whose sera showed evidence of antibody to HeLa extract, 75 percent were from patients with known metastatic disease. The titers observed (1:10 to 1:80) were of the same order as those found by Aizawa and Southam (*7*) following implantation of viable cell lines derived from tumor tissue.

A total of 13 freshly excised human tumors of various origin and six adult normal human tissues including one each of liver, spleen, kidney, brain, skin, and muscle have been treated with Genetron as described. Protein material remained in all of the extracts from tumor but not in those from normal tissue. These proteins were serologically distinct from normal tissue, but were serologically interrelated.

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Possible Transpacific Contact on the Coast of Ecuador

Abstract. The earliest pottery-producing culture on the coast of Ecuador, the Valdivia culture, shows many striking similarities in decoration and vessel shape to pottery of eastern Asia. In Japan, resemblances are closest to the Middle Jomon period. Both early Valdivia and Middle Jomon are dated between 2000 and 3000 B.C. A transpacific contact from Asia to Ecuador during this time is postulated.

The earliest phase of the Valdivia culture, discovered on the coast of Ecuador in 1956, is dated by carbon-14 at 4450 ± 200 years ago (U.S. Geological Survey sample No. W-631), making it one of the earliest dated occurrences of pottery in the New World (*1*). The technical and artistic level of Valdivia pottery is too high, however, for it to represent a local invention of pottery making. An explanation for this anachronism has been suggested by new material recently recovered from large-scale excavations in the deepest portion of the Valdivia site.

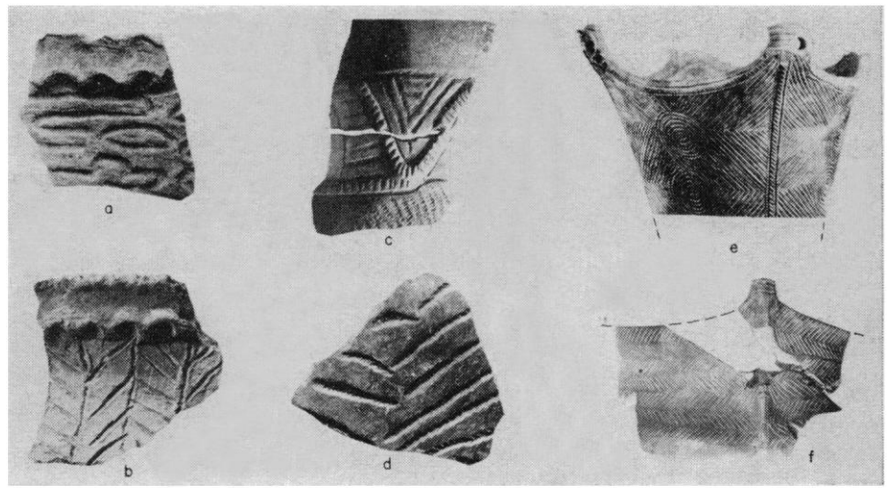

Fig. 1. Examples of resemblances between Jomon (*a, c, e*) and early Valdivia (*b, d, f*) pottery in form and decoration. *a–b*, Folded-over and finger-pressed rim; *c–d*, "braid" impression; *e–f*, castellations on rim and zig-zag arrangement of incised lines. Provenience: *a*, Iwasake type, Kyushu, Middle Jomon (*2*); *c*, Katuzaka type, Honshu, Middle Jomon (*3*); *e*, Horinouchi shell-mound, Chiba, Late Jomon (*4*); *b, d, f*, Valdivia site, Guayas Province, Ecuador.

The basic Valdivia cultural complex is part of an early shellfish-gathering subsistence pattern represented by sites along the Pacific coast of the New World from California to Chile. Shell fishhooks and crudely chipped stone tools are characteristic artifacts. Pottery making, and perhaps other cultural traits, was introduced into this horizon on the coast of Ecuador, and characteristics of vessel shape and decoration suggest that the introduction came from Asia across the Pacific Ocean.

Preliminary comparative analysis shows the following features shared by early Valdivia pottery and that of the Middle to Late Jomon period of Japan, also dated between about 3000 and 2000 B.C.: folded-over rims with finger-pressed edge (Fig. 1, *a–b*); "braid" impression (Fig. 1, *c–d*); castellated rims (Fig. 1, *e–f*); zoned punctation; incised lines embellished with nicks; shell stamping in rows; small rectanguloid areas with a central punctate; crude anthropomorphic faces on rim exterior of open bowls; finger-made grooves; incisions in zig-zag, crosshatch, and zoned parallel line patterns; undulating rims bordered by an incised line on the exterior; alternating incised lines and rows of punctates; small trianguloid excised areas incorporated into incised designs; ornamental unsmoothed coils; three parallel incised lines partly obliterated by later surface smoothing along the rim interior; red slipped surfaces; and small tetrapod supports.

Nonceramic traits found in early Valdivia culture include stone mortars, shell bracelets, and small stone figurines. Except for the figurines, these also occur in Middle Jomon, but it cannot yet be determined whether such similarities are traceable to the generalized ancestral shellfish-gathering complex from which both Valdivia and Jomon are derived, or to direct contact.

A transpacific introduction rather than a land route is postulated on several grounds: (i) the absence of any similar pottery complex on the Pacific coast of Central and North America, the expected route of a migrant people living on shellfish; (ii) the closeness of the similarities, which imply a direct and firsthand contact; and (iii) the location of Ecuador with respect to two major ocean currents. One is the Equatorial Counter Current, flowing from the Caroline Islands eastward just north of the equator; the other is the Japan or Black Current flowing from Japan toward the British Columbia coast, where it divides into the Alaska and California currents.

The latter current flows southward along the coast of Mexico and Cen-

tral America. During the first four months of the year, another current begins at Panama, where the Equatorial Counter Current and the California Current meet, and flows south toward the Ecuadorian coast, where it merges with the westward-flowing Humboldt Current. If these currents have not changed their paths markedly in the past 5000 years, they would have brought a drifting vessel almost inevitably to the part of the Ecuadorian coast where the Valdivia culture appears.

Whether the influence originated in Japan or on the Asiatic mainland is still questionable. While the resemblances to Middle Jomon are numerous, many Valdivia features are duplicated in pottery of continental eastern Asia, by which Jomon was also influenced. Further field work in Ecuador and more extensive consultation with experts on Asiatic archeology are being undertaken in an effort to delimit the place of origin more specifically than can now be done.

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2 June 1961

Retinal Cholinesterase and Glycolysis in Rats Raised in Darkness

Abstract. Rats that are raised in the dark from birth to 17 weeks of age have significantly lower acetylcholinesterase activities in the retina than control rats raised under standard conditions. Pseudocholinesterase and the glycolytic enzymes are not affected.

Raising animals in the dark provides an experimental situation for an investigation of cytological and biochemical correlates of visual deprivation. Riesen (*1*) has reported loss of retinal ganglion cells in chimpanzees raised in darkness for over 1 year. Cats show no cell losses but do have narrowed inner plexiform layers after they are deprived of light for 3 months to 3 years. No cytological changes have been described for rabbits reared to maturity in the dark (*2*). The decreasing cytological sensitivity of an animal to visual deprivation as the phylogenetic scale is descended requires the use of sensitive biological measures to detect the effects of raising lower mammals in the dark.

This is a report on the effect of long-term light deprivation on the cholinesterase and glycolytic activities of rat retina. These biochemical parameters were chosen because of their important roles in retinal function.

Transmission of nerve impulses in the retina may involve the acetylcholine-cholinesterase system (*3*). The retina contains both acetylcholine and its synthesizing enzyme, cholineacetylase. A high concentration of cholinesterase occurs in the vertebrate retina where it is located primarily in the inner plexiform layer among the synapses connecting the bipolar and ganglion cells.

Glycolysis is required for normal visual function. Injection of iodoacetate, a potent inhibitor of glycolysis, into a rabbit, produces a complete loss of the electroretinogram and selective destruction of rod and cone cells (*4*). Neonatal rats and rabbits show a sudden increase in glycolytic activity as their eyes open and the retina begins to function (*5*).

Twenty age-matched rats of the S-3 Tryon strain were used in the experiment. Ten of these rats were raised in the normal light-and-dark conditions of the animal room while the other ten were put into the dark with their mothers at age 3 days (before their eyes opened). At 17 weeks of age, the rats were killed and their retinas were quickly removed. For the cholinesterase experiments, 28 retinas (from seven dark-raised and seven normally raised rats) were weighed and individually homogenized in 0.1*M* phosphate buffer (*p*H 8.0); 1 ml of buffer was used for each 8 mg of tissue. Cholinesterase assays were performed by the method of Ellman *et al.* (*6*) with acetylthiocholine and butyrylthiocholine used to determine total cholinesterase (that is, acetylcholinesterase plus pseudocholinesterase) activity and pseudocholinesterase activity, respectively. Glycolytic experiments were performed with six retinas each from the dark-raised and normally raised groups. Single, whole retinas were incubated in 2 ml of Krebs-Ringer phosphate buffer with glucose (20 mmole) for 1 hour at 37°C. Lactic-acid production was determined by the Barker and Summerson technique (*7*) and is expressed on a dry-weight basis.

Table 1. Total cholinesterase, pseudocholinesterase and glycolytic activities in retinas from dark-raised and normally raised rats (mean plus or minus standard error of the mean).

Total cholinesterase activity*	Pseudocholinesterase activity†	Glycolytic activity‡
	Dark-raised rats	
88.8 ± 2.1	3.6 ± 0.7	1.25 ± 0.12
	Normally raised rats	
108.7 ± 5.0§	4.5 ± 0.6	1.29 ± 0.07

*Moles of acetylthiocholine hydrolyzed per minute per milligram (wet weight) × 10^{10}. †Moles of butyrylthiocholine hydrolyzed per minute per milligram (wet weight) × 10^{10}. ‡Micromoles of lactic acid formed per hour per milligram (dry weight). §$p < .01$.

The retinal cholinesterase and glycolytic activities of dark-raised and normally raised rats are shown in Table 1. No difference in glycolysis between the two groups was found. This indicates that the glycolytic process, necessary for normal visual function, is not influenced by lowered retinal excitation. Total cholinesterase activity in retina of dark-raised rats is 19 percent lower than that in retina of normally raised rats ($p < .01$). The activity measured represents both acetylcholinesterase and pseudocholinesterase, but in the retina more than 95 percent of the total activity is made up by acetylcholinesterase (see Table 1). Since pseudocholinesterase activity does not differ between the two groups, the lower total activity in the retina of dark-raised rats must be the result of an effect on acetylcholinesterase, the enzyme intimately involved in nerve transmission.

Animals raised in the dark have less visual stimulation than their normally raised counterparts. Presumably this lower level of stimulation results in less acetylcholine being released in the retina. Chang *et al.* have reported lower levels of acetylcholine in the retina of a dog who had one eye blindfolded for 30 weeks (*8*). If the synthesis and maintenance of acetylcholinesterase are dependent upon the level of acetylcholine, then the lower acetylcholinesterase activity found in the retina of dark-raised rats would be explained. There is evidence that supports the hypothesis that acetylcholinesterase activity is directly related to the amount of acetylcholine present. For example, Burkhalter *et al.* (*9*) have shown that