Table 1. Numbers of various scolytid beetles, in flight, attracted to traps baited with Douglas fir oleoresin and terpene hydrocarbons during 10-hour testing. Df, Douglas fir.

Bait, in ethanol	*Dendroctonus pseudotsugae*		*Gnathotrichus*		*Trypodendron lineatum*	*Hylastes*		*Dryocoetes autographus*	*Pseudohylesinus*	
	♀	♂	*sulcatus*	*retusus*		*nigrinus*	*ruber*		*nebulosus*	*grandis*
2.5% Df resin	342	187	48	10	6	32	19	7	31	0
1% α-pinene	310	157	182	7	7	38	25	10	8	29
1% β-pinene	10	5	62	8	10	10	12	9	9	8
1% limonene	161	108	14	7	7	16	0	0	0	7
1% camphene	403	235	88	0	9	18	9	8	12	0
1% geraniol	9	5	45	5	0	11	0	0	0	6
1% α-terpineol	0	0	11	7	0	12	8	0	0	0
1% myrcene*	0	0	0	0	7	0	0	0	0	41
					Controls					
Df log	103	32	36	8	0	16	5	2	128	22
Grand fir log	0	0	0	0	0	0	0	0	0	114
95% ethanol	0	0	0	0	0	0	0	0	0	0

* Benzene solution.

Franco, 280 years old, about 32 km west of Corvallis, Oregon. The forest also contains a few other conifers: western hemlock, *Tsuga heterophylla* (Raf.) Sarg.; grand fir, *Abies grandis* (Dougl.) Lind.; and western red cedar, *Thuja plicata* Donn. Nine species of bark and ambrosia beetles are there associated with Douglas fir: *Dendroctonus pseudotsugae* Hopkins, *Pseudohylesinus nebulosus* (Lec.), *P. grandis* Sw., *Dryocoetes autographus* Swaine, *Hylastes ruber* Swaine, *H. nigrinus* (Mann.), *Trypodendron lineatum* (Oliv.), *Gnathotrichus sulcatus* (Lec.), and *G. retusus* (Lec.).

The proportion of terpene hydrocarbons in Douglas-fir wood differs from that in the bark (*4*). Wood contains 30 percent α-pinene, 6 percent 1-camphene, 14 percent 1-limonene, and 32 percent 1-α-terpineol; in bark are 28 percent 1-α-pinene, 24 percent 1-β-pinene, 7 percent 1-camphene, 8 percent limonene, 6 percent geraniol, and azulenogenic sequiterpenes (*5*). After preliminary experiments with various concentrations, a 2.5-percent solution of Douglas-fir oleoresin and a 1-percent solution of the terpene hydrocarbons in ethanol were chosen; with myrcene, the solvent used was benzene. The solutions were placed in six baited traps (*6*), and tests were run for several hours at a time at weekly intervals throughout the 1964–65 seasons. Fresh logs of Douglas fir and grand fir, ethanol, and empty traps were used as controls. The traps were stationed throughout the forest, 90 m apart, and the insects were collected two or three times per hour.

The results appear in Table 1. Since the density of population of any particular species of insect varied from day to day because of such factors as temperature and intensity of emergence throughout the season, it was not intended to establish exact quantitative differences in attractive power of the various terpenes. However, at least with abundant species such as *Dendroctonus pseudotsugae* and *G. sulcatus*, there were evident differences in attractive power of the terpenes. For example, α-pinene, limonene, and camphene were more attractive to the Douglas-fir beetle than β-pinene, geraniol, and α-terpineol, but β-pinene and geraniol attracted considerable numbers of *G. sulcatus*. Although *Dryocoetes autographus* and *T. lineatum* also abounded, few responded; unlike *Dendroctonus pseudotsugae, G. sulcatus*, and *P. nebulosus* these species do not prefer freshly cut or wind-thrown trees, and it is probable that products of tree deterioration play a role in attracting them. The slight response by *P. nebulosus* may reflect the fact that its speak flight had occurred in March, before the tests with terpene hydrocarbons were begun. The principal host of *P. grandis* is grand fir; its preference for the grand fir log and myrcene is evident.

The fact that twice as many females as males of the Douglas-fir beetle responded to resin and the terpenes (Table 1) may reflect the selection behavior of the beetle, as only females locate the breeding material and initiate the galleries. The fact that attraction to the terpenes is more pronounced in those species that prefer freshly cut and wind-thrown trees indicates that their dispersal flight is directed toward breeding material in the forest by the volatile terpenes. Such orientation is termed "host or primary attraction" and precedes the "secondary or beetle attraction" that occurs in several species in response to beetle-produced pheromones (*6, 7*).

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13 December 1965

Seroprimatology of Chimpanzees: Blood-Group Distribution as a "Racial" Characteristic

Abstract. *Significant differences in the distribution of human-type and simian-type blood groups have been demonstrated in chimpanzees classified into subspecies or "races" on the basis of morphological traits. The differences in chimpanzees are analogous to racial differences in the distribution of blood groups in man.*

We use the term "seroprimatology" in analogy to the term "seroanthropology," which refers to the anthropological characterization of human populations by differences in the distribution of their serological properties. This branch of physical anthropology originated from the demonstration by L. and H. Hirszfeld (*1*) of differences in distributions of the A-B-O blood groups among contingents of troops of various ethnic origins stationed at Salonika, in the Balkans, during World War I. Numerous subsequent studies concerned A-B-O blood groups, other blood groups that were later discovered, and serum groups. Expeditions have obtained blood samples from the less-explored parts of the world, and large-scale surveys have used blood-typing data from hospitals and transfusion centers of practically all nations (*2*).

During study of the human-type (*3*) and simian-type (*4*) blood groups of chimpanzee populations, we encountered high chi-square values in the 2 × 2 contingency tables, suggesting associations between blood factors which, according to serological evidence, did not belong to the same blood-group system (*5*). We postulated that these high values may have resulted from a stratification effect caused by nonhomogeneity of the chimpanzee populations investigated.

Two species of chimpanzees are generally known: *Pan satyrus (Pan troglodytes)* and *Pan paniscus*. The former divides into four subspecies or "races" (*6*) designated *Pan satyrus satyrus, Pan satyrus schweinfurthi, Pan satyrus verus*, and *Pan satyrus koolokamba*. Morphological characteristics and geographical distribution of the four races have been described by Osman Hill (*6*), whose morphological examination of the chimpanzee population tested by us revealed representatives of all four races (*7*). We now report differences in the distribution of blood groups among the four races comparable to the racial differences in man.

Despite the relatively small number of samples (which are difficult to obtain), statistically significant differences in distribution of both human-type and simian-type blood factors were demonstrated (Table 1). Statistical analysis of the results is limited to the subspecies *Pan satyrus schweinfurthi* and *Pan satyrus verus*, which show the most striking differences in distribution; they also comprised the great majority of the animals tested.

The frequency of human-type blood group O ranged from a low of 9.5 percent in *Pan satyrus verus* to a high of 39.4 percent in *Pan satyrus schweinfurthi*, which difference is statistically significant. Also, the differences in distribution of the simian-type C-E-F blood-group system, and of the blood factor $\mathbf{H}^c$ associated with this system, are statistically highly significant. The frequency of type c ranged from 6.0 percent among *Pan satyrus schweinfurthi* to 64.3 percent among *Pan satyrus verus*, and variations were parallel in the distribution of blood factor $\mathbf{H}^c$ (*8*). On the other hand, no significant differences were demonstrable in the distribution of the simian-type V-A-B blood groups and of the simian-type blood factor $\mathbf{G}^c$. Thus the serological data so far obtained confirm Osman Hill's subdivisions of the species for at least two of the four groups of chimpanzees.

This variation in blood-group distribution in chimpanzees compares with the extremes of variations encountered in man: in isolates of American Indians (*9*) and of Australian aborigines (*10*). Similar recent observations in gibbons (*Hylobates lar*) show significant differences in distribution of the human-type A-B-O blood groups and the M-N blood types between the subspecies *H. lar lar* and *H. lar pileatus* (*11*). Our observations on chimpanzees suggest more general occurrence of this phenomenon in primates and may help to elucidate the mechanism of the origin of polymorphism and of the varying distribution of blood groups in man.

Table 1. Distribution of blood groups among 91 chimpanzees belonging to four subspecies of *Pan satyrus*.

Blood group	Subspecies of *Pan satyrus*				*Pan satyrus satyrus* versus *Pan satyrus verus*		
	satyrus	*schweinfurthi*	*verus*	*koolokamba*	χ^2	df	*P*
Human-type A-B-O							
O	2	13	4	1	9.2	1	$<.05$
A	12	20	38	1			
Simian-type C-E-F							
c	2	2	27	0	26.6	**3**	$<.0001$
E	1	5	3	0			
F	7	16	8	2			
EF	3	10	4	0			
C	1	0	0	0			
Simian-type $\mathbf{H}^c$ *factor*							
h	2	1	17	0	14.1	1	$<.0001$
H	12	32	25	2			
Simian-type $\mathbf{V}$ *factor*							
v	9	24	25	2	1.38	1	$<.3$
V	5	9	17	0			
Simian-type $\mathbf{A}^c$-$\mathbf{B}^c$ *factors*							
O^c	0	3	5	0	7.77	3	$\approx.5$
A^c	1	4	14	0			
B^c	9	21	14	2			
A^cB^c	4	5	9	0			
Simian-type $\mathbf{G}^c$ *factor*							
g	5	6	13	0	1.63	1	$\approx.20$
G	9	27	29	2			

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14 February 1966