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Ensembles of Subclass Characteristics in Physical Evidence Examination

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ABSTRACT: Ensembles of class characteristics resulting from indifferent quality assurance in manufacturing techniques may legitimately transcend conventional attitudes concerning class characteristics. Ensembles of these subclass characteristics converge on individual characteristics. This is illustrated using the data describing Titan .25-caliber automatic pistols contained in the Criminalistics Laboratory Information System (CLIS) list.

KEYWORDS: criminalistics, physical evidence, ballistics

The distinction between class and individual characteristics is a fundamental tenet of physical evidence examination. Implicit in the notion of class characteristics is that they may to some extent permit a group of objects to be segregated as to provenance, but that they will not permit further individualization. It is this assumption that is challenged in the present work.

It is proposed here that in some instances a set of characteristics may be described that is intermediate between class and individual characteristics, and that consideration of *ensembles* of these "subclass" characteristics will tend toward individualization.

An example is to be found in the data describing Titan .25-caliber automatic pistols presented in the Criminalistics Laboratory Information System (CLIS) list [1] of firearms class characteristics. These data are those developed by the FBI laboratory, and were derived from firearms submitted to the FBI laboratory in connection with actual casework. After those with incomplete data are culled from the 1978 CLIS list, 241 Titan .25 automatics are listed. These weapons form the basis of the present inquiry.

All 241 automatics have 6 lands and grooves with a right-hand twist. This is the sort of information that over the years we have come to expect regarding class characteristics of firearms. All of the Titans have these characteristics in common, and these two characteristics simply partition the universe of firearms into those with six lands and grooves with a right-hand twist, including the Titan, and all those with some other number of lands and grooves or with a left-hand twist.

But when we look at the remaining class characteristics for the Titan .25 automatics, we see that all of the other characteristics show variation to a greater or lesser extent. (This may be contrasted with, for example, Smith and Wesson .38-caliber revolvers; the CLIS list contains page after page of Smith and Wesson .38-caliber revolvers with little or no variation in class characteristics.)

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Reference to the CLIS list shows that Titan .25 automatics have been encountered with land widths varying from 0.838 to 2.235 mm (0.033 to 0.088 in.). The variation in land widths, incremented in thousandths of an inch, will actually partition the 241 Titan automatics into 46 discrete groups. (In the CLIS data, there are minimum land widths that simply do not appear, for example, 0.132 mm (0.035 in.), 1.955 mm (0.077 in.), 2.184 mm (0.086 in.), and so forth). Furthermore, the six lands measured on a particular firearm may vary by as much as 0.178 mm (0.007 in.). This variation in land width difference forms eight groups (0.000 to 0.178 mm [0.000 to 0.007 in.]). Two different firing pin finishes are observed—circular and hemispherical. The distribution is overwhelmingly skewed toward the circular, but clearly two groups are formed. Three different breechblock finishes are observed—circular, parallel, and smooth. A fourth category with respect to breechblock finish is formed by the superimposition of both circular and parallel marks.

These variations in class characteristics are the result of (to be charitable) nonchalance in the manufacturing process. It is suggested here that these characteristics within the entire population of Titan .25 automatics, considered individually or as ensembles, tend toward individuality by partitioning the total population of firearms into much smaller groups. Viewing these characteristics individually contributes relatively little to the issue of individuality, for example, firing pin finish will partition the weapons into two categories, and breechblock finish into only four.

But by looking at the characteristics as *ensembles*, discrimination is greatly enhanced. If we consider the ensemble of [narrowest land/firing pin finish/breechblock finish], then the 241 Titan automatic pistols may be partitioned into 91 discrete groups. The ensemble of [narrowest land/land width difference] will partition the Titans into 114 groups. And the ensemble of [narrowest land/land width difference/firing pin finish/breechblock finish] will partition the population into 156 groups. In the CLIS list, the largest cluster of weapons with identical properties for the ensemble of [narrowest land/land width difference/firing pin finish/breechblock finish] is twelve weapons.

If one adds groove impression width to the latter ensemble, the 241 Titan automatics may be partitioned into 232 groups, with 2 groups of 3 weapons and 7 groups of 2 weapons. (Parenthetically, the author personally has no particular enthusiasm for groove impression widths because of the imprecision of measurement, but this is tangential to this discussion in which the Titan automatics are used simply as an example.) Stated somewhat differently, of the total number of 241 firearms, 221 of them *do not share the exact same configuration of class characteristics with even one other firearm*. Of the remaining twenty weapons, a replication of class characteristics between *two* firearms occurs seven times, and a replication of class characteristics between *three* weapons occurs twice. The groups formed by various ensembles are illustrated in Table 1, and the number of firearms per group given the ensemble of [narrowest

TABLE 1—Groups formed by class characteristics and their various ensembles from 241 Titan .25 automatics.

	Class Characteristics and Various Ensembles														
Narrowest land	•					•	•	•			•	•	•	•	•
Narrowest groove		•						•							
Land width difference			•			•	•	•			•	•			
Firing pin finish				•		•		•	•	•			•	•	
Breechblock finish					•	•		•	•		•	•			•
Number of groups formed	46	49	8	2	4	156	114	232	6	117	156	91	52	84	

TABLE 2—Groups formed with the ensemble of [narrowest land/narrowest groove/land width difference/firing pin finish/breechblock finish]. The total number of groups formed is 230. The total number of firearms represented is 241.

Number of Groups	Firearms per Group	Number of Firearms
221	1	221
7	2	14
2	3	6

land/narrowest groove/land width difference/firing pin finish/breechblock finish] is given in Table 2.

Note also that the Titans are not equitably distributed among the groups formed. With respect to firing pin finish, 7 have a circular finish and 234 have a hemispherical finish. This characteristic is so skewed that alone it is not likely to be of much use; obviously, one is much more likely to encounter a hemispherical finish. But with respect to breechblock finish, 151 firearms have circular markings, 58 have parallel markings, 27 are smooth, and 5 are the superimposition of both the circular and the parallel finish. And with respect to land width difference, that is, the difference between the narrowest and the widest land, 5 weapons had the same width for all 6 lands, 14 firearms had lands that differed by no more than a thousandth of an inch, 89 differed by 0.051 mm (0.002 in.), 63 differed by 0.076 mm (0.003 in.), 34 differed by 0.102 mm (0.004 in.), 29 differed by 0.127 mm (0.005 in.), 2 differed by 0.152 mm (0.006 in.), and 5 differed by 0.178 mm (0.007 in.).

If ensembles of these class characteristics resulting from poor quality assurance in manufacturing techniques are considered from the standpoint of their ability to discriminate between objects, then they may legitimately transcend conventional attitudes concerning class characteristics and contribute meaningfully toward individualization. When class characteristics are factored into a problem of physical evidence evaluation, it would appear reasonable to ascribe greater weight to these subclass characteristics than to class characteristics in the ordinary sense of the term. The significance of this view with respect to firearms identification is that when a number of class characteristics agree between the evidence and test firings from a Titan .25 automatic, the firearm in question may well be the one responsible for the evidence, quite apart from any individual characteristics.

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Reference

[1] *Criminalistics Laboratory Information System (CLIS)*, National Crime Information Center, Washington, DC, 1978.

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