the "POA method," previously called the "analysis of sperm" method and the "analysis of men" method, has extended that logic to provide evidence *for paternity*.

The steps in routine tests of a mother, child, and AF are described below, each starting with a question that reflects the logic supporting the procedure.

1. What is the chance that a woman of the mother's phenotype at a given locus would produce a child of its phenotype if the mother mated with the AF? Converting the trio's phenotypes to genotypes and determining the four possible genotypes of children of the couple help determine the probability. Table 4-1 lists the likely genotypes determined from the phenotypes of an imaginary trio. The mother in the example would transmit her A allele with a probability (p) of 0.5, and the AF would transmit his C allele with p of 1.0. Using the product rule for independent events, the combined p that A and C are inherited by the child is $0.5 \times 1.0 = 0.5$.
2. What is the chance that the mother mated with another man to produce the A/C child? This man must represent all possible mates of the mother who carry the C allele. The representative man, or the RM carries the POA (C) and would transmit it to his child with a frequency of "c." (See "The Representative Random Man" later in this chapter.) The probability that a mating of the mother and the RM would produce an A/C child is the product of the probability that the child would inherit A from its mother and C from the RM: $0.5 \times c = 0.5c$.
3. How much more or less likely is the child to be genotype A/C if the AF fathered the child *as compared to* the RM? The comparison is the quotient or LR that divides the AF probability by the RM probability: 0.5(1.0)/0.5(c). The probability that the mother

Table 4-1. Example of a Trio's Phenotypes and Genotypes

Trio Member	Phenotype	Presumed Genotype
Mother	A, B	A/B
Child	A, C	A/C
Alleged father	C	C/C

transmitted the POA (0.5), common to the LR numerator and denominator, is irrelevant and drops out of the LR.

If the case is complicated because a mother is untested, neither the RM's genotype nor the mother's is known. The LR denominator is the empirical frequency of the child's genotype in the population or an estimate of it. An A/C child is expected with probability of 2ac, as calculated from a Hardy-Weinberg formula. (See Chapter 1.)

Pretest Considerations

Usually, only two alternate SONs are considered:

- The AF is the child's BF as claimed by the mother.
- The RM from the AF's ethnic population is the BF. (See "The Representative Random Man" later in this chapter.)

Two *testable* genetic hypotheses are derived from the two SONs:

- A man of AF's genotype at a given locus transmitted the child's POA. (When mother and child have identical locus phenotypes, there are two possible MOAs and, therefore, two possible POAs.)
- An RM of any genotype that contains the POA transmitted the child's POA. (The representative RM transmits the POA with a probability equal to the POA's frequency.)

Determining an MOA and a POA

A diallelic phenotype *denotes* a heterozygous genotype, but a monoalleleic phenotype is assumed to be (*connotes*) a homozygous genotype. Silent alleles are not considered at this stage of analysis. Each locus genotype of the mother is compared with the genotype of her child at the same locus in order to deduce the MOA per locus:

- If mother and child share one allele per locus, that allele is the MOA.
- If mother and child share two alleles per locus, both are considered the MOA.

Examples of trio phenotypes and MOA determinations are shown in Table 4-2.

The child is then reexamined to determine the POA, defined as a child's allele(s) at a test locus that *must* have been transmitted by the child's BF. Note that each locus' POA of the child is determined *before* observing if the AF carries it or not. (The child's POA per locus is transmitted by its BF, but the AF may not be the BF.) Only

Table 4-2. MOAs and POAs from a Trio's Genotypes and Probabilities

Genotypes of Paternity Trio					Probability OA Is Inherited by Child			Paternity
Mother	Child	AF	MOA	POA	M➔MOA	AF➔POA	RM➔POA	Index
A/B	A/C	D/E	A	C	0.5	0.0	c	0.0
A/A	A/B	B/C	A	B	1.0	0.5	b	0.5/b
A/A	A/A	A/B	A	A	1.0	0.5	a	0.5/a
A/A	A/A	A/A	A	A	1.0	1.0	a	1.0/a
A/B	A/C	C/D	A	C	0.5	0.5	c	0.5/c
A/B	A/C	C/C	A	C	0.5	1.0	c	1/c
A/B	A/B	A/C	A or B	A or B	1.0	0.5	a + b	0.5/(a + b)
A/B	A/B	A/B	A or B	A or B	1.0	1.0	a + b	1/(a + b)
A/B	A/A	A/C	A	A	0.5	0.5	a	0.5/a
A/B	A/A	A/A	A	A	0.5	1.0	a	1/a
A/B	A/B	A/A	A or B	A	0.5	1.0	a	1/a

Uppercase letters indicate alleles; lowercase letters indicate respective allele frequencies; MOA = maternal obligate allele; POA = paternal obligate allele; AF = alleged father; M➔MOA = mother transmits maternal obligate allele; AF➔POA = alleged father transmits paternal obligate allele; RM➔POA = random man transmits paternal obligate allele.