Forensics @ NIST
December 7, 2010 – Gaithersburg, MD

STRBase &
Information Resources

John M. Butler

Information Gathering and Sharing

- We live in the information age and need to share what we learn as scientists with others
- Sharing information impacts validation of techniques, which impact court use of the technique
- DNA is often referred to as the "gold standard" because of the scientific studies performed and information sharing that has occurred
- **You need a good library (information collection) to be successful in developing any scientific discipline**
- Knowing the literature provides a solid foundation

Our Project Team Library

>9,000 references gathered and cataloged in Reference Manager

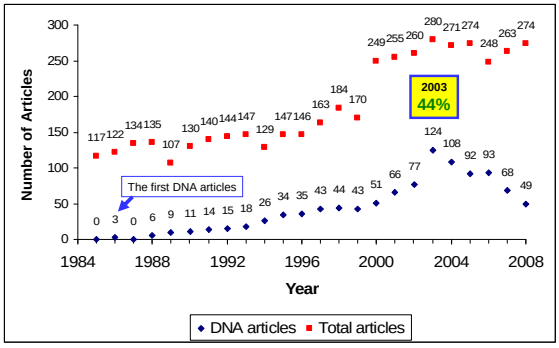
- Started by Christian Ruitberg
- Maintained now by **Jan Redman**
- **Updated Monthly** and provided to NIST Human Identity Project Team

Comprehensive set of forensic DNA articles

Forensic Science Publications

Journal of Forensic Sciences

DNA publications vs total articles

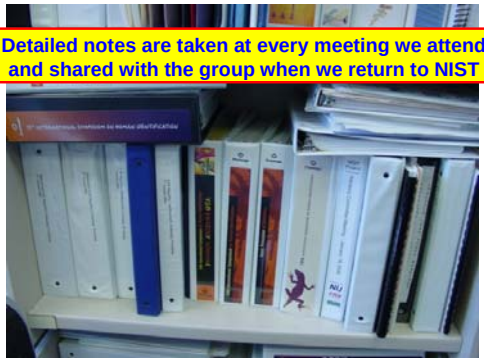


From PubMed searches performed Feb 2009 using http://www.ncbi.nlm.nih.gov/sites/entrez

Collection of Journals in My Office

Collection of Notes from Meetings Attended

Detailed notes are taken at every meeting we attend and shared with the group when we return to NIST



AAFS 2009 Topics Regarding Forensic DNA

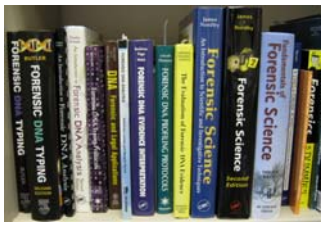
From abstracts of presentations at AAFS meeting in Denver, CO (Feb 2009)

- Improved DNA extraction
- Predicting hair color and ancestry with SNPs
- X-chromosome STRs
- **Familial searching**
- Y-STRs and mixtures
- **Low level DNA samples**
- miniSTRs
- DNA screening assays
- Optimizing database labs
- Microfluidic biochip systems
- Use with property crimes
- Recovery from handguns
- DNA from IEDs
- Expert systems
- Automation with robotics
- DNA quantitation – qPCR
- PCR directly from blood
- mtDNA
- RNA
- Non-human DNA (dogs & cows)
- **Mixture interpretation**

Forensic DNA Library

Books Located in 227/B250

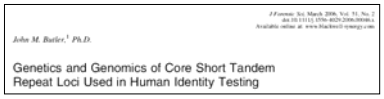
- Have purchased ~300 books on topics related to forensic DNA analysis as of Dec 2010



Initially funded from 2002-2007 by PECASE award money

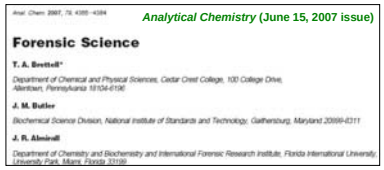
Fruits of a Good Literature Collection

Review Articles



John M. Butler,[1] Ph.D.

Genetics and Genomics of Core Short Tandem Repeat Loci Used in Human Identity Testing



Analytical Chemistry (June 15, 2007 issue)

Forensic Science

T. A. Brettell*

Department of Chemical and Physical Sciences, Cedar Crest College, 100 College Drive, Allentown, Pennsylvania 18104-6196

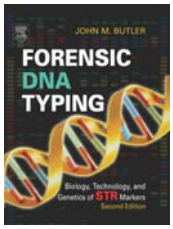
J. M. Butler

Biochemical Science Division, National Institute of Standards and Technology, Gaithersburg, Maryland 20899-8311

J. R. Almirall

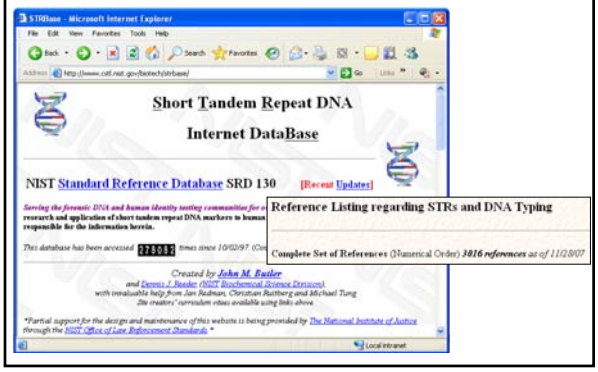
Department of Chemistry and Biochemistry and International Forensic Research Institute, Florida International University, University Park, Miami, Florida 33199

Textbooks



2nd Edition 688 pp.
Feb 2005

And a Useful Reference Website…



STRBase

- NIST website and resource for forensic DNA begun in July 1997
- URL: **http://www.cstl.nist.gov/biotech/strbase**
- Became a NIST Standard Reference Database (SRD 130) because of its high visibility
- Lessons learned can benefit other forensic disciplines

History of STRBase

- As a graduate student at the FBI, I had gathered a lot of information on STRs (short tandem repeats)
- While a NIST postdoc, I decided to share what I had learned (writing a review article was going to be too static … so I turned to the Web and started creating hyperlinked pages on my computer)
- A website was built and demonstrated at the January 1997 SWGDAM meeting
- STRBase was launched in July 1997 and presented to the community at the Oct 1997 Promega meeting
- I went to work for a start-up company in California (GeneTrace Systems) during 1997-1999 so STRBase did not grow until I returned to NIST in Oct 1999
- Since 1999, STRBase has expanded significantly

Benefits of Website like STRBase

http://www.cstl.nist.gov/biotech/strbase

- Develops expertise when collecting information
- Requires NIST to stay up-to-date with field
- Provides transparency to our team's work
- Training tool and resource for the world
- Respected resource for >13 years
- ~10,000 pages of information available now
- >350,000 hits cumulative
- **Method for sharing information (PowerPoint files, population data, etc.)**

Aid to Court Cases and Early Admissibility Hearings on STR Typing

FROM THE SCIENTIST'S POINT OF VIEW: WHAT CONSTITUTES GENERAL ACCEPTANCE?

Robin W. Cotton
Cellmark Diagnostics, Germantown, MD, 20876

GENERAL ACCEPTANCE: THE LOCI

STR loci are part of a larger class of polymorphic loci, which are based on length polymorphisms arising from the presence of alleles having varying numbers of tandem repeats. These include both variable number of tandem repeat (VNTR) loci used for RFLP testing and STR loci used with PCR amplification. The references listed in section A include information about the organization of repeated sequences in the genome (Section A1), selected historical references for RFLP typing (Section A3), genome database web sites for accessing up-to-date information regarding map position of loci and the National Institute of Standards and Technology (NIST) web site (STRbase). The NIST site contains a comprehensive reference list for the thirteen CODIS STR loci and associated typing methods (Section A4). The 800-plus peer-reviewed publications listed on this site, by themselves, demonstrate general scientific acceptance of STR typing.

http://www.promega.com/geneticidproc/ussymp11proc/content/cotton.pdf

STR DNA ADMISSIBILITY HEARINGS AND THE MINNESOTA LEGISLATIVE RESPONSE TO THE STATUTE OF LIMITATIONS FOR SEXUAL ASSAULTS

Steve Redding
Hennepin County Attorney's Office

HOW CAN LABS HELP PROSECUTORS MEET THESE ATTACKS ?

There is much that lab scientists can do to assist prosecutors in presenting a powerful court case for STR typing admissibility. Scientists must remember that information they take for granted is not information which is known to prosecutors let alone judges. Scientists must continually remind themselves that it is impossible to be too simplistic in explaining DNA typing to lawyers and judges. The best policy is to assume that lawyers and judges have a zero DNA IQ. Scientists should be prepared to assist in the presentation of a persuasive court case by doing the following;

- Present a list of published scientific articles and papers concerning STR typing. At the latest count, the Short Tandem Repeat DNA Internet Database web site maintained by the National Institute of Standards and Technology contained over 1300 published articles referencing STR typing. The existence of such an extensive body of information is impressive in and of itself to a court of law. The web site is found at www.cstl.nist.gov/biotech/strbase.

http://www.promega.com/geneticidproc/ussymp11proc/content/redding.pdf

NIST Human Identity Team Projects

Funded by the National Institute of Justice

http://www.cstl.nist.gov/biotech/strbase/NIJprojects.htm

Projects

33 different projects are described

[Human DNA Quantitation] [Mitochondrial DNA] [Y Chromosome] [Compromised DNA Evidence] [Miniaturization and Automation] [General Tools and Information] [Non-Human DNA] [Alternative Forensic DNA Markers]

Alphabetical Listing of Projects

ABI 3100 performance with various STR typing systems (April 2001-June 2003)

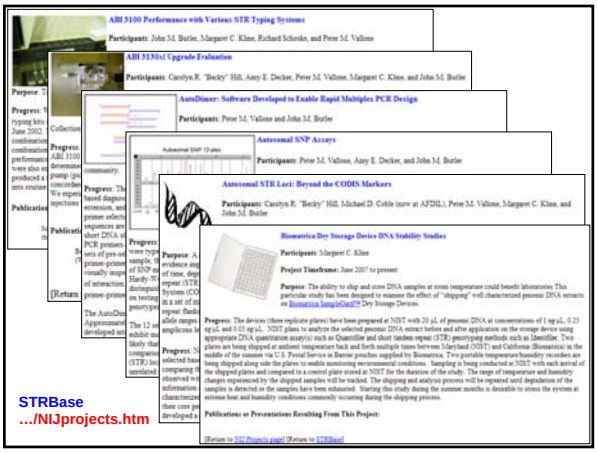
ABI 3130xl upgrade evaluation (Sept 2005-May 2006)

AutoDimer: software to enable rapid multiplex PCR design (2000-2005) [see also software.htm]

Autosomal SNP loci (July 2002-present)

Autosomal STR loci beyond the CODIS markers (Jan 2004-present) [see also newSTRs.htm]

Biomatrica dry storage device DNA stability studies (June 2007-present)



STRBase …/NIJprojects.htm

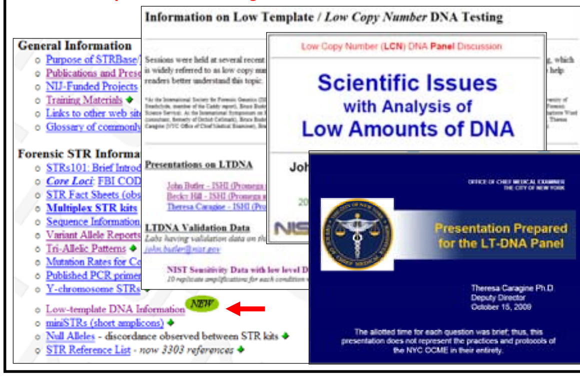
New STRBase Sections

Forensic STR Information

- STRs101: Brief Introduction to STRs
- *Core Loci*: FBI CODIS Core STR Loci and European Core Loci
- STR Fact Sheets (observed alleles and PCR product sizes)
- **Multiplex STR kits**
- Sequence Information (annotated)
- Variant Allele Reports ◆
- Tri-Allelic Patterns ◆
- Mutation Rates for Common Loci
- Published PCR primers
- Y-chromosome STRs ◆
- Low-template DNA Information *Updated*
- Mixture Interpretation *NEW*
- Kinship Analysis *NEW*
- miniSTRs (short amplicons) ◆
- Null Alleles - discordance observed between STR kits ◆
- STR Reference List - *now 3400 references* ◆

New STRBase Website on LT-DNA (LCN)

http://www.cstl.nist.gov/biotech/strbase/LTDNA.htm



Complete Set of NIST Sensitivity Data Available on New LT-DNA Website

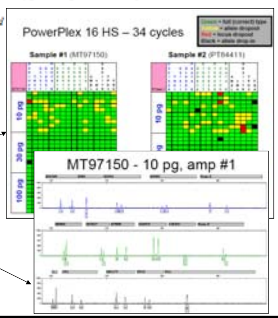
http://www.cstl.nist.gov/biotech/strbase/LTDNA.htm

NIST Sensitivity Data with low level DNA templates

10 replicate amplifications for each condition with two fully heterozygous, single-source samples

Click on links to see summaries and DNA profiles observed

STR kit - PCR conditions	Sample 1	Sample 2
Identifiler - 28 cycles	100 pg	100 pg
	30 pg	30 pg
	10 pg	10 pg
Identifiler - 31 cycles	100 pg	100 pg
	30 pg	30 pg
	10 pg	10 pg
PowerPlex 16 HS - 31 cycles	100 pg	100 pg
	30 pg	30 pg
	10 pg	10 pg
PowerPlex 16 HS - 34 cycles	100 pg	100 pg
	30 pg	30 pg
	10 pg	10 pg



Literature Listing on LT-DNA (LCN)

http://www.cstl.nist.gov/biotech/strbase/LTDNA.htm

Subdivided into categories

- Peer-reviewed literature *(containing data)*
- Reports *(evaluating the methodology)*
- Review articles *(commenting on other's data)*
- Non-peer reviewed literature *(representing the authors' opinions only)*

LTDNA References

Peer-reviewed literature (containing data)

Buckleton, J. (2009) Validation issues around DNA typing of low level DNA. *Forensic Sci. Int. Genet.* 3: 255-260.

Caragine, T., Mikulasovich, R., Tamariz, J., Bajda, E., Sebestyen, J., Baum, H., Prinz, M. (2009) Validation of testing and interpretation protocols for low template DNA samples using AmpFlSTR Identifiler. *Croatian Med. J.* 50: 250-267. [link to paper]

Findlay, I., Taylor, A., Quirke, P., Frazier, R., and Urquhart, A. (1997) DNA fingerprinting from single cells. *Nature* 389(6651): 555-556.

Gill, P., Whitaker, J., Flaxman, C., Brown, N., and Buckleton, J. (2000) An investigation of the rigor of interpretation rules for STRs derived from less than 100 pg of DNA. *Forensic Sci. Int.* 112(1): 17-40.

Links to papers when freely available

Forensic Science Review Article

Anal. Chem. **2007**, *79*, 4365–4384

Analytical Chemistry (June 15, 2007 issue)

Forensic Science

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Department of Chemistry and Biochemistry and International Forensic Research Institute, Florida International University, University Park, Miami, Florida 33199

560 references covering articles published in 2005-2006

181 articles on forensic DNA analysis

Brettell, T.A., Butler, J.M., Almirall, J.R. (2007) Forensic science. *Anal. Chem.* 79: 4365-4384.

Training Workshops Conducted in 2009

Individual Forensic DNA Laboratories

Sorenson Forensics

AFDIL · Harris Co. ME, Houston PD, TX DPS · New York City · Wisconsin · Utah

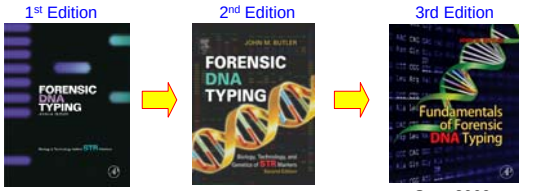
Scientific Conferences

ISFG · Promega · CODIS · MAAFS · Green Mountain DNA Conference

Universities

FIU Florida International University · Towson University · The George Washington University · UAlbany · Iona · Bowie State University · Northeast Regional Forensic Institute · University of Virginia

The Expansion of *Forensic DNA Typing*



Jan 2001
335 pp.
17 chapters

Feb 2005
688 pp.
24 chapters

Chinese Translation (2007) Y. Hou, translator

Japanese Translation (2009) Y. Fukuma, translator

Sept 2009

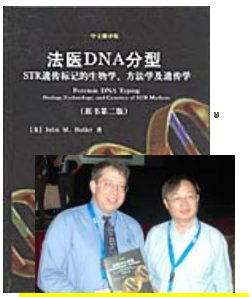
Fundamentals
18 chapters (520 pp.)

Advanced Topics
25 chapters (~800 pp.)

Planned for Oct 2011

Language Editions of Forensic DNA Typing

Chinese (2007)
Translated by Y. Hou



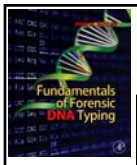
http://www.sciencep.com/s_single.php?id=12683

Yiping Hou (Chinese translator)

Japanese (2009)
Translated by Y. Fukuma

http://www.amazon.co.jp/gp/reader/4320056825

Yoshiya Fukuma
(Japanese translator)



Written as Part of My Job at NIST
(no royalties to be received)

Fundamentals of Forensic DNA Typing

Contribution of the National Institute of Standards and Technology. 2010.

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84 Theobald's Road, London WC1X 8RR, UK

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New Materials in *Advanced Topics* book

Planned release date: October 2011

- Will cite >1500 new references
- New chapter on legal aspects
  - expert witness prep, perspectives from lawyers
- New chapter on X-chromosome markers
- Extensive updates on mixtures, LCN, Y-STRs, miniSTRs, mtDNA, SNPs, non-human DNA, database, & kinship issues
- Coverage of all the new STR kits
- Listing of all known STR alleles for all 23 kit loci

Summary and Lessons Learned

- Need a good team to become the experts in the field – having the right people is crucial
- Comprehensively gather information, create standardized information formats that are useful, share what is learned through multiple avenues
- Be plugged into the community and willingly help meet their needs

Thank you for your attention…

Our team publications and presentations are available at:
http://www.cstl.nist.gov/biotech/strbase/NISTpub.htm

Questions?

See also http://www.dna.gov/research/nist
http://www.cstl.nist.gov/biotech/strbase
john.butler@nist.gov