Philately & DNA

by Robert M. Bell and Robert S. Blackett

It's an interesting marriage: Philately & DNA. Philately, on the one hand, is more than 150 years old. One thinks of collections held for decades and the tedious philatelic research of yesteryear aided primarily by a magnifying glass and a pair of tweezers, plus the difficult access to libraries — research that only recently has become a little easier with the advent of the Internet and improved global communications. DNA analysis, on the other hand, is not only new it is very high tech. One thinks of white lab coats and fancy robots resulting in near-magical discoveries. This article will explore the relationship between philately and DNA.

The philatelist co-author (RMB) had his interest stimulated by an Internet comment about the amount of DNA that must be present in a basin of water when soaking off stamps, and by a recent news story about Pearl Harbor World War II remains being identified and sent home for burial. The key was matching bone DNA to the sailor's old mail and subsequently to a living relative. RMB had also wondered whether a genetic mutation in the DNA of a famous person could be discovered from a licked envelope or stamp — which that individual had mailed — thereby explaining illness during life, or even the cause of death.

The crime laboratory DNA co-author (RSB) has on two occasions typed stamps for DNA traces. The first was to obtain his long-dead father's DNA profile for genealogical reasons, using World War II-era love letters sent to his mother.

The other instance was a case of criminal sabotage of a gas pipeline. DNA typing was requested on a threatening letter sent to the company. The stamp was self-stick, but there was still enough DNA, likely from skin cells when the stamp was touched or peeled off the backing, to give a partial profile. This was later matched to a suspect and led to a search warrant, which uncovered other evidence, which in turn eventually led to a guilty plea.

236 AMERICAN PHILATELIST / March 201



World War II cover from western France from Fred Blackett to Norma Blackett, dated December 13, 1944 showing 6-cent air mail stamp (Scott C25) used in the genealogy typing in 2000. One corner was cut when undertaking the typing analysis



Most readers will be familiar with the double helix discovery by Watson and Crick in 1953.¹ In 1985 DNA was found by Dr. Alec Jeffreys to give individual-specific "fingerprints."² A brief general introduction to genetics and DNA can be found at http://en.wikipedia.org/wiki/Introduction_ to_genetics. The genetic typing techniques originally used involved what was called restriction fragment length polymorphism, or RFLP analyses.³ However, this took months of processing time and a great deal of DNA. About fifteen years ago crime laboratories switched to Polymerase Chain Reaction (PCR) based techniques, where tiny traces of DNA are used as the template to produce up to a million times as much material.⁴ Typing today can be done in less than twenty-four hours — in rare instances, almost as fast as on TV!

These Nobel/Lasker-DeBakey Prize winning discoveries of Watson/Crick and Jeffreys, together with others, have made it possible not only to identify/type DNA in body fluids, including saliva found on stamps and envelopes, but also on surfaces that we all touch.

DNA was typed initially on body fluids such as blood and semen. PCR techniques later enabled typing of saliva



on drinking containers, half-eaten food, and cigarette butts, as well as licked stamps and envelope flaps. The current common typing method is known as Short Tandem Repeat (STR). To illustrate how this works, one author's (RSB) STR DNA profile is shown on page 238. Results are shown at fifteen STR DNA loci and at the sex indicator Amelogenin, on the X and Y chromosomes.

Touch DNA typing is now increasingly performed typing the DNA from left-behind skin cells. This works best with repeatedly touched things like weapons, dirty clothes, steering wheels, etc. Brief touching rarely leaves enough skin cells to analyze. Swabs of touched areas also often give mixtures of multiple people's DNA.

Standard (autosomal) STR DNA typing most recently has been supplemented by Y-chromosome typing and by mitochondrial DNA typing.⁵ The Y-chromosome is paternally inherited in males, while the mitochondrial DNA (in both males and females) is always inherited from the mother. That leaves them "unmixed" from generation to generation,



STR DNA profile of RSB. Fifteen autosomal STR loci. Results can be homozygous (single peak, inherited from both parents) or heterozygous (two peaks, one from each parent). Amelogenin (4th row "XY" shows "male") indicates sex.

and both Y-DNA and mitochondrial DNA are thus widely used for genealogy reasons.

Other DNA systems called Single Nucleotide Probes (SNPs) are being developed.⁶ DNA sequencing can be done to identify mutations and genetic disease. At present, faster automated typing systems are being developed in this very rapidly developing field.⁷

All DNA types show racial/regional variability, and many population studies have been done. Given a DNA profile, a race or region and, most recently, even the general physical appearance of an otherwise unknown individual can be suggested.⁸

Philatelic Considerations

Rowland Hill's famous 1837 proposal recommended that postage stamps be coated with adhesive gum and licked to affix the stamp to the envelope/cover.⁹ This took place in 1840, and since that time most stamps have had gum applied. A stamp that is licked should have significant amounts of DNA.

With the advent of the postage stamp there was a corresponding need for large numbers of envelopes, and these were slowly introduced. By 1867 Karl Marx had noted in *Das Kapital* the expansion of the envelope industry. And, by the end of the twentieth century, 2 billion envelopes were being manufactured in the United States each year, with the majority requiring moisture (and often licking) to seal.¹⁰

Envelopes, stamps, and hinges have now been licked for many years, leaving much DNA to be found and analyzed. However, this is one of those "good new/bad news" scenarios. If the envelopes and stamps have been stored well over the years, the DNA does not degrade to any extent and should produce good results. Unfortunately, if the envelopes and stamps have been handled repeatedly over a long period of time, the touch DNA from multiple people may contaminate and complicate attempts to type the original saliva. The possibility exists of co-mingled DNA not only from the original stamp licker/handler, but also from

the basin of water that soaked off the stamp, and from various collectors handling the stamp or attaching it to a stamp album with a licked hinge. Nevertheless, DNA testing has the potential to confirm, if reference samples are available, that a particular person used/handled a stamp, envelope, or hinge.

As far as can be ascertained, there are no formal DNA study groups in thematic philately (if there are, the authors would be pleased to learn about them), although there does seem to be an interest in genetics as a collecting theme. On the Internet are several references to DNA and Stamps, and one site is devoted to stamps and genetics.¹¹

David Herendeen and colleagues have recently established the Institute for Analytical Philately, devoted to solving philately's puzzles through science.¹² It would seem that DNA analysis of letters and stamps could well be a topic for further research.

Laboratory Handling

There are some general considerations for laboratory handling of philatelic materials:

- 1. Care of forensic evidence must maintain the chain of custody. Transferred evidence must be signed for and/or sent by registered or certified mail.
- 2. Where the stamp or envelope flap can be sacrificed, a portion is cut out, placed in a tube, and the DNA extracted, usually by soaking overnight. The DNA is then concentrated, quantified, PCR amplified, and analyzed. It is less destructive to swab the licked/touched surface and extract the swab. Swabbing also can be used to concentrate larger weaker areas. Self-stick stamps would be treated in the same way, although there shouldn't be saliva. The gum backing should not interfere with extraction. One also could remove the back flap from a cover, do the analysis of the gum, removing some or all of it. Then the back flap could be re-attached.
- 3. As mentioned, the age of the sample is not necessarily important, so long as it was properly stored. Moisture, high heat, and sunlight can degrade DNA.
- 4. Crime laboratories are limited to "forensic" samples from crimes, and they are overwhelmed with work. Fortunately, there are a number of private DNA typing laboratories. The fee for an analysis in 2011 was typically about \$1,000 per sample. This price is a bit prohibitive for most non-police uses. No doubt there are other technologies and efficiencies being developed that will lower this price in the future. In addition, if it is desired not to damage the stamp or envelope in any way in order to maintain its value, then special handling may be necessary that would increase the cost still further.

Possible Philatelic Applications

DNA is typed from philatelic materials for forensic reasons, to try to solve crimes. Unknown profiles from the evidence would be compared to standards, usually buccal swabs from a person's mouth. If the person is deceased, exhumation could provide bones or teeth for typing. Standards from close living relatives could also be used, particularly for Y-chromosome or mitochondrial DNA. Court orders might be needed to obtain standards.

For no-suspect crimes, DNA profiles could be compared to CODIS, the national U.S. DNA database (about 9 million profiles), or UK-NDNAD, the national United Kingdom DNA database (about 6 million profiles), or to other foreign databases through Interpol. All these databases are very closely regulated to try to avoid inclusion of innocent people. Most recently "familial" DNA comparison to databases is being done to try to identify parents, siblings, children.¹³ Again, it is very closely regulated.

Additionally, DNA typing might have application in

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cases of philatelic fakes or forgeries, to try to identify a particular person in order to show authenticity or a forger. Once again, the less handled, the better.

2. DNA is typed to try to identify famous people and show they used the philatelic material. This is another instance where buccal standards from living relatives might be needed. Personal privacy concerns would enter in.

Potential problems with personal identification include low levels of DNA and complicated mixtures of DNA. The letter/stamp might have been written/licked by a secretary/ assistant to the sender. Wartime censors might have handled the item. If hairs happened to be present in a letter or envelope, they could be used to corroborate the DNA findings.

- 3. DNA is typed for genealogical reasons, to try to identify relatives and even the part of the world an individual's ancestors came from.
- 4. DNA sequencing is done to identify mutations and genetic disease. This could tie the DNA to a specific person; e.g., Abraham Lincoln, thought to have Marfan syndrome or another genetic disease called MEN 2B.
- 5. Other Research Possibilities: There are probably many more research projects that will come to mind that are not directly related to DNA analysis. Our reviewers have suggested Public Health disease research with analysis of bacteria and viruses transmitted in letters, perhaps even airborne pollution or trace chemicals from a person's saliva, all of which potentially may have been captured in the gum.

In the United Kingdom, The Human Tissue Act 2004 makes it an offense to store or analyze human tissue samples for any purpose other than that for which consent has been granted. There are some exceptions, including the pursuit of

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One of the four letters sent in the Anthrax saga. The image is poor quality, most likely due to being photographed inside an evidence bag.

crime, the work of Coroners, hair and nail cuttings, and tissues more than 100 years old.

One also can expect laws and regulations around the world regarding DNA to become more restrictive as the years pass.

Famous Crimes

The Bournemouth, U.K. Bomber: This was a blackmail plot in 2000–2001 during which several bombs were mailed to customers of the chain store Tesco.¹⁴ On most of the bombs the stamps were wetted with a cloth; however, on one the suspect (Robert Dyer) licked the postage stamp. This was used with other information to tie him to the crime. At his trial Dyer pleaded guilty to nine counts of blackmail with menaces and one of assault. He received a prison sentence of sixteen years, which was reduced to twelve years on appeal.

The Anthrax Letters: In 2001 an estimated four letters containing anthrax were mailed to media and to politicians in the United States.¹⁵ Twenty-three people, mostly postal and media workers contracted the disease - five died from it. Handwriting and ink analysis of the envelopes linked all four. Extensive circumstantial evidence, including the potent strain of anthrax and the particular print run of the prestamped "Federal Eagle" envelopes, implicated one Bruce Ivins, an army biodefense researcher. Dr. Ivins committed suicide in 2008 before he could be arrested. The DNA connection is the excitement that resulted when a minute quantity of human DNA was found on one of the letters - only to be matched to the lab technician doing the analysis. [Authors' note: No stones thrown here; the sensitivity of DNA analysis means that most analysts, despite their best efforts, have experienced such contamination.]

The Lindbergh Baby Kidnapping: The infant son of the famous flyer Charles A. Lindbergh was kidnapped from his home in 1932.¹⁶ Multiple requests for ransom were subse-

quently sent. The \$50,000 ransom was paid, after recording the serial numbers of the bills. Sadly, the badly decomposed child's body was found about two months afterwards. According to the FBI files, he probably had been dead since the night of the kidnapping.

After a massive investigation, Bruno Richard Hauptmann was found with much of the money in 1934. He was arrested and charged; tried and convicted in 1935; and executed in 1936. Extensive evidence linked him to the crime, although he never admitted to it, and conspiracy theorists have doubted his guilt or suggested accomplices.

It has been recently suggested that the ransom envelope flaps could be DNA tested and compared to Hauptmann's living de-

scendants; however, requests to analyze them have been denied.

Conclusions

Stamps, hinges, and envelope flaps have been licked for more than 150 years, with saliva DNA being transferred to the philatelic item. DNA typing has been possible for about twenty years, but has rapidly developed to an immensely powerful technique for personal identification.

There are numerous applications to philately, including crime solving, genealogy, and genetic disease identification. Many opportunities for further research exist.

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Two of the Lindbergh ransom covers.

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The Authors

Robert M. Bell trained as a Pharmacist at Portsmouth College/University in the U.K. and then as a physician at the Godfrey Huggins School of Medicine in Salisbury, Rhodesia, graduating with a Birmingham University, U.K. degree. He was in academe for three years in pharmacology at the Godfrey Huggins School of Medicine where he was involved in clinical research projects. He came to the United States in 1972 and worked in the pharmaceutical industry (clinical research and medical communications). He was in private practice (family medicine) in Charlotte, North Carolina for six years. He retired from the Searle (Monsanto Corpora-



tion) in 1998 and moved to Arizona in 2000. His philatelic interests have been in the area of Rhodesian, Romanian, and U.K. postal history. He recently published a book on *Folded Typewriter Postcards*¹⁷ and has been interested in changes to encourage more philatelists to exhibit their collections. He can be contacted by e-mail at rmsbell200@yahoo.com

Robert S. Blackett was the Tucson Police Department's DNA Supervisor. He has undergraduate degrees in chemistry and biology from Colorado, and a master's degree in forensic sciences from George Washington University. He has more than thirty-one years experience in forensics (twenty-four of them with the Arizona Department of Public Safety), and more than twenty years experience typing DNA. He recently retired (for the second time!). He hasn't collected stamps since he was a Boy Scout in the 1960s, but is reconsidering.

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