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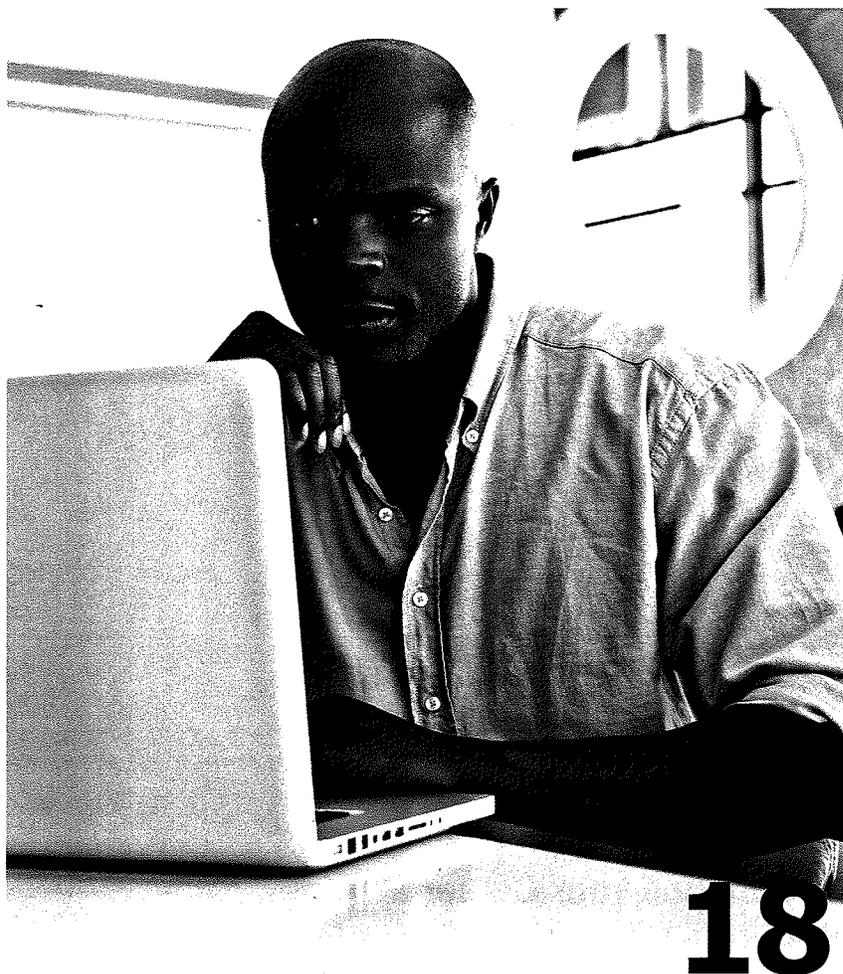
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TABLE OF CONTENTS



FEATURES



14 Rapid DNA

Investigators at a Florida police department are working with scientists to develop DNA analysis tools that can be used quickly in the field.

John W. Blackledge, Roy R. Swiger, Douglas F. Muldoon

18 The Online Option

Online degree programs give criminal justice students the ability to take classes on their own schedule while working full time.

Linda J. Cook

22 Big Shoes to Fill

When I was appointed National Academy historian, I knew that I would have to work very hard to equal the records of my predecessors.

Terry Lucas

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MAY / JUNE 2012 • VOLUME 14 / ISSUE 3

COLUMNS

6 Association Perspective

Travel the World with the National Academy Associates
Diane Scanga

23 Message from our Chaplain Resisting Temptation

Honesty and integrity are tested every day in law enforcement; stay strong.
Billy Gibson

24 Staying on the Yellow Brick Road Combating Internal Inflammation

Are bad habits damaging your arteries? It's time to turn that around..

John G. Van Vorst

EACH ISSUE

2 Executive Board
8 Alliances
10 Chapter Chat

AD INDEX

IFC IntegenX, Inc.
2 Trident University
3 Purdue
4 Elbeco, Inc.
5 Kaplan University
7 Troy University
9 University of Phoenix
12 G2 Research
13 Regis University
17 Liberty Mutual
19 Justice Federal Credit Union
21 BLI, Inc.
IBC American Military University
BC Taser International

Rapid DNA

John W. Blackledge, Roy R. Swiger, Douglas F. Muldoon

NO law enforcement investigative technology is more misunderstood by the public and consequently juries than DNA matching. On numerous crime procedural TV shows, DNA is gathered from the most unlikely sources, processed in minutes, and generally always yields a match. As every law enforcement officer knows, reality is quite different. It takes weeks and even months to receive the results of DNA matching and they often lead to no one. That's why instant DNA processing is the holy grail for detectives and crime scene investigators.

It is the dream of every law enforcement officer from police chiefs and sheriffs to the newest officer on the street to use an exacting science like DNA instantly at the crime scene. Due to the influences of media and television, citizens and juries of today expect it. That's why the Palm Bay (Fla.) Police Department as part of a private-public partnership is working toward the goal of developing rapid DNA analysis technology.

DNA Processing

The criminal justice system uses DNA profiles to investigate criminal activity, identify missing persons, and exonerate the wrongly accused. Samples obtained by law enforcement from people or from crime scenes are processed by labs to generate DNA profiles. Profiles result from the analysis of DNA regions called short tandem repeats (STR).

A DNA profile can be developed from human tissues or bodily fluids. Samples are categorized as references from an identifiable person or as evidence collected at the crime scene. Crime scene collections can also include "touch" or "con-

tact" samples derived from skin cells deposited by an individual upon touching or rubbing an object.

In order to generate a DNA profile acceptable for the Combined DNA Index System (CODIS) or similar databases, forensic labs typically require about 12 hours of lab bench time and may require several days to several months to generate a usable profile working just a few items. This process requires technical instruments that cost hundreds of thousands of dollars and advanced training or expertise to operate (see diagram below). The process and the cost of DNA analysis contributes to the existing nationwide backlog and limits the use and application of DNA analysis to violent or high-profile crimes.

The Big Picture

Most law enforcement across the United States would agree that: most crime is localized; property crimes comprise the bulk of criminal activity; most major crimes are committed by persons with a past history of property crimes; a small number of criminals commit most crimes.

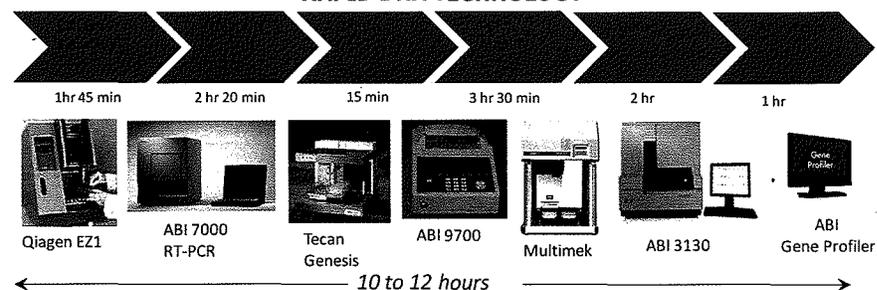
Investigating property crimes uses considerable law enforcement resources, manpower, and time. It is also problematic that often these investigations are not provided "high-powered" resources and are mostly limited to intuitive methods that can be incorrect, resulting in wasted resources following false leads. Lacking a tool like DNA analysis for investigation has resulted in a low clearance rate, about 15% nationwide.

More importantly, the failure to solve more of these high-volume, nonviolent crimes earlier in an offender's criminal career shows that the system lacks effi-



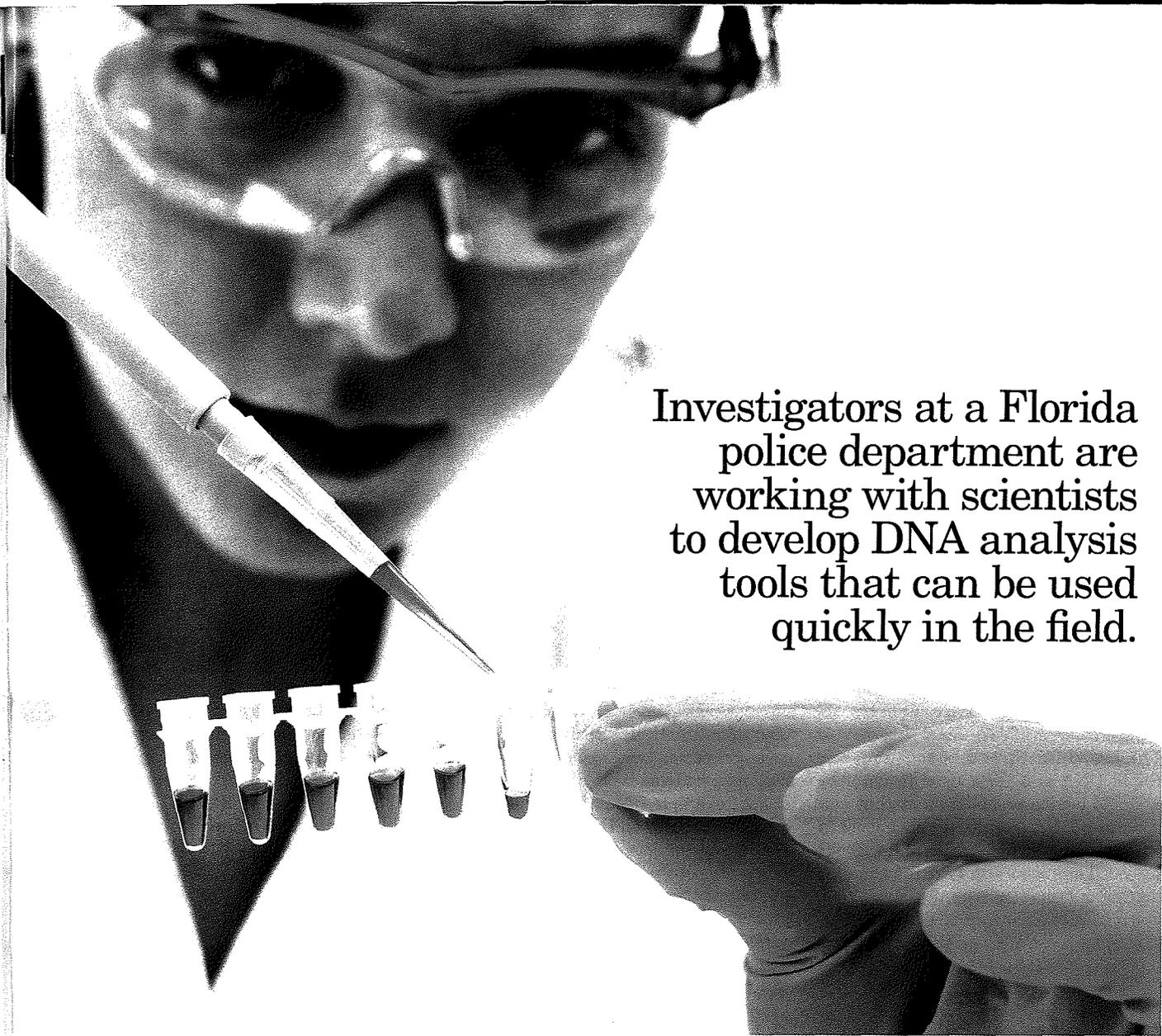
cacy, amounting to lost opportunities to interrupt crime behavior early, particularly with juveniles. Most serious criminals began as petty offenders who were never caught or effectively dealt with because of lack of substantial evidence or intelligence to identify them. One of law enforcement's goals for the near future is to expand the use of DNA and DNA databases to the most common and prevalent crimes, property crimes and drug offenses.

RAPID DNA TECHNOLOGY



Products Mentioned:

- ★ QiaGen EZ1
- ★ Applied Biosystems 7000 Real-Time PCR System
- ★ Tecan Genesis
- ★ Applied Biosystems PCR System 9700
- ★ Beckman MultiMek
- ★ Applied Biosystems 3130 Genetic Analyzer
- ★ Applied Biosystems Gene Mapper ID-X



Investigators at a Florida police department are working with scientists to develop DNA analysis tools that can be used quickly in the field.

PHOTO: @ISTOCKPHOTO.COM

Property Crimes

Although the use of DNA has positively affected law enforcement's ability to convict criminals and assist in the identification of missing persons, until now it has not been feasible to use DNA analysis as actionable intelligence in the early stages of an investigation, except in rare, high-profile cases. This results in an environment where DNA analysis is typically used after the fact to confirm intuitive investigative processes rather than to drive an investigation where suspect identification is a priority, a common issue in property crimes. Local and state law enforcement usually experience long delays in getting DNA results from crime labs, particularly for property crimes.

Lack of control by the investigating agency has historically limited the application of DNA to higher profile violent crimes. Although DNA is not routinely collected on high-volume property

crimes, DNA analysis could have a significant impact on solving these cases.

The Palm Bay Project

Located in the east central part of the state near the Kennedy Space Center, Palm Bay is Florida's 7th largest city by area and 19th largest in population at 107,000. The city is primarily a sprawling bedroom community with a large high-tech industry base.

More than 80% of the reported crime in Palm Bay is property or miscellaneous offenses. In 2006, Palm Bay experienced a crime rate of 3,870 per 100,000 population (FDLE UCR Index Crimes) and a clearance rate of 19%. In 2007, the Palm Bay PD began a pilot DNA project called the Local DNA Indexing System (LODIS) in a joint private-public partnership with DNA:SI Labs Inc. DNA:SI is accredited by ASCLD/LAB and provides DNA services for law enforcement agencies, including database and re-

porting services.

During the first four years of the program from 2007-2010, Palm Bay's crime rate was progressively reduced to 2,882 per 100,000 population, while the annual clearance rate rose to 34%. During this same period, the local economy suffered significantly and the population continued to grow. Moreover, at 1.5 officers per 1,000 population, Palm Bay PD is well under the national and Florida averages of 2.5.

Palm Bay officers and crime scene technicians collect approximately 300 evidence swabs and 100 reference swabs monthly. All swabs are prioritized every two weeks by detectives and crime scene personnel based on investigative value. Currently about 150 evidence items and 20 reference items are analyzed each month.

Because items are shipped in batches, the program is cost effective. All profiles generated by the lab are reviewed by ex-

Rapid DNA

pert analysts and then searched against the Palm Bay database. The lab provides reports in numerous user-friendly formats to the agency LODIS administrator and investigative supervisors, generating investigative leads and blind hits that directly identify suspects. Easy-to-read e-mail results go directly to the collecting officer for feedback.

Five years of collections have resulted in roughly 3,500 reference swabs and 11,500 evidence swabs processed with 1,383 matches including duplicates. A large percentage of evidence swabs collected have been contact or touch DNA. Because DNA results are delivered within 30 days rather than multiple months, Palm Bay officers are able to not only identify suspects and combine related cases, but can also reduce the number of recurring incidents earlier, thus reducing the overall number of crimes committed.

So how can we improve the Palm Bay DNA success?

The Need for Speed

Rapid DNA is a term used to describe a single device or instrument that can generate DNA results like that of a crime lab in just a few hours and without the need of a laboratory setting or much by way of hands-on technical expertise. Currently, several Rapid DNA technologies or instruments are being developed by private sector companies. All are envisioned as portable, rugged, simple to use, fully automated sample-to-answer devices. According to the FBI, the IntegenX RapidHIT is ready for evaluation by law enforcement at this time.

The ultimate goal for application of DNA to intelligence-led policing is to add the capability of immediate DNA analysis either at the station or at the scene. The focus of Rapid DNA is to provide immediate DNA identification at a booking station and to create actionable DNA intelligence leads for the street officer and investigators in real time. A Rapid DNA capability can provide the law enforcement community with maximal forensic DNA information in the shortest amount of time while preserving the integrity of the data.

Examples where transportable Rapid DNA capability can provide actionable information include on-scene screening of suspects, victims, crime-scene processing,



PHOTO: ©ISTOCKPHOTO.COM

unknown homicide identification, and during crime investigations. Additionally, there could be a positive impact on case assignment and resource allocation with respect to current investigations.

For example, seemingly unrelated burglary cases with the same DNA profile can be connected even when a suspect's identity is unknown. Combining the information from multiple cases may produce a suspect through other investigative methods. This is a major benefit of using DNA databases as an intelligence-

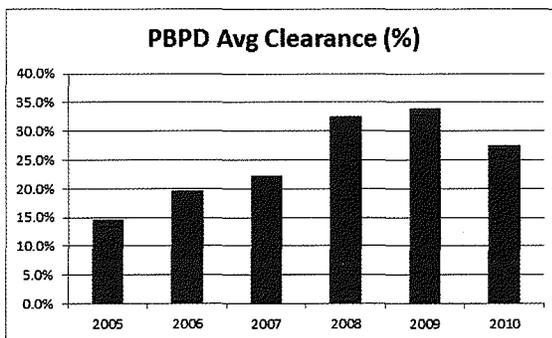
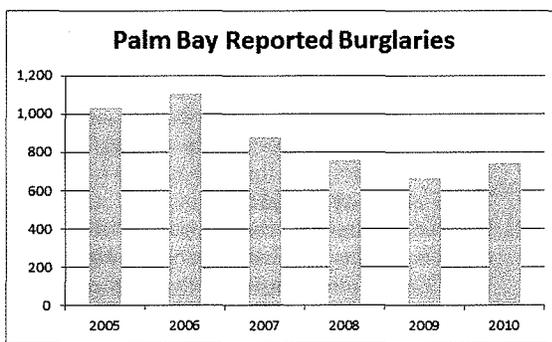
led policing tool. Another unique benefit is the ability to connect stolen property at pawnshops back to the victim, as the victim's DNA profile is actually developed from the recovered property.

The IntegenX Inc. RapidHIT 200 device advances DNA identification from a slow laboratory process to an immediate-use, DNA identification system that runs without human interaction. Palm Bay officers field tested a RapidHIT prototype system that analyzed four buccal swabs simultaneously in just under two hours. The next step in field testing was to evaluate a RapidHIT system that can run up to eight swabs simultaneously in less than 90 minutes.

New Technology

Last summer the Palm Bay PD conducted a field trial utilizing the RapidHIT 4-channel prototype system. The exercise spanned three full days without interruption. Three to four analysis runs were conducted each day, comprising 36 samples. Highlights from the exercise included successfully analyzing samples stored for up to four years by the Palm Bay PD. In these instances full profiles were generated. All reference swabs analyzed produced full CODIS-ready DNA profiles.

The exercise culminated with a mock crime scene in which the instrument was placed into the department's Unified Mobile Command Center and transported to a residential neighborhood. The



Year-over-year (2005-2010) reported burglaries (top) and average clearance rate (bottom), based on Unified Crime Reporting Statistics, published by NJ. DNA LODIS program started in 2007.

scenario involved two suspects committing a burglary and theft at a residence.

Blood droplets and a water bottle were some of the items processed by the Palm Bay Crime Scene Unit. Partial profiles were generated from these samples, and when compared to the Palm Bay DNA database, a suspect was identified. Within five hours from the forensics team being sent to the scene, the suspect was identified using rapid DNA at the crime scene. While the Palm Bay demonstration was limited, it nevertheless showed the potential of gathering actionable intelligence from rapid DNA analysis. Previous field-based IntegenX demonstrations have also reinforced the potential high value of rapid DNA to provide actionable intelligence.

Rapid DNA technologies have the potential to produce a significant leap in capability for police investigations. Their implementation for use in intelligence-led policing will be essential to cost-effective crime fighting in the future of reduced budgets.

Plausible implementation scenarios include transmitting results from in-

struments securely using various remote means so that review by a qualified analyst can still be conducted while the instrument is operated by officers at the scene. Other examples of new operational uses that are enabled by Rapid DNA capability are high-priority law enforcement cases, border security and customs, paternal claims, mass catastrophes, airport security, military operations, and counter-terrorism. The speed of analysis will permit a quick screening to determine the inclusion or elimination of suspects during investigations, making investigations more efficient and effective. Because of the size and full automation, remote rural environments may also benefit from the technology where neither a laboratory nor technical staff is widely available. As Rapid DNA systems are released over the next year, validation must be conducted to ensure that these systems meet the high standards required for evidentiary application.

It's anticipated that Rapid DNA devices will become available within the next year from multiple vendors. As with any new technology, the applications will

grow, and the cost of using the systems should drop considerably. Soon Rapid DNA analysis will become commonplace. As budgets for law enforcement continue to shrink, Rapid DNA will provide police agencies with a new effective tool to combat crime. ■ FBINAA

Roy R Swiger, Ph.D., is the chief scientific officer for the Palm Bay (Fla.) Police Department and director of advanced technologies programs for IntegenX Inc. Deputy Chief John W. Blackledge began his career with the Palm Bay Police Department in 1980, and has served as commander over uniformed services and investigations divisions for 15 years. He is a graduate of Session 193 of the FBI National Academy.

Chief Douglas F. Muldoon of the Palm Bay Police Department is a graduate of Session 153 of the FBI National Academy and subsequently served as an FBI-NAA Florida chapter president and was elected to the executive national board of directors in 2005. He is currently the 1st vice president and will serve as president in 2013.

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