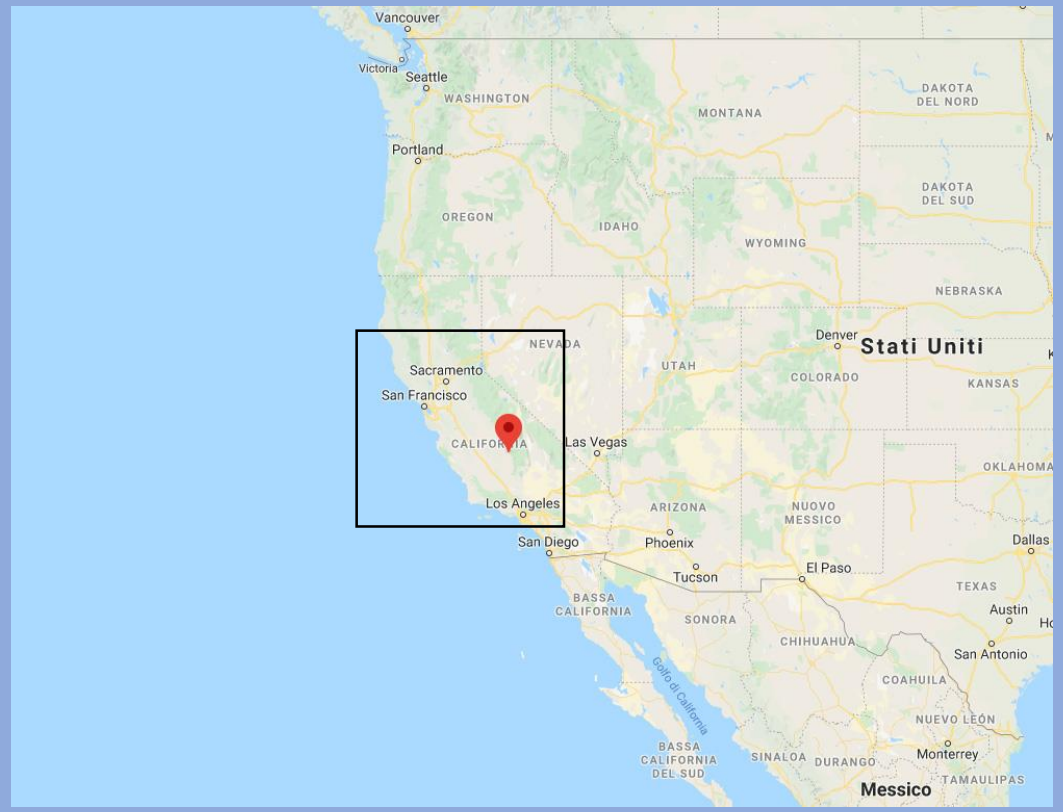
Forensic Genetics and Legal Medicine
2019-2020

26th May 2020

The capture of the Golden State killer
(or how to solve a 40-year-old cold case with 99$)



The ransacker

This story begins (maybe) in Visalia, Tulare County, California, where - between **April 1973** and **December 1975**- a wave of over one hundered bizarre theft episodes occurs. The mysterious thief is nicknamed «The Ransacker».

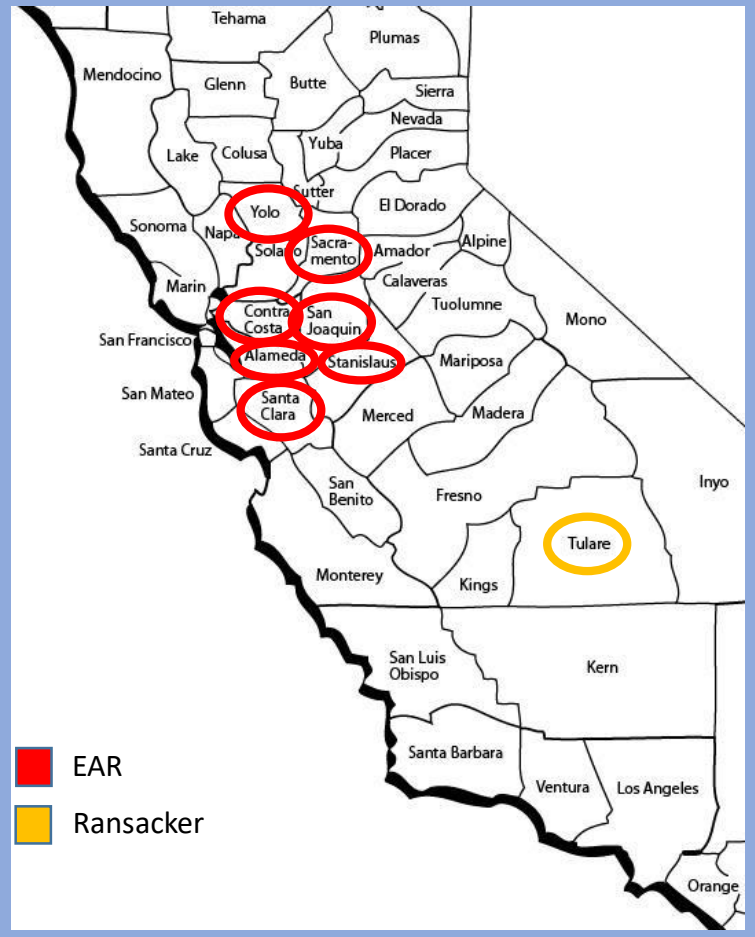
Bizarre behaviour of the Ransacker included a preference for personal objects (photographs, wedding rings…), stamp collections and cosmetic creams, whereas valuable items in the houses that were broken into were often spared.

Housbreaking was often accompanied by acts of vandalism, sometimes just nasty tricks (unplugging household appliances, stealing of one earring per pair…).

On the night of **11th September 1975** a dramatic episode occurs: a 16-year old girl is attacked in her own bedroom at kinfe and gun point by a man wearing a balaclava. The girl is dragged in the rear garden of the house. The girl's father, woken up by the noise, faces the aggressor in the garden but is shot and dies… Forensic firearm examination of the bullet indicates it may come from a gun stolen 10 days earlier in one of the Ransacker's thefts.

On the **11th December 1975** the local police almost catches the Ransacker who, however, manages to escape (by firing some bullets). Pursuers describe him as «robust», «with curious physical proportions», «clumsy in his movements», «with high-pitched voice», «having a pale, round, child-like face».

After this episode, the Ransacker apparently disappears…



The East Area rapist

From **June 1976** to **December 1979** the area east of San Francisco is affected by a wave of 50 rape cases, possibly committed by the same individual. The unknown rapist is dubbed «The East Area rapist» (EAR).

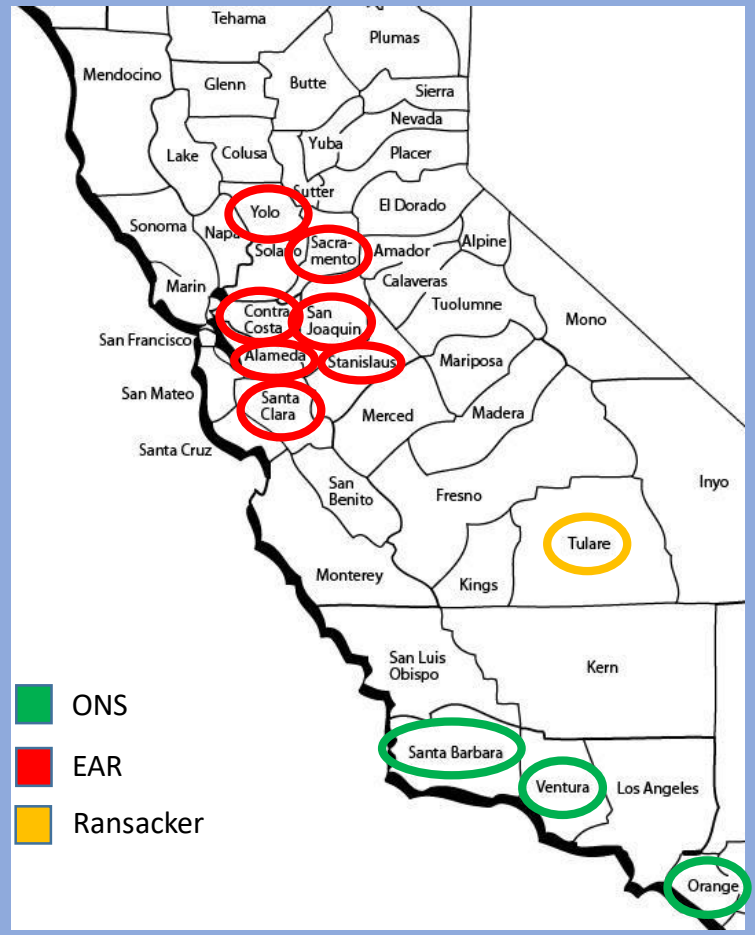
The rapist strikes at night-time, in one-storey single-family houses. In the beginning he targets women living alone or single mothers. However, starting from **2nd April 1977**, couples are attacked: the EAR, before raping his female victim, forces her to tie the man.

EAR's modus operandi has something in common with the Ransacker:

- each attack appears carefully planned through previous stakeouts
- rape is often accompanied by theft of personal objects of little value
- often, before raping his victims, the EAR makes use of cosmetic creams found in the house

However, several apparent differences with the Ransacker are present, so that no link is made:

- shoeprints of EAR and Ransacker found outside of attacked houses seem different
- EAR apparently dislikes stamp collections
- mostly, the identikit made by victims does not overlap: the EAR is described as «thin» (tough with «robust legs»). He is caucasian, 175-180 cm tall, between 25-30 years old, with rather long blond hair.



The original night stalker

Between **October 1979** and **July 1981** in southern California, a series of sexual aggressions similar to those of the EAR's culminate in the killing of a single woman and four couples.

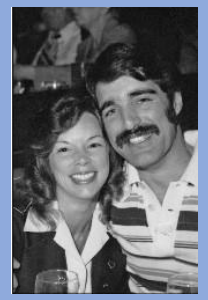
The author of these crimes will be later nicknamed the «Original night stalker» (ONS), to distinguish him from another rapist and killer that operated in California between 1984 and 1985, dubbed the «Night stalker». A further case of rape and homicide of a single woman possibly committed by ONS in may 1986 will be later identified.

Robert Offerman & Debra Manning 30.12.1979

Charlene & Lyman Smith 13.03.1980

Keith & Patrice Harrington 19.08.1980

Manuela Witthuhn 6.2.1981



Cheril Domingo & Gregory Sanchez 27.7.1981

Janelle Cruz 4.5.1986

70's and 80's scientific evidence

- Ransacker/EAR/ONS apparently wear gloves: almost no relevant fingerprints are found at the different crime scenes and no matching fingerprints are found between cases (link between the two criminals is simply based on modus operandi)

- One of the victims fought with the EAR, hurting him. Analysis of ABO blood groups identifies at the crime scene bloodstains of group B (as the victim) and group A (~50% of Caucasians are group A).

- In the last murder attributed to ONS in 1986 semen stains are found. Forensic serology indicates that the ONS is «non secretor» (a person who does not present water-soluble ABO blood group antigens in his/hers body fluids). The percentage of non secretors is ~25%.

- At the time DNA analysis breaks in, at the end of the 90's, EAR rapes had become statute-barred and relevant evidence destroyed (Ransacker's murder case had no biological evidence). But Contra Costa County police forgot to destroy its evidence: 3 rape cases linked by the same DNA profile

- Between 1996 and 1998, DNA confirms that 3 of the ONS murders (Smith, Harrington, Witthuhn) were committed by the same individual, who was also the autor of the Cruz 1986 rape/murder previously not linked to ONS

- It took until 2001 to realize that ONS' DNA corresponds to that of EAR found in Contra Costa cases

- ONS/EAR DNA finding are instrumental in leading in 2004 to the passing of Proposition 69 that creates a criminal DNA database in the State of California

- In 2011 LT-DNA technology allowed investigators to definitely link to EAR/ONS the 1979 Domingo-Sanchez homicide

Suspects

- ✓ 1979 A man found sleeping in a car in the area of activity of EAR is arrested. The car is similar to one previously spotted possibly in connection with EAR's aggressions. The man has a criminal record for burglary and his identikit (including shoe size) corresponds to that of EAR. **Exonerated** because secretor

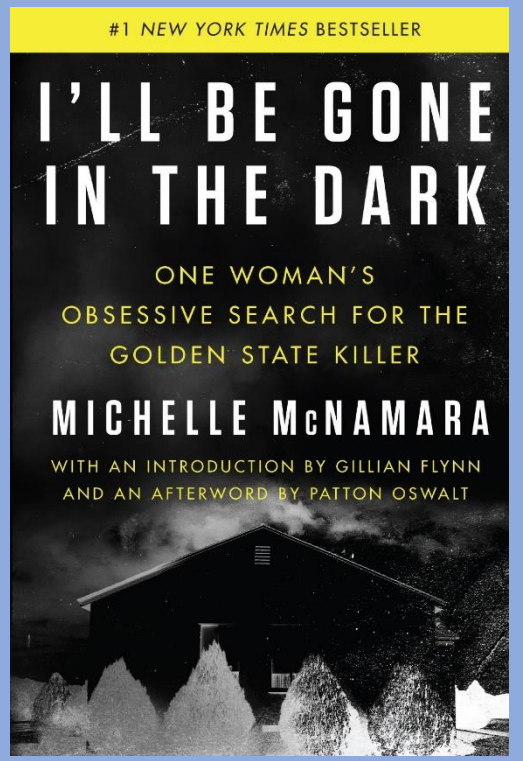
- ✓ 2001 A match with a fingerprint found at one of EAR's crime scenes is found in the national criminal fingerprint database. The fingerprint belongs to a subject with a criminal record for theft who died in 1996. Further investigations indicated that he was a friend of the victim's boyfriend. The two had a quarrel a few days before the rape and thereafter the victim's and boyfriend's flat was burglarized (possibly by the suspect who then left the stain). **Exonerated** by DNA analysis on the exhumed body

- ✓ 2007 A man who in april 1977, a few hours after an EAR attack, was found in the surroundings and put in police custody (but released soon after) because of a matching identikit and the presence of cosmetic cream in his car is suspected.. **Exonerated** by DNA

- ✓ 2011 Forensic serology tests performed on 1979 suspect are questioned. Further evidence against him is collected: he apparently knew some of the EAR's victims; he had had a male elementary school teacher (quite uncommon in the USA in the 50's) and after one of EAR's attacks investigators had found near the crime scene a notebook sheet, possibly written by the EAR himself, insulting his former male elementary school teacher; he had a facial scar similar to that reported by one EAR's victim; whereabouts unknown (on the run?) since 2003, when interest on EAR/ONS crimes resurfaced. When finally found, **exonerated** by DNA

The www breaks in…


Michelle McNamara (1970-2016)



- ✓ In 2006 McNamara starts the «True Crime Diary» website, a community for amateur investigators of cold cases
- ✓ McNamara develops a specific interest for the EAR/ONS, whom she dubbes the **«Golden State killer» (GSK)**, involving in her reasearch and networking several police officers (many retired) who investigated GSK crimes
- ✓ She takes advantage of emerging internet resources. In her most promising lead, she cross-checks postal codes of public libraries outside California that acquired an obscure self-published book by one retired policeman who once worked on the GSK cases with addresses of former convicted offenders for sex crimes drawn from national database (assuming that the GSK could be pleased of reading of himself, while California matches could be false leads due to local interest). She finds a particularly interesting match in Nebraska: through an amatorial genealogy website she learns that the suspect's mother and ex-wife both live in the Sacramento area; from photos on his facebook page is evident the suspect has a bull tattoo on his forearm (something reported by one of EAR's victims). **Exonerated** by DNA

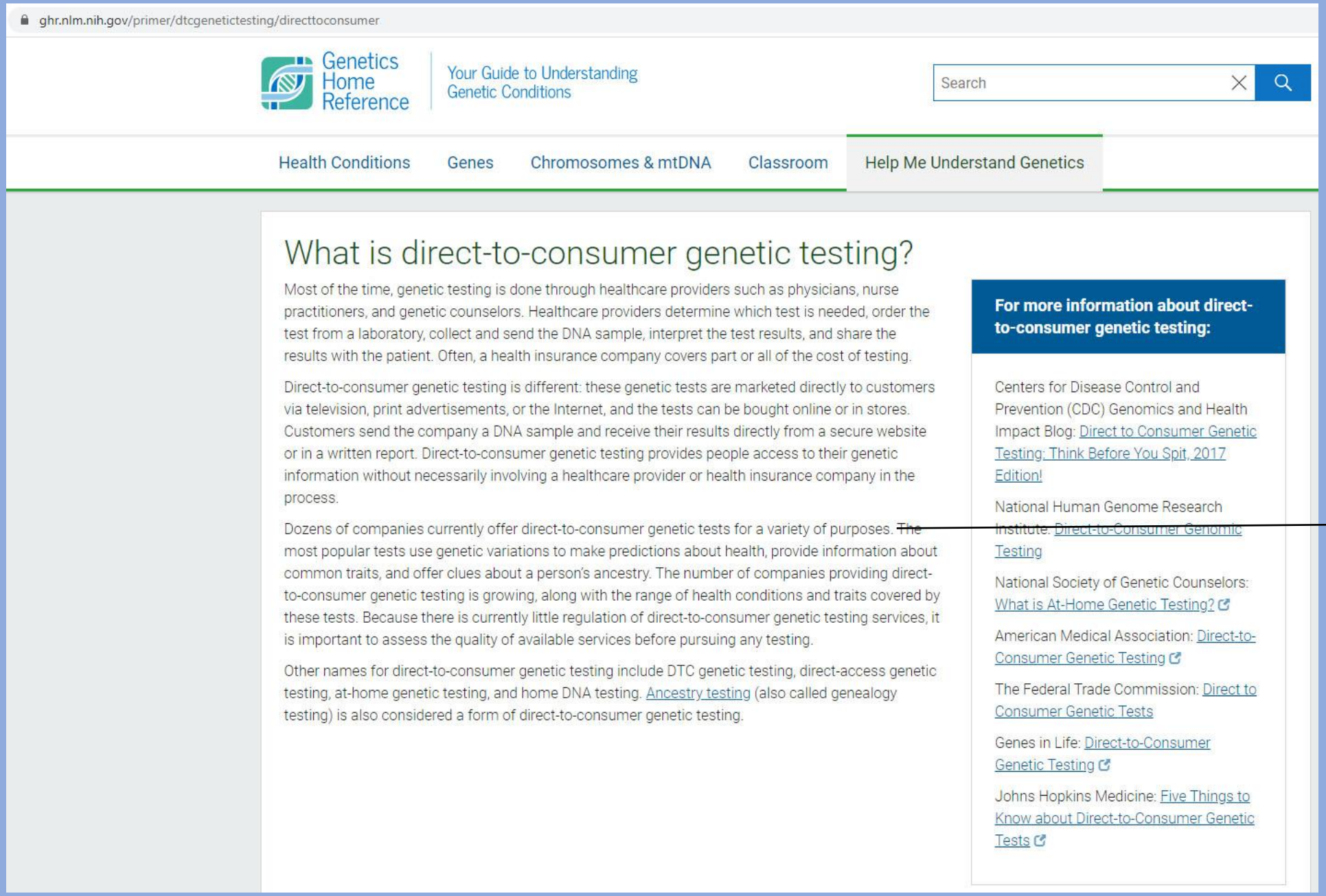
Great expectations

- ✓ When in 2004 California starts its criminal DNA database there were high hopes this could lead to the solution of several cold cases including the EAR/ONS/GSK case
- ✓ Sadly this wasn't true for the GSK case: no direct match is found between the EAR/ONS/GSK DNA profile and those archived in the database since 2004
- ✓ In 2008 California started familial searching in the criminal DNA database (see resource [1] pagg. 14-23) with multiple success, including some high-profile cases.
- ✓ No possible parent/child or sib of GSK identified through familial searching

The Grim Sleeper

Lonnie David Franklin, Jr. is a serial killer responsible for at least 11 murders and one attempted murder in Los Angeles from 1985 to 2007. A 14-year pause in his crimes from 1988 to 2002 earned him the nickname, "the Grim Sleeper." The LAPD cold case unit reexamined the murders in 2007 as part of *NIJ's Solving Cold Cases with DNA* program. After a CODIS search found no hits, California performed a familial search in 2008, also to no avail. Eighteen months later, the state lab ran a second familial search with several hundred thousand new offender profiles in the database. An association was made to Franklin's son, who was in the DNA database for a felony weapons conviction. After further investigation, detectives surreptitiously collected a piece of discarded pizza with Franklin's DNA, and matched that sample to DNA found at multiple crime scenes. The LAPD arrested Franklin in July 2010, and in 2016 he was convicted of ten counts of murder and sentenced to death.

Direct to consumer genetic testing



- ✓ Carrier testing for diseases (e.g. cystic fibrosis)
- ✓ Pharmacogenomic testing
- ✓ Testing for predisposition to:

- complex diseases (hereditary cancer, cardiovascular disease, depression...)
- physical abilities (e.g. genetic variants of muscle fibers)

- ✓ Testing of genetic traits for food intolerances

NIH U.S. National Library of Medicine

Share This Page

Genetics Home Reference | Your Guide to Understanding Genetic Conditions

Search

Health Conditions | Genes | Chromosomes & mtDNA | Classroom | Help Me Understand Genetics

What is genetic ancestry testing?

Genetic ancestry testing, or genetic genealogy, is a way for people interested in family history (genealogy) to go beyond what they can learn from relatives or from historical documentation. Examination of DNA variations can provide clues about where a person's ancestors might have come from and about relationships between families. Certain patterns of genetic variation are often shared among people of particular backgrounds. The more closely related two individuals, families, or populations are, the more patterns of variation they typically share.

Three types of genetic ancestry testing are commonly used for genealogy:

Y chromosome testing

Variations in the Y chromosome, passed exclusively from father to son, can be used to explore ancestry in the direct male line. Y chromosome testing can only be done on males, because females do not have a Y chromosome. However, women interested in this type of genetic testing sometimes recruit a male relative to have the test done. Because the Y chromosome is passed on in the same pattern as are family names in many cultures, Y chromosome testing is often used to investigate questions such as whether two families with the same surname are related.

Mitochondrial DNA testing

This type of testing identifies genetic variations in mitochondrial DNA. Although most DNA is packaged in chromosomes within the cell nucleus, cell structures called mitochondria also have a small amount of their own DNA (known as mitochondrial DNA). Both males and females have mitochondrial DNA, which is passed on from their mothers, so this type of testing can be used by either sex. It provides information about the direct female ancestral line. Mitochondrial DNA testing can be useful for genealogy because it preserves information about female ancestors that may be lost from the historical record because of the way surnames are often passed down.

Single nucleotide polymorphism testing

These tests evaluate large numbers of variations (single nucleotide polymorphisms or SNPs) across a person's entire genome. The results are compared with those of others who have taken the tests to provide an estimate of a person's ethnic background. For example, the pattern of SNPs might indicate that a person's ancestry is approximately 50 percent African, 25 percent European, 20 percent Asian, and 5 percent unknown. Genealogists use this type of test because Y chromosome and mitochondrial DNA test results, which represent only single ancestral lines, do not capture the overall ethnic background of an individual.

Genetic ancestry testing has a number of limitations. Test providers compare individuals' test results to different databases of previous tests, so ethnicity estimates may not be consistent from one provider to another. Also, because most human populations have migrated many times throughout their history and mixed with nearby groups, ethnicity estimates based on genetic testing may differ from an individual's expectations. In ethnic groups with a smaller range of genetic variation due to the group's size and history, most members share many SNPs, and it may be difficult to distinguish people who have a relatively recent common ancestor, such as fourth cousins, from the group as a whole.

For more information about genetic ancestry testing:

The University of Utah provides video tutorials on molecular genealogy.

The International Society of Genetic Genealogy promotes the use of DNA testing in genealogy.

The National Human Genome Research Institute discusses human origins and ancestry.

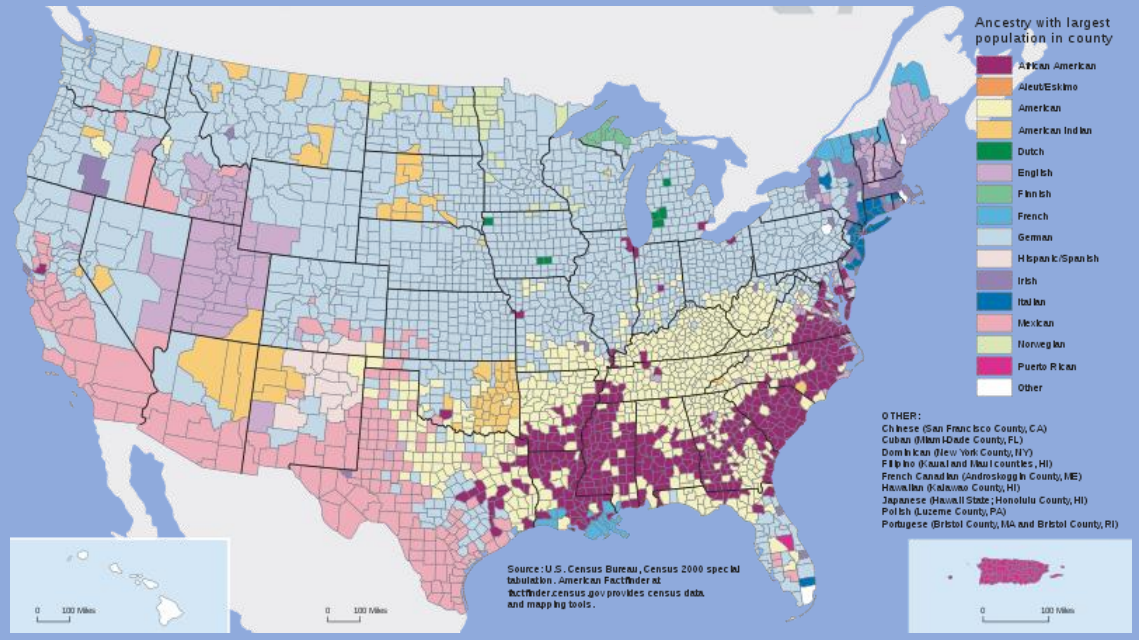
GeneReviews: Resources for Genetics Professionals--Direct-to-Consumer Genetic Testing

Detailed information about genetic ancestry testing is available from Sense About Science.

The Tech Museum of Innovation provides information about how ancestry testing works.

The Smithsonian National Museum of Natural History's exhibit 'Genome: Unlocking Life's Code' discusses genetic ancestry testing. The exhibit also discusses the African Diaspora and its influence on heredity and genealogy.

https://www.23andme.com/en-int/ancestry-composition-guide/



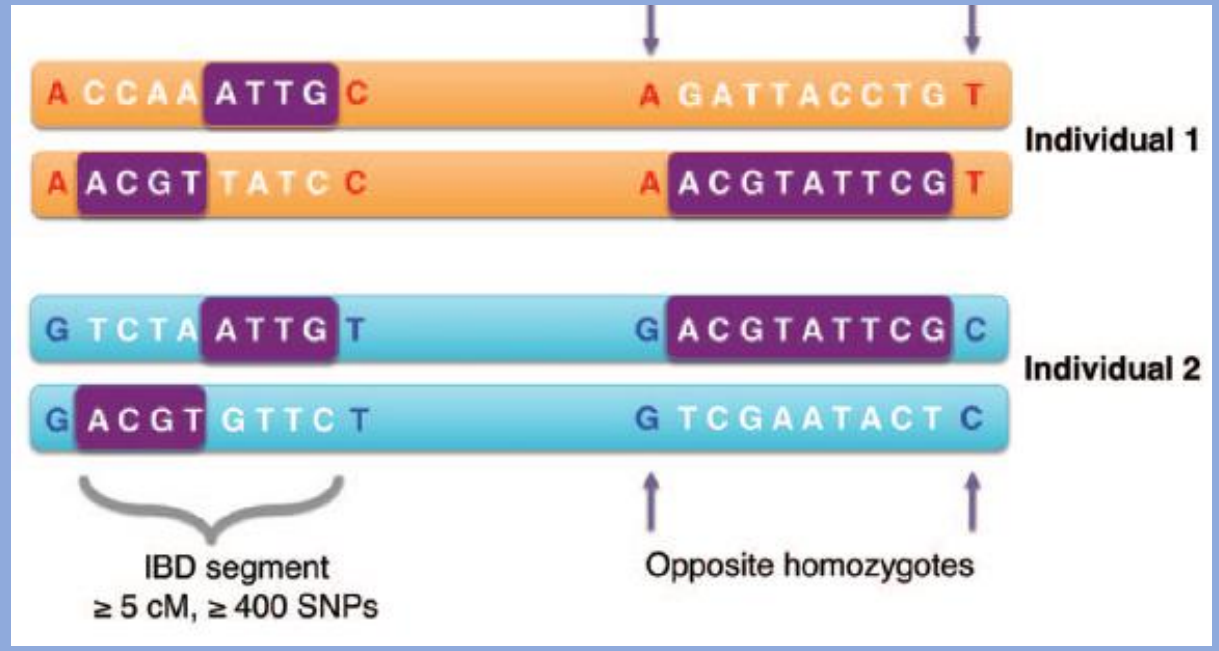
It is estimated that, at the end of 2019, ~10% of US citizens has performed an ancestry DTC test

- ✓ In the beginning ancestry DTC test were limited to Y-SNPs and mtDNA sequencing, but later moved to genotyping of 500.000-900.000 using DNA microarray technology

- ✓ A 2012 study from researchers of the DTC company 23andMe demonstrated that by ancestry testing there was a ~90% chance to identify 3rd cousins and a ~50% chance to identify 4th cousins ([2] Henn et al. PloS ONE 2012)
- degree of cousinship corresponds to the n+1 number of generations back to the most recent common ancestor

- ✓ length of DNA segments that are consistent with identity by descent (IBD) from a common ancestor, were used to detect relatively distantly related individuals
- Because recombination breaks down these shared segments rapidly, pairs of relatives vary in the number and length of shared segments that they inherit from a common ancestor, depending on the degree of relatedness

- ✓ To infer IBD, authors scanned each pair of genomes (typed with 650k-550k DNA chips in HGDP and 23andMe populations) for long runs of genotype pairs that lack ‘‘opposite homozygotes’’
- ✓ ‘‘IBDhalf’’ = sum of the lengths (in cM) of genomic segments where two individuals share DNA identical by state for at least one of the homologous chromosomes



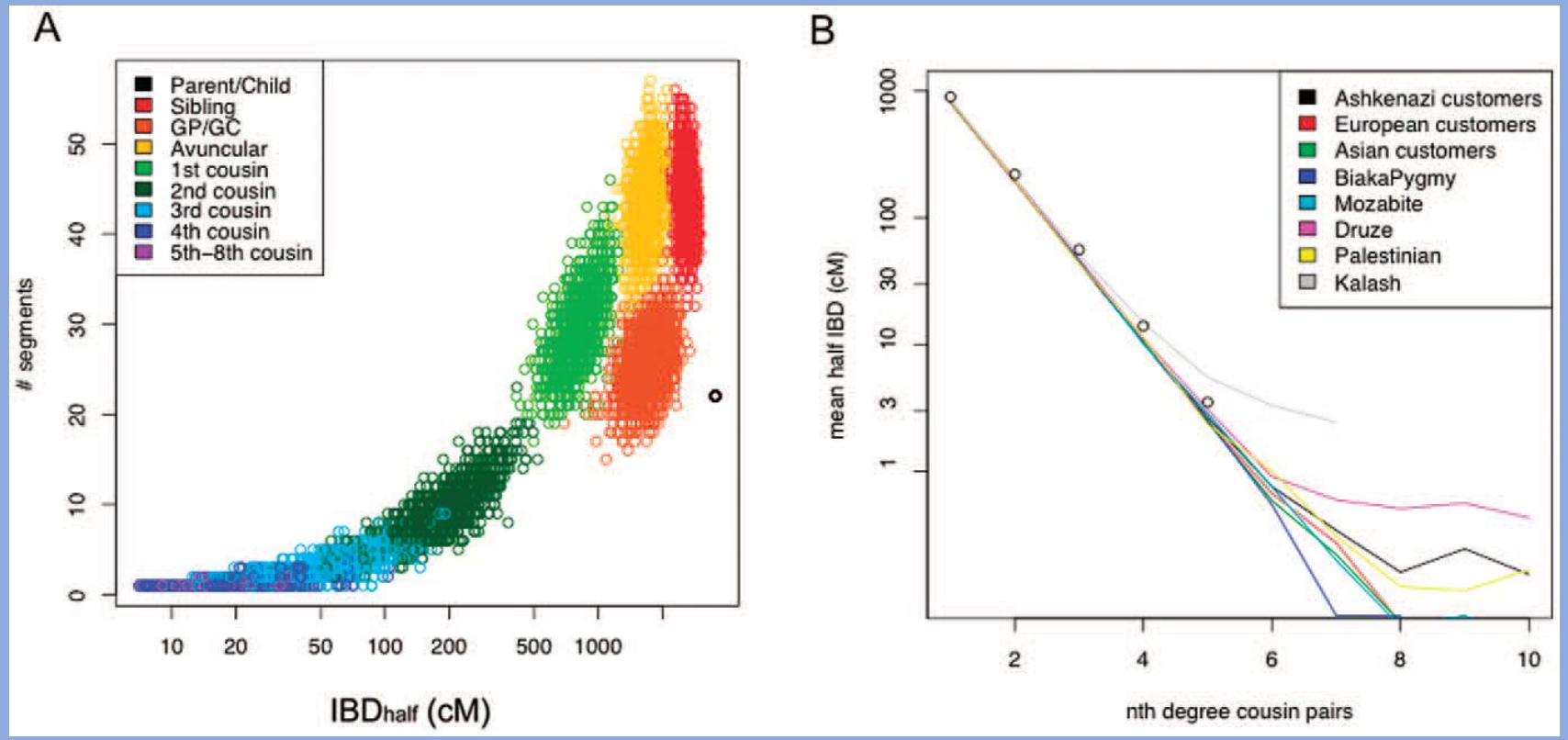
Pairs of individuals sharing less than 7 cM were considered to have zero IBDhalf

- ✓ Drawing from pools of computationally-phased haplotypes from HGDP-CEPH and 23andMe population samples, authors simulated extended family pedigrees of 11 generations assuming random mating of individuals from the sample
- joint distribution of IBDhalf and number of IBDhalf segments is shown for simulated relationships of Europeans

✓ In populations with moderate to high mean IBDhalf (due to isolation, endogamy, founder effect...), IBDhalf alone cannot be used to distinguish accurately between 5th or greater cousinships

Population	Region of Ancestry	Mean IBD_{half}[b]	Sample size	F_{IBD}[c]
Surui	S. America	1870.5	8	1.00
Karitiana	S. America	1229.5	14	0.88
Kalash	C. Asia	260.0	23	1.00
Yakut	E. Asia	85.4	25	0.92
Biaka Pygmies	C. Africa	73.2	21	0.96
Maya	N. America	47.3	21	0.47
Sardinian	Europe	12.4	28	0.38
Tuscan	Europe	9.3	8	0.43
Ashkenazi	Europe/Near East	23.0	847	0.85
Finland	Europe	10.0	149	0.53
Yoruba	W. Africa	1.0	21	0.06
Canada	Mixed	0.6	373	0.04
Han Chinese	E. Asia	0.3	44	0.01
Italy	Europe	0.1	386	0.01

fraction of pairs that share at least one IBDhalf segment ≥7 cM



fraction of nth degree cousins detected using IBD algorithm and based on simulated pedigrees

Degree of cousinship	Expected amount of IBD (cM)[a]	Chance of detecting *n*th cousin (%) with IBD_{half}[b]
1	900	100
2	225	100
3	56	89.7
4	14	45.9
5	3.5	14.9
6	0.88	4.1
7	0.22	1.1
8	0.055	0.24
9	0.014	0.06
10	0.0034	0.002

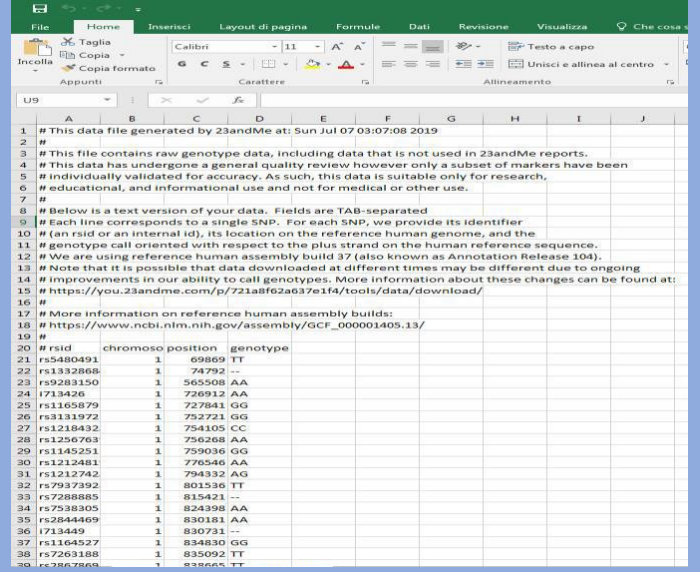
Assuming 3600 cM for whole genome

- ✓ DTC ancestry tests can be used to get in touch with distant, unknown relatives, or by adopted children to identify their biological parents.

- ✓ A limit to this researches is that, obviously, each provider offert to costumers tools to crossmatch their data exclusively with other costumers of the same company.

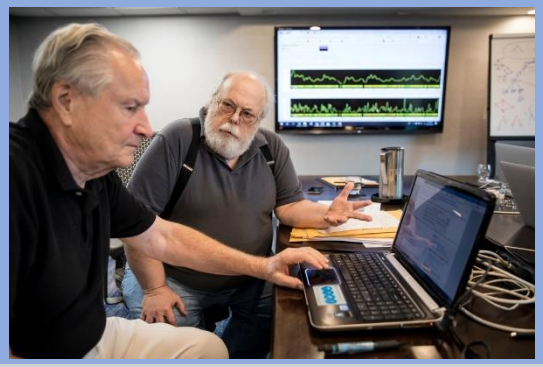
- ✓ DTC services, however, offer costumers the opportunity to download their own raw data (a txt file with hundred thousands of SNP genotypes).

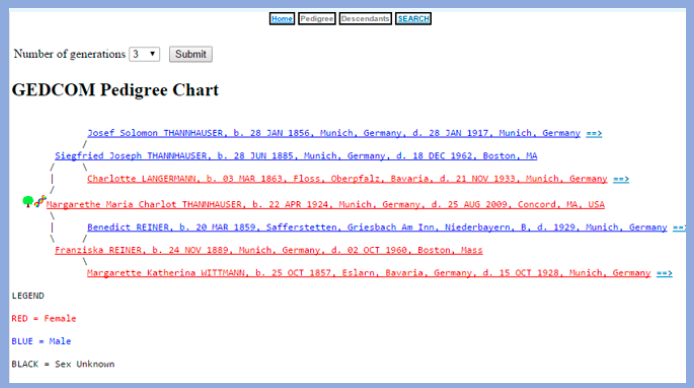
- ✓ In 2010 a retired businessman and a transportation engineer from Florida with a knack for genealogy created **GEDmatch**, an amateur website that enables DTC costumers to aggregate and compare raw data from different DTC companies and integrate them with GEDCOM files (standard input/output format for specialized genealogy software used to record, organize, and publish genealogical data).



This data file generated by 23andMe at: Sun Jul 07 03:07:08 2019
#
This file contains raw genotype data, including data that is not used in 23andMe reports.
This data has undergone a general quality review however only a subset of markers have been
individually validated for accuracy. As such, this data is suitable only for research,
educational, and informational use and not for medical or other use.
#
Below is a text version of your data. Fields are TAB-separated
Each line corresponds to a single SNP. For each SNP, we provide its identifier
(an rsid or an internal id), its location on the reference human genome, and the
genotype call oriented with respect to the plus strand on the human reference sequence.
We are using reference human assembly build 37 (also known as Annotation Release 104).
Note that it is possible that data downloaded at different times may be different due to ongoing
improvements in our ability to call genotypes. More information about these changes can be found at:
https://you.23andme.com/p/721a8f62a637e1f4/tools/data/download/
#
More information on reference human assembly builds:
https://www.ncbi.nlm.nih.gov/assembly/GCF_000001405.13/
#

# rsid	chromoso	position	genotype
rs5480491	1	69869	TT
rs1332868	1	74792	--
rs9283150	1	565508	AA
i713426	1	726912	AA
rs1165879	1	727841	GG
rs3131972	1	752721	GG
rs1218432	1	754105	CC
rs1256763	1	756268	AA
rs1145251	1	759036	GG
rs1212481	1	776546	AA
rs1212742	1	794332	AG
rs7937392	1	801536	TT
rs7288885	1	815421	--
rs7538305	1	824398	AA
rs2844469	1	830181	AA
i713449	1	830731	--
rs1164527	1	834830	GG
rs7263188	1	835092	TT





Home | Pedigree | Descendants | SEARCH

Number of generations 3 Submit

GEDCOM Pedigree Chart

Josef Solomon THANNHAUSER, b. 28 JAN 1856, Munich, Germany, d. 28 JAN 1917, Munich, Germany ==>
Siegfried Joseph THANNHAUSER, b. 28 JUN 1885, Munich, Germany, d. 18 DEC 1962, Boston, MA
Charlotte LANGERMANN, b. 03 MAR 1863, Floss, Oberpfalz, Bavaria, d. 21 NOV 1933, Munich, Germany ==>
Margarethe Maria Charlot THANNHAUSER, b. 22 APR 1924, Munich, Germany, d. 25 AUG 2009, Concord, MA, USA
Benedict REINER, b. 20 MAR 1859, Safferstetten, Griesbach Am Inn, Niederbayern, B, d. 1929, Munich, Germany ==>
Franziska REINER, b. 24 NOV 1889, Munich, Germany, d. 02 OCT 1960, Boston, Mass
Margarette Katherina WITTMANN, b. 25 OCT 1857, Eslarn, Bavaria, Germany, d. 15 OCT 1928, Munich, Germany ==>

LEGEND

RED = Female

BLUE = Male

BLACK = Sex Unknown

GEDCOM	Combined	Individual	Ancestor Name	Birth	Death	Spouse(s)	Father	Mother
3818430			Hans Olsen Brekke	1665 Aurland, Sogn	1715 Ulvik	Anna Katarina Riber		
5751705			Hans Olavsson Brekke	ABT 1665 Granvin, Hordaland, Norway	ABT 1715 Ulvik, Hordaland, Norge	Anna Katarina Riber	Ole Karlson Brekke	Kona Ukjend

Click HERE to indicate that you have confirmed this is a match.

[GED match] **Tools for DNA and Genealogy Research**

Welcome to GEDmatch. If you are already registered, just enter your login ID and password in the place provided below.

If you are not previously registered, click on the registration link near the bottom of this page. You will be asked to provide a valid email address and a password. After you are registered, you will be required to accept the GEDmatch Terms of Service. You can read the Terms of Service before you register by clicking on the link at the bottom of this page.

GEDmatch provides applications for comparing your DNA test results with other people. There are also applications for estimating your ancestry. Some applications are free. More advanced applications require membership in the GEDmatch Tier1 program at $10 per month.

If you have any questions or comments, you can reach us at GEDmatch@Gmail.com

Log In

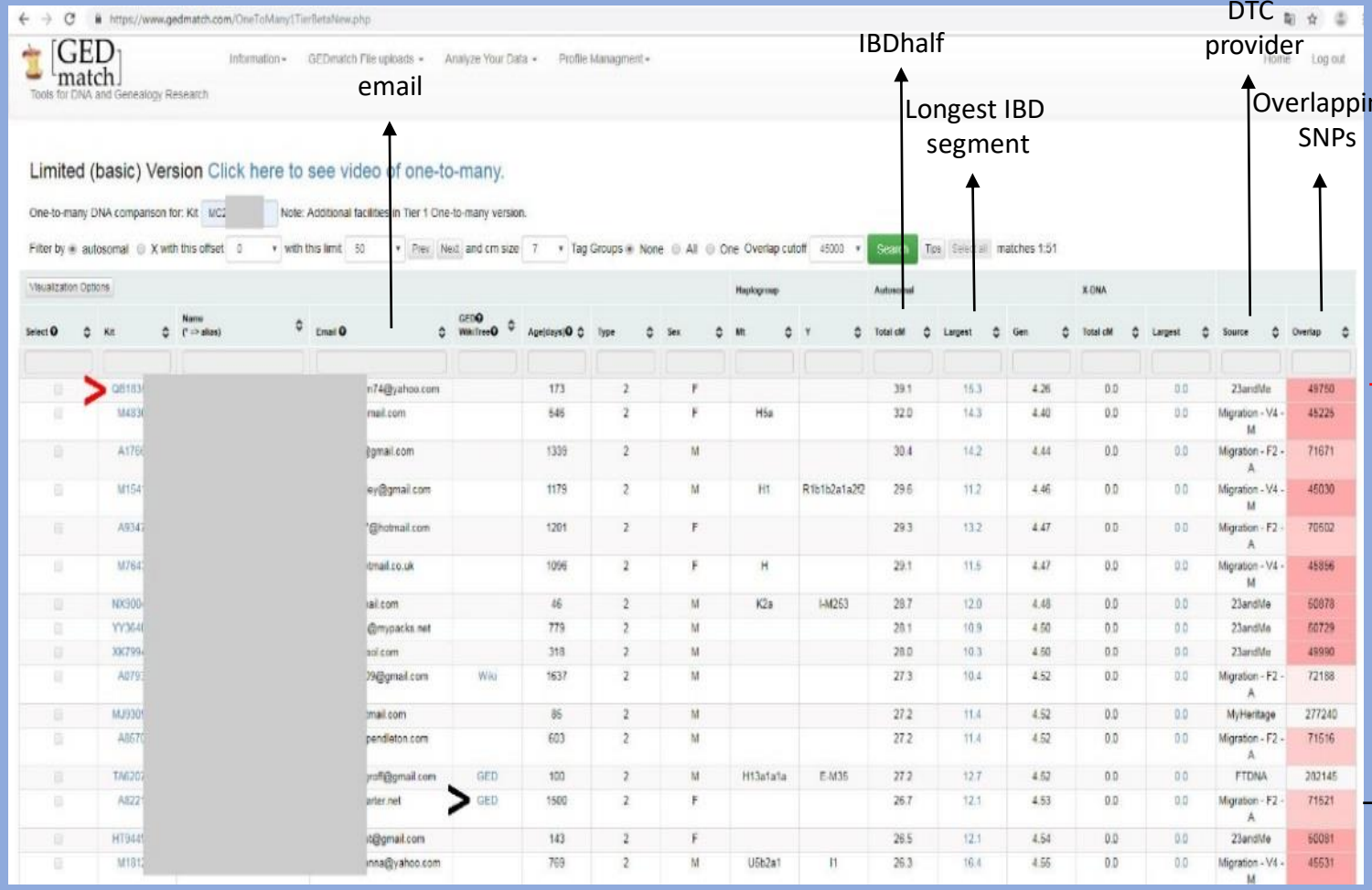
Email Address:

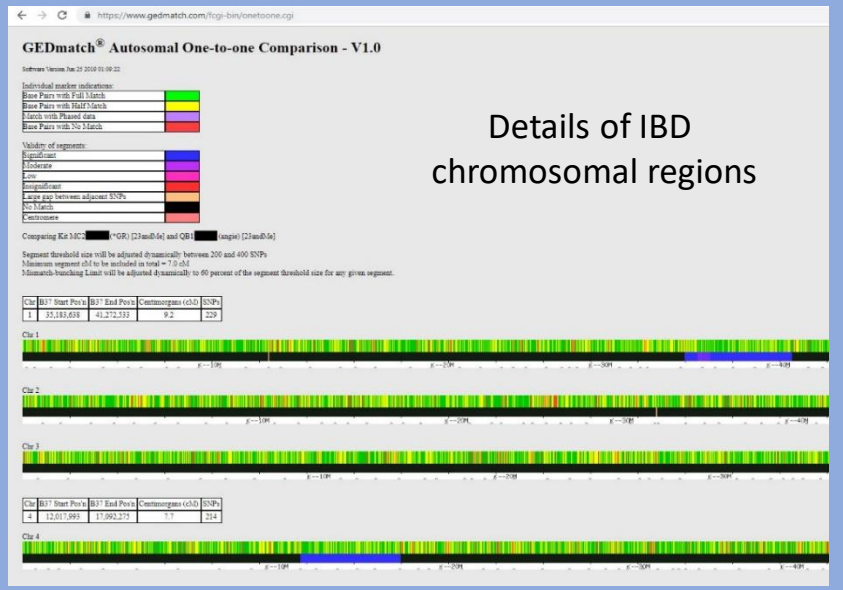
Password:

Log in

- ✓ In 2017 Contra Costa County forensic analyst Paul Holes, who in 1997 contributed to the identification of EAR's DNA, discovers an untouched evidence item from the Smith murder (1980) possibly yielding abundant and high molecular weight DNA of EAR/ONS/GSK. Police submits the sample to a DTC provider (passing it for a sample from a regular costumer) and for 99$ get the EAR/ONS/GSK raw data.
- ✓ Transferred to GEDmatch the raw data return around ten possible 3rd cousins.

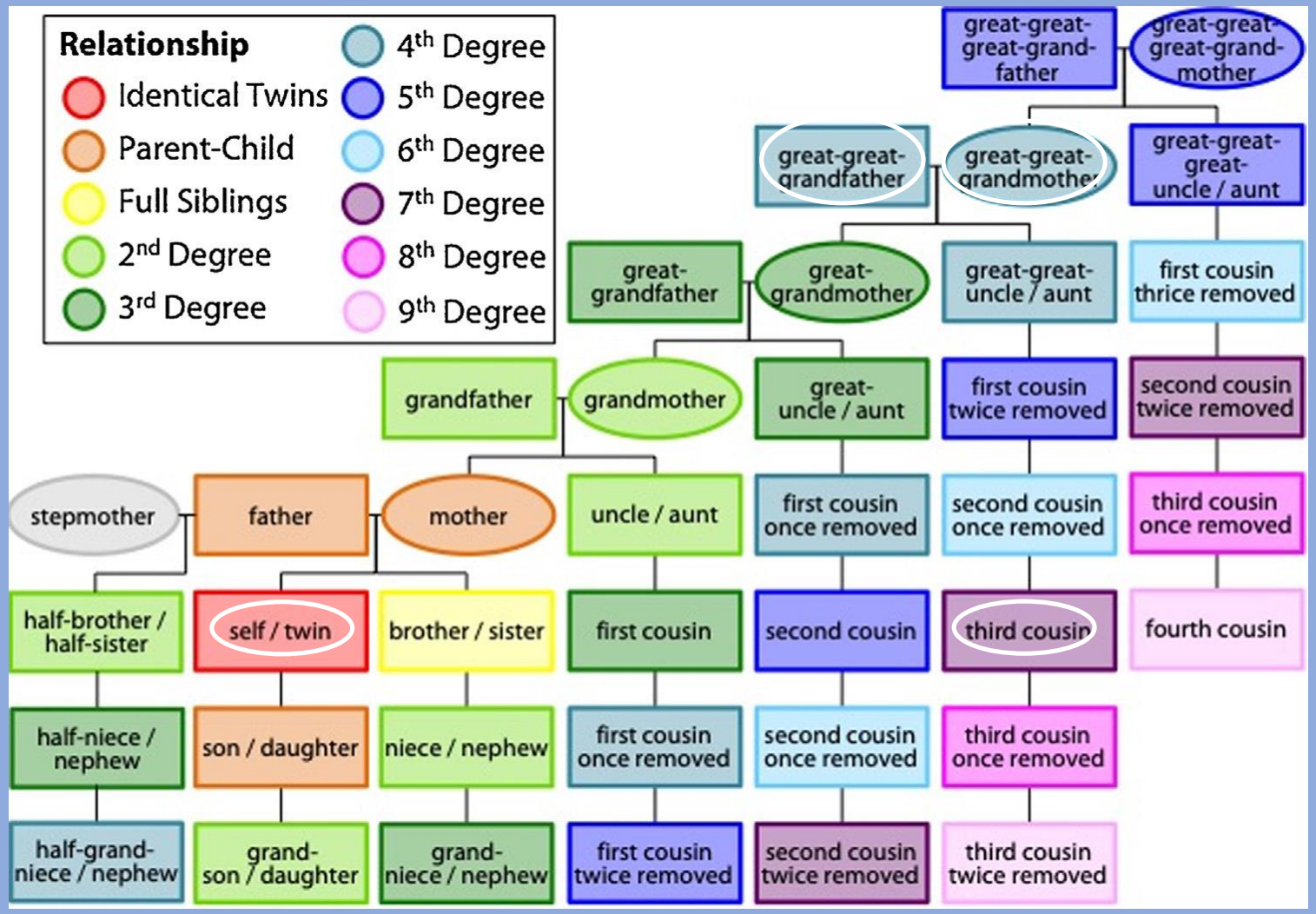
Paul Holes





Details of IBD chromosomal regions

Link to GEDCOM file

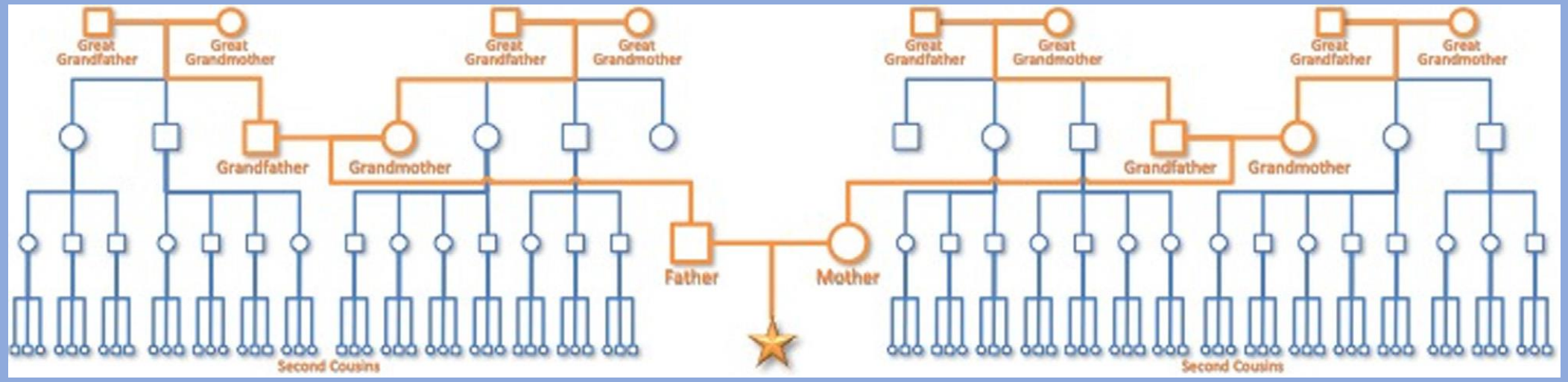


Greytak et al. Forensic Sci Int 2019

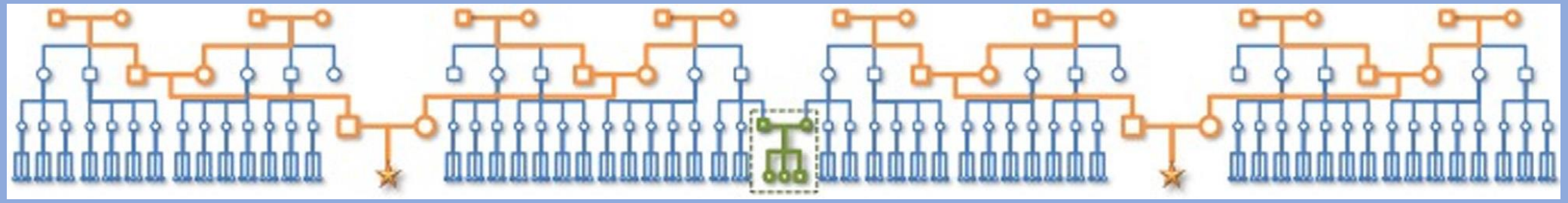
- ✓ 3rd cousins share their great great parents: in the case of the GSK, considering his likely age) they must have lived at the beginning of the XiX century
- ✓ Holes then seeked help from a professional genealogist (Barbara Rae-Venter) to perform traditional genealogy research, combing through public records to determine, for each possible GSK relative, the identities of each generation's parents.

✓ Once possible common ancestors have been identified, the family trees must then be built forward in time to elucidate the possible identities of the unknown individual. This can be helped by genetic data:

- Ancestry information of the unknown subject can point to some branch of the pedigree (e.g. if the unknown has 25% Native American ancestry, searching for a possible grandparent of known Native American origin)
- Lineage markers (Y, mtDNA) and X chromosome IBD regions help to understand if unknown and match are related through father or mother, and to exclude some branches (e.g. males sharing X iBD regions cannot be linked by two males in a row)
- health risk report predicted through SNPs (promethease.com) can point to some branch of the pedigree



- If matches do not share any DNA with one another, they are likely related to the unknown individual on different branches of his/her family tree, and the genetic genealogist can then search for an intersection ("triangulation") between the two matches' families to narrow the list of suspects



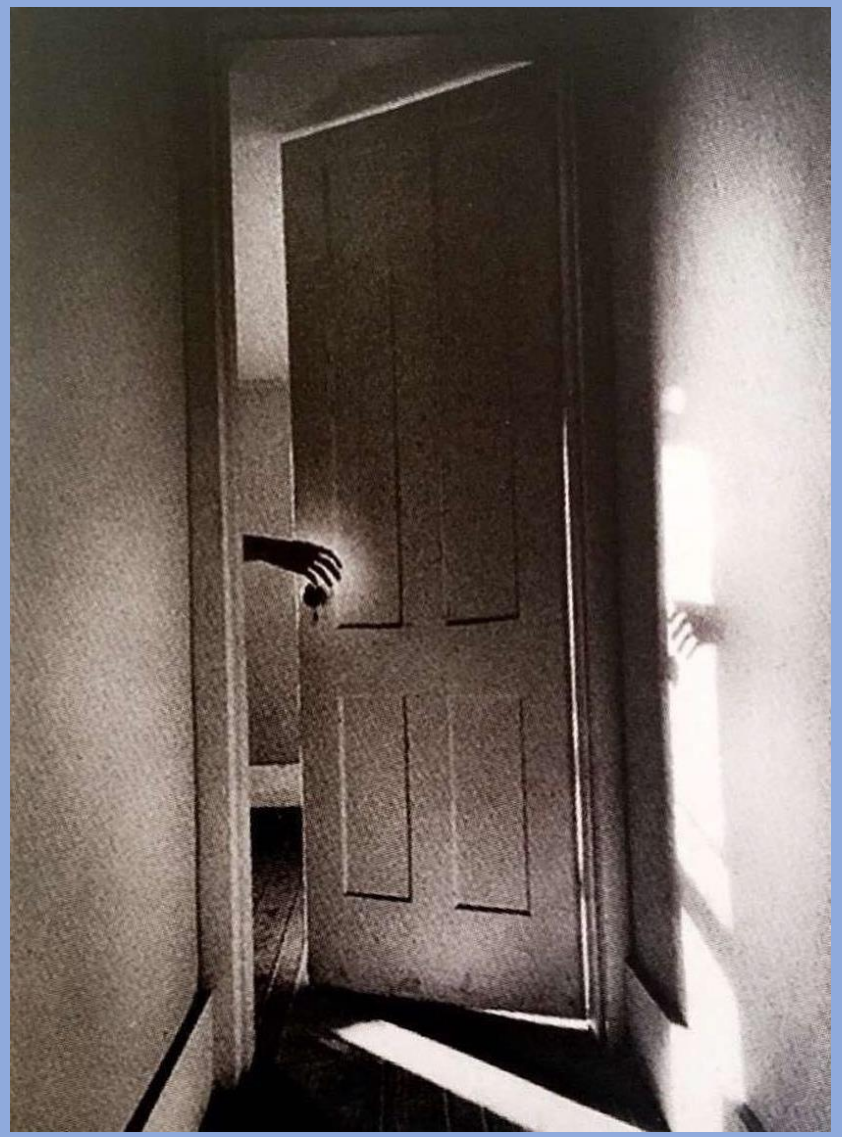
Greytak et al. Forensic Sci Int 2019

With all these expedients, genealogical research lead to hundreds of possible identities for the GSK, that were painstakingly checked via conventional investigations:

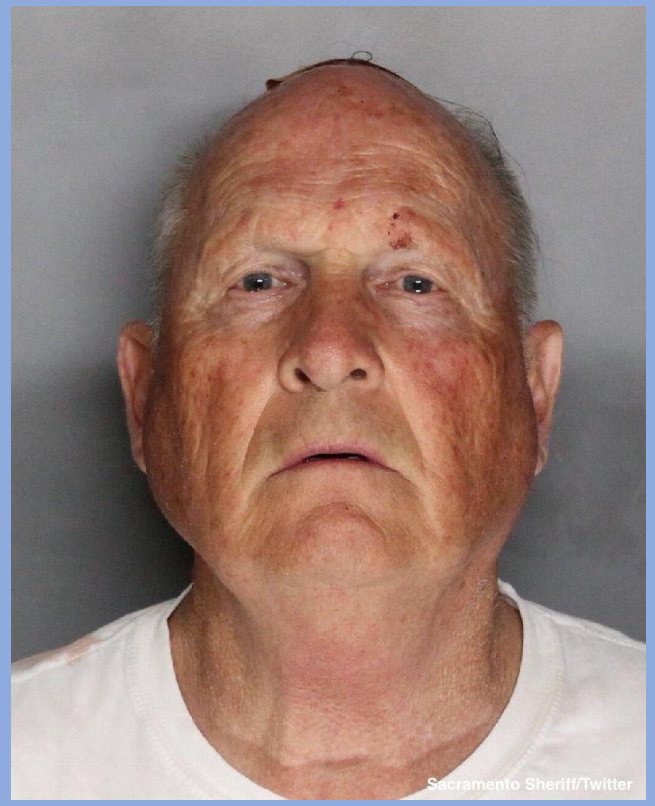
- sex
- age
- alive and physically capable of committing the crime at the time it occurred
- living close to the location of the crime
- EVC derived from yearbook photos, social media…

A final short list of candidates was directly investigated by conventional STR typing and comparison with the GSK profile through biological samples surreptitiously obtained by police forces

On April 2018, 45 years from the first Ransacker episode, a direct STR match was announced.

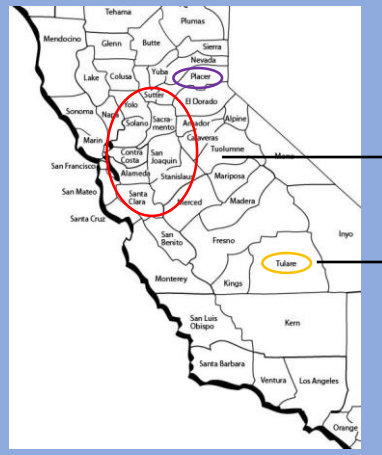


"The best closed door is one that can be left open"
(Chinese proverb)



EAR's identikit!!!

Joseph James DeAngelo, born in 1945, from 1973 to 1976 he was a burglary unit police officer in Exeter (Tulare County). By 1976, DeAngelo had been promoted to sergeant and was in charge of the Exeter Police Department's "Joint Attack on Burglary" program. From June 1976 he served in Placer County until July 1979, when he fired after being arrested for shoplifting a hammer and dog repellent. In 1980 he moved to Citrus Heights (Sacramento County) and his employment history in the 80's is unknown. He still resided in Citrus Heights, with a daughter and grandaughter, at the time of arrest in 2018.



EAR
(1976-1979)

Ransacker
(1973-1975)

All's well that ends well?

- ✓ DeAngelo is actually charged with 8 counts of first-degree murder and 13 kidnapping and abduction attempts (owing to California's statute of limitations he could not be charged with 1970s rapes)
- ✓ In the 9 months following the capture of GSK, 27 authors of cold case crimes were identified by means of genetic genealogy

	Location	Case	Year(s)	Identified as	Date announced	Genetic genealogist
1	California	Multiple homicides and sexual Assaults —"Golden State Killer"	1974–1986	Joseph James DeAngelo	April 24, 2018	Barbara Rae-Venter
2	Snohomish County, WA	Double homicide of Jay Cook (20) and Tanya Van Cuylenborg (18)	1987	William Earl Talbott II	May 21, 2018	Parabon
3	Tacoma, WA	Homicide of Michella Welch (12)	1986	Gary Charles Hartman	June 20, 2018	Parabon
4	Lancaster, PA	Homicide of Christy Mirack (25)	1992	Raymond Charles Rowe[b]	June 25, 2018	Parabon
5	Brazos County, TX	Homicide of Virginia Freeman (40)	1980	James Otto Earhart[a]	June 25, 2018	Parabon
6	Fort Wayne, IN	Homicide of April Tinsley (8)	1988	John Dale Miller[b]	July 15, 2018	Parabon
7	Woonsocket, RI	Homicide of constance Gauthier (81)	2016	Matthew Norman Dessault	July 18, 2018	Parabon
8	St. George, UT	Sexual Assault of Carla Brooks (79)	2018	Spencer Glen Monnett[b]	July 28, 2018	Parabon
9	Fayetteville, NC	Multiple Sexual Assaults —"Ramsey Street Rapist"	2006–2008	Darold Wayne Bowden	August 22, 2018	Parabon
10	Champaign County, IL	Homicide of Holly Cassano (22)	2009	Michael F. A. Henslick	August 29, 2018	Parabon
11	Montgomery County, MD	Multiple Sexual Assaults	2007–2011	Marlon Michael Alexander	September 14, 2018	Parabon
12	Sarasota, FL	Homicide of Deborah Dalzell (47)	1999	Luke Edward Fleming	September 19, 2018	Parabon and Barbara Rae-Venter
13	California	Multiple Sexual Assaults —"NorCal Rapist"	1991–2006	Roy Waller	September 21, 2018	Law Enforcement
14	Greenville, SC; Memphis, TN; Portageville, MO	Multiple Homicides and Sexual Assaults	1990–1998	Robert Eugene Brashers[a]	October 5, 2018	Parabon
15	Starkville, MS	Double homicide of Betty Jones (65) and Kathryn Crigler (81)	1990	Michael W. DeVaughn	October 8, 2018	Parabon
16	Greenbrier, AR	Homicide of Pam Felkins (32)	1990	Edward Keith Renegar[a]	October 29, 2018	Parabon
17	Fulton County, GA	Homicide of Lorrie Ann Smith (28)	1997	Jerry Lee	November 1, 2018	Parabon
18	Anne Arundel County, MD	Homicide of Michael Temple (29)	2010	Fred Lee Frampton, Jr.	November 2, 2018	Parabon
19	Orlando, FL	Homicide of Christine Franke (25)	2001	Benjamin L. Holmes	November 5, 2018	Parabon & Florida Dept. of Law Enforcement
20	Carlsbad, CA	Homicide of Jodine Serrin (39)	2007	David Mabrito[a]	November 13, 2018	Parabon and Barbara Rae-Venter
21	Santa Clara, CA	Homicide of Leslie Marie Perlov (21)	1973	John Arthur Getreu	November 21, 2018	Parabon
22	College Station, TX	Multiple Sexual Assaults	2018	Christopher Quinn Williams	December 12, 2018	Parabon
23	Cedar Rapids, IA	Homicide of Michelle Martinko (18)	1979	Jerry Lynn Burns	December 19, 2018	Parabon
24	Hernando County, FL	Sexual Assault of Unnamed Victim (12)	1983	William L. Nichols[a]	January 10, 2019	Parabon
25	Orange County, CA	Sexual Assaults of Two Unnamed victims (9 and 31)	1995 & 1998	Kevin Konther	January 11, 2019	Law Enforcement
26	La Mesa, CA	Homicide of Scott Martinez (47)	2006	Zachary Aaron Bunney	January 24, 2019	Parabon
27	Fremont, CA	Homicide of Jack Upton (30)	1990	Russell Guerrero	January 24, 2019	Parabon
28	Portland, OR	Homicide of Anna Marie Hlavka (20)	1979	Jerry Walter McFadden[a]	January 31, 2019	Parabon

[a] Deceased.
[b] Pled guilty.

[3] Greytak et al. Forensic Sci Int 2019

Concerns [4]

✓ Technical

- DNA amounts required to generate data are higher (≥1 ng) than those needed in forensic STR typing: further evaluation and validation of microarray and whole genome sequencing platforms for forensic genealogy purposes is needed
- The same apply for effects on genotyping of DNA degradation and possible mixtures in forensic samples
- Companies and websites use proprietary methods for generating matches; only in some cases algorithms have been published in peer reviewed journals for general evaluation
- All software evaluation was done on reference samples, neglecting possible effects on matching algorithms of increased genotyping errors and rate of missing data expected in forensic samples

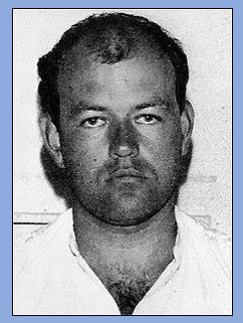
Genetic genealogy is just an investigative tool.
The proper identification will be done through a conventional STR profile match done by accreditated forensic laboratories

So purely technical concerns could be put aside…

Concerns [4]

✓ Ethical

- People who contributed with their samples to DTC genetic genealogy databases may not have had (at least before the GSK case) awareness of potential use of their data for law enforcement purposes
- DTC companies cannot ensure who the actual donor of a sample is and if collection was legitimate or not (minors), also they cannot prevent that misleading genetic and genealogical information is uploaded in genetic genealogy databases on purpose



Colin Pitchfork

DATABASE & PRIVACY POLICIES

Four (4) classes of DNA data on GEDmatch:

CLASS	COMPARISONS
Private	DNA data aren't available for comparisons with other profiles.
Research	DNA data are available for one-to-one comparison to other **Public or Research DNA.**
Public + opt-in	DNA data are available for comparison to the GEDmatch database.
Public + opt-out	DNA data are available for comparison to the GEDmatch database, except DNA identified as being uploaded for Law Enforcement purposes.

GEDmatch contributors have been given the opportunity to opt-out, but what if the crime-related unknown DNA samples was uploaded surreptitiously (like in the GSK case) and therefore could not be identified as a sample uploaded for law enforcement purposes?

Concerns [4]

✓ Ethical

- With the progressive increase in number of people taking DTC tests, in the near future it will not be necessary to be in the actual DTC genetic genealogy database to be identified as a potential relative of an unknown crime stain, since some of our (known/unknown) relatives will be in the database!

- Indirict involvment in a genetic genealogy investigation may reveal unknown relationships or exclude assumed relationships

→

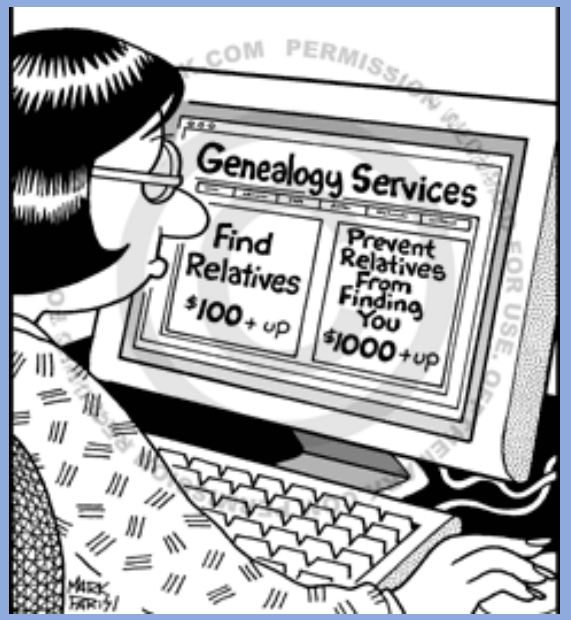
- It is expected that when ~2% (~3 millions) of Americans of European descent will be included in the database there will be a 99% probability for any individual to have a 3rd cousin in the database and a 65% probability to have a 2nd cousin (Erlich et al. Science 2018)
- Please note that GEDmatch included ~1 million individuals in 2018 (most of them of European origin)

Concerns [4]

✓ Ethical

- There are privacy issues regarding the ways data are stored and protected (especially in amateur databases), compared to high security levels granted by public criminal DNA databases

- No legislation and very few operational guidelines are presently available to define when, who, and how is entitled to perform genetic genealogy investigations in criminal cases



→

- Limitation to major crimes (murder/rape) due to possible privacy issue
- Limitation to cold cases still unsolved after traditional investigations
- Access regulation for law enforcement agencies
- Regulation for reference sample collection and storage of DNA from potential suspect's relatives or suspects
- Public information regarding use of DTC genetic genealogy databases by law enforcement agencies (all cases, including false leads, not only success stories)

←

Among the leading companies in the field of DTC testing, AncestryDNA and 23andMe do not accept transfers (from other DTC companies), and do not permit law enforcement agencies to access their databases (unless required by valid legal process).
In January 2019 FTDNA announced that they were collaborating with the FBI and allowing them to upload DNA profiles and create accounts with the same level of access as ordinary users. Existing customers could choose to opt out of matching but this would mean that they would not benefit from the services they had paid for.
In November 2019 a Florida judge ordered GEDmatch to provide access to the whole database (including samples of subjects who opted-out) in order to solve a cold case