constituents of cigarettes and any and all public and/or policy implications. TRDRP would also like to thank Dr. Karagueuzian for initiating his ground-breaking documents review.

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