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SPECIAL REPORT

Correction: On page 70 of the May/June issue, it should have stated that the resolution of WatchGuard Video's VISTA™ body-worn camera system is 1280 x 720, not 640 x 480.

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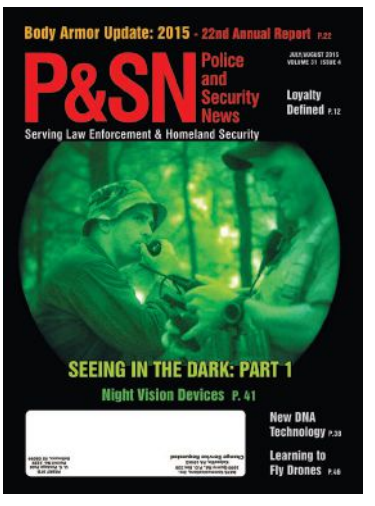
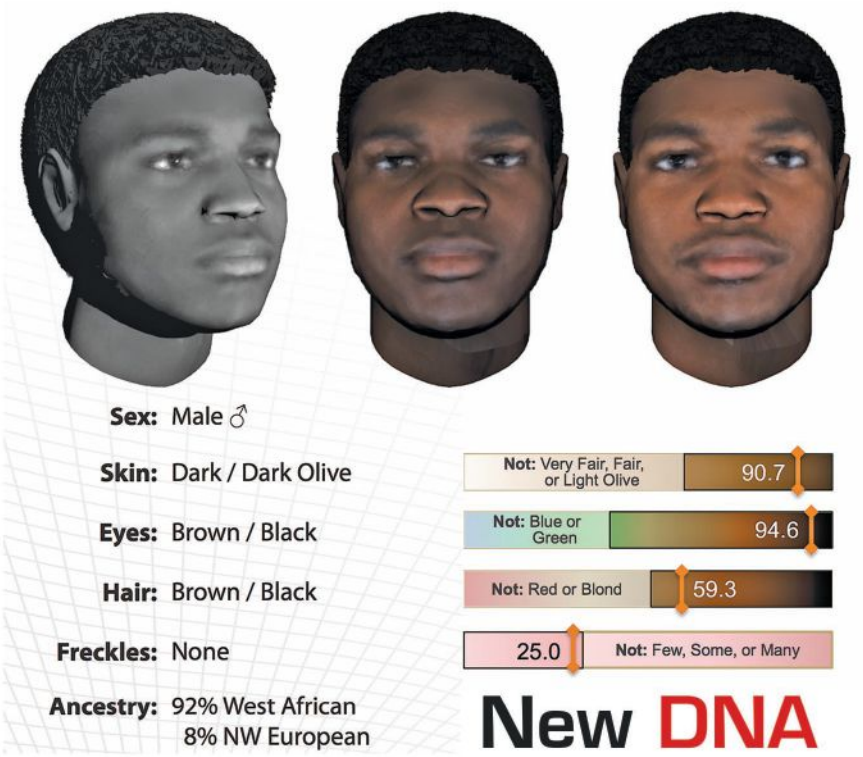
ON THE COVER



As seen through a night vision device, Sgt. Tony Bonnagio makes a call on a radio during a joint operational access exercise at Fort Bragg, NC.

Photo courtesy of US Department of Defense



New DNA Analysis Technology Could Help Solve Cold Cases

DNA Phenotyping is the prediction of physical appearance from DNA. It can be used to generate leads in cases where there are no suspects, or to help identify remains.

William Siuru, Ph.D., PE

In 2011, 25-year-old Candra Alston and her three-year-old daughter, Malaysia Boykin, were found dead in their apartment in Columbia, SC. The crime is still unsolved. The murders appeared to be of a personal nature and whoever did the killing may have been in conflict with Alston. There were no signs of a forced entry and investigators believe the victims knew their killer, or killers. That's about all that was established about the perpetrator(s) until now.

After four years, Columbia Police Chief Skip Holbrook hopes to finally solve the case since new details regarding the investigation are now available. Using a technology called DNA phenotyping, the Columbia Police Department has been able to release a computer-generated image of a "person of interest" who might have been involved in the crime, a possibly dark-skinned male with brown hair and brown eyes. This breakthrough used DNA collected from the scene of the crime.

Over the past several years, Parabon NanoLabs (Parabon) in Reston, VA, with funding support from the Department of Defense, has developed the Snapshot™ DNA Phenotyping System. According to the company, Snapshot can accurately predict genetic ancestry, eye color, hair color, skin color, freckling, and face shape in individuals from any ethnic background – even individuals with mixed ancestry.

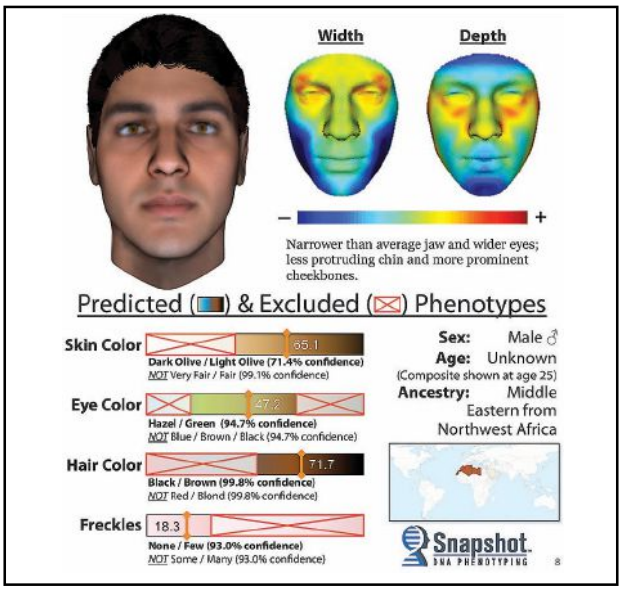
Genetic Instructions

It turns out that DNA carries the genetic instruction set for an individual's physical characteristics which result in the wide range of appearances among people. By determining how genetic information translates into physical appearance, it is possible to "reverse engineer" DNA into a physical profile.

Snapshot reads hundreds of thousands of genetic variants, or "genotypes," from a DNA sample and uses this information to predict what an unknown person looks like.

Recent advances in DNA sequencing technology make it practical and affordable to read genetic content from DNA. This allows the creation of datasets which

A composite predicted profile created by Parabon's Snapshot™ illustrates the accuracy of this technology. The actual photo of the subject is shown on the far right.



Reports from Parabon NanoLabs include confidence estimates for Snapshot™'s trait predictions.

include both *genotypic* (genetic content) and *phenotypic* (trait) data for thousands of subjects. Beginning with large datasets comprised of phenotypes of interest and genotype data for thousands of subjects, Parabon's bioinformatics team performed large-scale statistical analysis on millions of individual SNPs (Single Nucleotide Polymorphisms) and billions of combinations thereof to identify sets of these genetic markers which associate with the given trait.

A SNP is a DNA sequence variation occurring commonly within a population in which a single nucleotide in the genomes differs between members of a biological species or paired chromosomes. This *mining* process can take weeks running on hundreds – sometimes thousands – of computers. In the end, the SNPs with the greatest likelihood of contributing to the variation observed in the target trait are culled for potential use in predictive models.

Using data mining and machine learning, Parabon produces statistical models which translate the presence of specific genetic biomarkers into forensically relevant trait predictions. The *modeling* phase further refines this set of SNPs to a final set which most accurately predicts the target trait. Models are validated against data held out for such testing and calibrated with all available data before being installed into the Snapshot architecture.

On the Money

Snapshot's trait predictions have been shown to be highly accurate in testing thousands of out-of-sample genotypes. Because some traits are partially determined by environmental factors and not DNA alone, Snapshot trait predictions are presented with a corresponding measure of confidence. This reflects the degree to which such factors influence each particular trait. Traits such as eye color which are highly heritable, and not greatly affected by environmental factors, are predicted with higher accuracy and confidence than those which have lower heritability.

For example, Snapshot predicts pigmentation traits with an average accuracy of greater than 80% and its ability to discriminate between pigmentation extremes is considerably higher – often 99% or better. Even in cases where it is difficult to distinguish between two similar phenotypes (for example, hazel eyes versus green eyes), Snapshot can, with high confidence, exclude certain traits. For instance, Snapshot can, with confidence approaching 100%, predict that a particular subject does not have brown or black eyes.

Requirements

Snapshot requires less than one nanogram of extracted DNA, although 2.5 nanograms is ideal. From this, Parabon can produce a report with a detailed composite profile which can greatly narrow down the number of possible suspects and/or provide new investigative leads. Besides being ideal for cases for which there are no suspects, Snapshot can also be used to identify unidentified remains.

As to the case in Columbia, SC, the CPD has put out a composite drawing of the potential suspect and has asked citizens to contact Crime Stoppers if they have any information. While the case has yet to be solved, Snapshot has resulted in many new leads and they keep coming in. P&SN

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