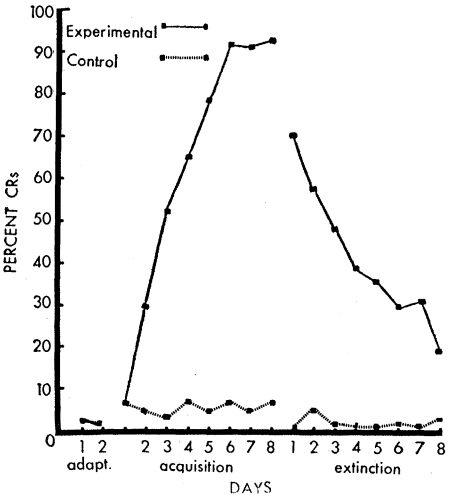

Fig. 2. Mean percentage of responses plotted in 70 trial blocks in acquisition and extinction.

consisted of an 800-cy/sec tone of 72 db SPL, presented for 600 msec.

Eighteen albino rabbits, 85 to 100 days of age, were assigned to one of two groups for 2 days of adaptation, 8 days of acquisition training, and 8 days of extinction. In each day of acquisition a control group of six rabbits (group C) received a random presentation of 70 CS alone and 70 unconditioned stimuli (UCS) alone trials restricted within two trials blocks at randomized intertrial intervals of 5, 10, and 15 seconds (mean of 10 seconds). A classical conditioning group of 12 rabbits (group E) received 70 paired presentations of the CS and UCS a day at a CS-UCS interval of 500 msec and randomized intervals between trials of 15, 20, and 25 seconds (mean of 20 seconds). For each of the 2 days of adaptation a measure of spontaneous membrane movement was obtained in both groups by recording the frequency of responses in intervals corresponding to the 70 CS-UCS trials that were employed in acquisition for group E.

In adaptation and acquisition all membrane extensions of at least 1 mm deflection from the baseline were recorded from 0 to 525 msec after initiation of the trial. In extinction the interval was extended to 600 msec. The distribution of response latencies for group E in acquisition and extinction is shown in Fig. 1. The left-hand side of the figure shows that the distributions are unimodal and the modal latency systematically decreases from 525 msec on the second day of acquisition to 150 msec on the eighth day. This finding is consistent with the progressive decrease in response latency reported by Pavlov (*4*) for simultaneous conditioning of the salivary response. An analysis of variance of the mean latency of conditioned responses over days revealed that the decrease in response latency was significant ($P < .01$).

In extinction, two modes appear in the distributions. Although there is a progressive decrease in frequency of responses over days of extinction, there appears to be no systematic shift in the modal latencies. The first mode on the left was primarily a function of a high frequency of short latency responses in two rabbits. Examination of the latency distributions of responses in both groups in adaptation (not shown) and those of group C in acquisition and extinction (not shown) revealed they were unsystematic and infrequent and essentially like that shown in Fig. 1 by group E on the first day of acquisition. Consequently, there is no evidence in the data of reflex responses to the CS, or of sensitization.

The percentage responses for both groups in adaptation, acquisition, and extinction are shown in Fig 2. For adaptation the percentage of spontaneous responses was about 1.5 for both groups. In acquisition, the responses for group C did not increase over days, and never exceeded a 6-percent level. Group E showed a steady increase in responses from 6 percent on the first day to an asymptotic level of about 92 percent on the last 3 days of acquisition.

However, in the previously reported study of the conditioning of the outer lid (*2*) the highest level of conditioning attained was 72 percent. A *t*-test comparison of mean percentage conditioned responses of group E on the first day and the eighth day of acquisition was highly significant ($P < .001$). Group E showed considerable resistance to extinction. The mean response was from 71 percent on the first day to 20 percent on the eighth day. On the other hand, in group C extinction and adaptation were closely parallel (*5*).

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Chemical Stratification in Lake Fryxell, Victoria Land, Antarctica

Abstract. A landlocked lake of sodium-mixed-anion type in lower Taylor Valley has a salinity ranging from 1/35 to 1/5 that of sea water. The lake seems to be chemically stratified into three distinct layers. Several possible sources are postulated for the dissolved salts. The chemical zonation may have been initiated by past climatic variation; however, a thermal or magmatic origin for some of the waters is also indicated. No single origin for the lake waters or the stratification seems likely.

Lake Fryxell occupies the center of a wide, shallow basin in lower Taylor Valley in latitude 77°35′S, longitude 163°35′E. The average depth of the lake, including a hummocky ice cover about 4.5 m thick, is about 8 to 10 m; maximal depth, measured near the center of the lake at hole number 2 (see Table 1), is 13 m. Water samples, including melted ice core, were collected only from hole number 2; however, some physical data recorded nearer shore (at hole number 1) are included for comparison. Similar ice thicknesses reported for Lakes Vanda and Bonney (*1*) and smaller lakes at Cape Royds (*2*), suggest a local equilibrium between ice formed and that lost by sublimation which is comparable to that described for arctic areas (*3*).

Fryxell is fed primarily by melt-water from Canada and Commonwealth glaciers. The concentration of dissolved salts in the lake ranges from approximately 1/35 to 1/5 that of sea water (Table 1). The principal dissolved salts are sodium chloride and sodium bicarbonate. The silica value is anomalously high in the water from 12-m depth; however, considering the *p*H of the water and the analytical method employed (silicomolybdate) the actual value is probably less than that reported. Lake waters in permanently landlocked drainage basins frequently owe their high salinity primarily to climatic aridity. In Taylor Valley this condition is met by low precipitation, high evaporation, and sublimation.

Table 1. Chemical analyses of lake water (hole No. 2). Iron and NO_2 were not detected; there was a trace of NH_3 at 12 m; and no check for NO_3 was made. Water samples, including melted ice core, were taken from depths of 4.5 m, 6 m, 9 m, 12 m, and 13 m.

Item	Ice core	Amounts at depths of				
		4.5 m	6 m	9 m	12 m	13 m
Field conductance No. 2 (μmho)	231	1,600	4,854	14,925	22,727	21,739
Field conductance No. 1 (μmho)		2,045	6,494	12,821	14,925*	
Temperature (°C)—hole No. 2	0°	1.0°	1.25°	2.5°	2.25°	2.0
Temperature (°C)—hole No. 1	0°	0.75°	1.5°	2.75°	2.25°*	
Cl (mg/liter)	40	640	1,640		2,740	
HCO_3 (mg/liter)		252	1,332		2,136	
SO_4 (mg/liter)		40	144		460	
PO_4 (mg/liter)		0.4	1.3		2.1	
SiO_2 (mg/liter)		9	58		205	
K (mg/liter)		23	108		187	
Na (mg/liter)		172	1,350		2,050	
Ca (mg/liter)		42	77		33	
Mg (mg/liter)		108	129		229	
*p*H		7.9	7.2		7.0	
Dissolved solids (total)		1,160	4,160		6,960	
		Ratio by weight				
HCO_3/Cl		0.394	0.812	0.780		
SO_4/Cl		0.062	0.088	0.168		
K/Na		0.134	0.080	0.091		
(Ca + Mg)/(Na + K)		0.770	0.141	0.117		

* Bottom of hole No. 1 is 11 m.

The water (from 9 m and 12 m) in the lake can best be considered a sodium chloride bicarbonate type. A comparison of ionic ratios of the lake with those of sea water emphasizes the higher bicarbonate content of the lake. McCraw (*4*) reported layers of $CaCO_3$ in the soils of Taylor Valley and we have observed $CaCO_3$ (aragonite) coating rock surfaces in the vicinity of Lake Fryxell. Leaching of these salts by glacial meltwater provides a source for the HCO_3^-. Atmospheric CO_2 is also a possible source. If the former source is postulated, the low concentration of Ca^{2+} is puzzling, inasmuch as the presence of sodium and potassium salts in water increases the solubility of $CaCO_3$. It is possible that Ca^{2+} is precipitated as either $CaCO_3$ or $CaSO_4$. Calcium sulfate should not be present in excess of 100 mg/liter in solutions as concentrated as the bottom waters of Fryxell.

Possible sources for these salts include: (i) ocean spray blown inland from McMurdo Sound, 4.5 km to the east, during the 2 to 2.5 months that it is open under present conditions (probably it was open longer during the past if warmer phases existed); (ii) minor sources of Na^+ and Cl^- from a white powdery efflorescence [NaCl and Na_2SO_4 by x-ray analysis (*5*)], common as large patches on glacial moraine, beach, and older lake deposits in the area; (iii) relict sea water; and (iv) thermal waters (volcanic hot spring). The third source seems improbable. If relict sea water were present, the amount of magnesium should be greater than that measured because of the greater solubility of its salts in waters of high sodium concentration.

Raised beaches, 20.5 m above present sea level, are located nearby (*6*). The area between lake and shore is covered by morainal material to a height of 46 to 50 m. Weakly developed shorelines lie approximately 45 m above the present lake level and occur in step-like fashion down to the lake (*7*).

The basin was filled probably by greater runoff of meltwater during a past climatic maximum, suggesting the possibility of an outlet to the sea concurrent with the highest levels of water in Lake Fryxell. Consequently, some of the present salt content may be the result of concentration of waters from former high stages. The concentration process would be aided by freezing out of salts during formation of surface ice. If a balance exists between amount of ice frozen to offset yearly sublimation, then this continual freezing process could accelerate and become the controlling factor in the concentration process.

The lake seemingly is chemically stratified into three distinct layers which suggests either more than one period of concentration or possibly different origins for the waters of the respective zones. A marked chemocline occurs between 11 and 12 m, and a less sharp chemocline and thermocline occurs between 6 and 9 m (Table 1). The chemical zonation may have been initiated by past climatic variations. Lacking more data on the chemical composition of the ice cover and of meltwater entering the lake, we find it difficult to evaluate this hypothesis or to explain definitively the chemical layering.

A thermal or magmatic (volcanic hot spring) origin for some of the waters is also indicated by applying White's (*8*) ratios to analytical data (see Table 1). The ratios HCO_3/Cl, K/Na, and (Ca + Mg)/(Na + K) suggest either a connate or a magmatic origin for the waters of different zones, whereas the SO_4/Cl ratio of respective layers all lie in the magnetic (volcanic hot spring) range in White's data. Recent runoff has most likely introduced the water found immediately beneath the ice cover.

When all data are consdered, no one origin for the lake waters can be demonstrated; however, the available evidence favors a thermal origin for at least some of the waters. Information regarding the minor constituents such as bromine, iodine, and boron would help considerably to elucidate the problem of a source.

The temperature profile suggests that part of the heat contributing to the warm water temperatures may be the result of solar radiation, and that heat is lost both through the bottom and top of the lake. A thermal source of heat, however, is possible.

The composition of waters from Lake Fryxell, different from that of Lake Bonney farther up Taylor Valley (*1, 9*), suggests either a different source for some of the dissolved salts or a different concentration mechanism for each lake (*10*).

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Unique Incompatibility System in a Hybrid Species

Abstract. All males of the weevil *Pissodes terminalis* Hopp. are heterozygous for an autosomal fusion ($cc \rightarrow C$); all females are homozygous (CC). A mechanism is operative whereby union of like gametes gives rise to females and of unlike gametes gives rise to males, and union of half-alike gametes is totally excluded. The perpetuation of this sexual dimorphism of karyotypes following crossing implicates *P. yosemite* Hopk. in the hybrid origin of *P. terminalis*.

Chromosomal polymorphism is said to be transient if it leads to changes in the genetic composition of a population. It is balanced if the structural heterozygotes exhibit heterosis. Heterosis usually expresses itself as a result of differential mortality, with more heterozygous adults comprising the population than are expected on the basis of the binomial square rule, or by greater fecundity, longevity, or sexual activity of the heterozygotes. The most extreme case of balanced polymorphism we can envisage would be achieved by the incorporation of a balanced lethal system that would eliminate both homozygous types. With a consequent 50 percent wastage in each generation, it is understandable that balanced lethal systems have not been encountered in natural populations of animals.

In *Drosophila tropicalis* Burla & da Cunha, Dobzhansky and Pavlovsky (*1*) have demonstrated that populations occur in Honduras in which the fitness of the homozygotes approaches zero, with about 90 percent of the adults being heterozygotes and most of the mortality occurring in the egg stage. Despite this, as judged by the relative abundance of *D. tropicalis* and three other siblings in the *D. willistoni* group, the populations were found to be "remarkably prosperous."

A radically different situation, which appears not to be attributable to differential mortality, prevails in the weevil *Pissodes terminalis* Hopping (*2*). In this case all 218 males examined cytologically, from populations in California, northern British Columbia, the Yukon Territory, and Saskatchewan, proved to be heterozygous and all 41 females, from the same localities, proved to be homozygous for the '*C*' metacentric chromosome (the fusion equivalent of two acrocentrics, 'c^1c^2') (*3*).

In other words, the *C*-chromosome complex behaves in heredity as though it were concerned with sex determination, the two *C* chromosomes determining femaleness, the Cc^1c^2 chromosomes, maleness. It is, however, perfectly obvious that it does not have this function. The highly distinctive *Pissodes X* and *Y* sex chromosomes, plainly evident in primary spermatocytes, segregate at random relative to the disjoining *C* and c^1c^2 chromosomes (*2*). Males may, therefore, be symbolized $XYCc^1c^2$ and females $XXCC$.

Preliminary egg sterility tests aimed at discriminating between selective fertilization (which would yield no inviable eggs) and a lethal system (which would eliminate half the theoretical recombinants) imply that multiple insemination occurs, and that it is through fertilization being selective that all males are heterozygous and all females homozygous for the *C* metacentric (*4*). The striking difference from the classical *Oenothera lamarkiana* device, in which both homozygous categories fail to materialize, resides, of course, in the unique autosomal dichotomy into heterozygous males and homozygous "metacentric" females (that is, to the total exclusion of CC males and Cc^1c^2 females). Unless the role of differential mortality is deferred until later in development, this attests the existence in *Pissodes terminalis* of a cytogenetic system entirely new to genetics: one that permits the union of totally dissimilar gametes ($XC + Yc^1c^2$) to give rise to males and of similar ones ($XC + XC$) to give rise to females, but completely debars the union of gametes that are only half alike ($XC + YC$ and $XC + Xc^1c^2$).

The diploid chromosome numbers observed in *P. terminalis* have been consistently 28 in the female and almost always 29 in the male. But the presence in a California population of a male heterozygous for an '*A*' metacentric and of another homozygous for the a^1a^2 acrocentrics and heterozygous for a '*B*' metacentric, both in addition to the invariable Cc^1c^2 complex, reveals a potential extending the diploid range to 34 (*2*). The lower limit, 28, is constant for both sexes of the California species *P. yosemite* Hopkins; the upper potential limit, 34, is restricted, so far as is known, to the eastern chromosomally monomorphic *P. strobi* Peck and to its western siblings or geographic races, *P. engelmanni* Hopkins and *P. sitchensis* Hopkins. Thus it is not immediately apparent whether the floating variants in *P. terminalis* are to be attributed to chromosomal polymorphism—the presence of structural rearrangements that originated within *P. terminalis* by chromosome mutation—or to introgressive hybridization between 28 and 34 chromosome-numbered species.

Two methods of approach to the problem suggested themselves. First, it was reasoned that if the system of permanently heterozygous males and permanently homozygous females could be synthesized by crossing a species with 28 chromosomes, namely *P. yosemite*, by one with 34 chromosomes, namely *P. strobi*, the "Gordian knot" would be effectively cut. Second, it seemed to us evident that if the unique sexual dichotomy of karyotypes could be perpetuated by crossing *P. terminalis*, as the male, to *P. yosemite*, as the female, this would constitute compelling evidence, if not rigorous proof, of the hybrid nature of *P. terminalis*, and, furthermore, would implicate *P. yosemite* in its origin. Both crosses were successful (*5*), but since the former requires the breeding of further generations, the F_1 being of necessity heterozygous for all three metacentrics, the following discussion is restricted to the latter cross.

Adults of *P. yosemite* were reared out of ponderosa pine root collars received from California (*6*) and *P. terminalis* adults out of jack pine terminal shoots shipped from Saskatchewan. The cytological constitution of males is readily and accurately determinable at first metaphase of meiosis.