unhydrolyzed sea water samples supports this inference.

We are checking the ligand-exchange properties of a wide number of organic constituents. These include amines, phenols, the bases of the purines and pyrimidines, hydrocarbons, sugars, peptides, and humic acids. In addition to copper-Chelex resins, we have prepared other metal resins as mentioned. All exhibit different ligand sorption characteristics; iron resins, for example, only retain the acidic and hydrophobic amino acids, but leave the others unaffected.

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4. Metal ions in the wash water were determined with KCNS for Fe^{3+}, eriochrome black T for Zn^{2+}, and pyrocatechol violet for Cu^{2+} and Ni^{2+}. In some cases the wash required up to 60 liters of distilled water.
5. The slight elution of copper from the resin by 3.0*M* NH_4OH occurs only after the passage of a strong electrolyte solution through the column. It does not occur after passage of distilled water through the column, for example. This copper interference is now eliminated by the introduction of a Chelex column (NH_4^+ form) immediately after the copper column during the ammonia elution. The copper is caught on the NH_4–Chelex resin, and the amino acids continue on, eluted by more ammonia. This use of a Chelex column to retain the copper eliminates the necessity for the use of the HCl. The ammonia eluent is evaporated in a vacuum, and the amino acids are taken up in citrate buffer.
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Thiosemicarbazide Injection Followed by Electric Shock Increases Resistance to Stress in Rats

Abstract. *Adult rats that had been raised with a minimum of stimulation were injected with thiosemicarbazide, a drug that lowers γ-aminobutyric acid concentrations. Fifteen minutes later the animals were given 30 mild electric shocks over a half-hour period. Two weeks later they were tested for their resistance to gastric ulceration induced by immobilization. The experimental animals showed a much greater resistance to stress than did the appropriate control groups. A replication confirmed the results of the first study.*

The fact that stimulation in infancy can reduce emotionality and physiological response to stress in the adult animal is well documented (*1*). Although many such studies have examined the stimulus conditions that are optimal for producing the effect, the underlying physiological mechanism has received little direct attention beyond Bovard's theoretical discussion (*2*). A clue to this mechanism was suggested during discussion of a Macy Symposium paper on biochemical maturation by Roberts (*3*). He had noted that the concentrations of γ-aminobutyric acid (GABA) and the enzyme involved in its synthesis, glutamic acid decarboxylase (GAD), were very low immediately after birth but rose to approximately adult values after several days; the exact time varied with the species. These time periods proved quite similar to those observed as critical periods for the establishment of imprinting; the same periods seem to define the developmental state during which the early stimulation manipulations have maximum effect.

Although there seems to be some question regarding identification of GABA as the inhibitory synaptic transmitter, substance I, it is generally agreed that GABA does inhibit activity of cells within the central nervous system. A period during which GABA is at relatively low concentrations, therefore, should be a period of reduced threshold for activation of the neural systems that are normally inhibited by GABA. If those systems in turn are normally implicated in the control of emotional responsiveness and of resistance to stress, they may be permanently and positively conditioned by stimulation during the critical period when threshold is low.

Table 1. Number of gastric ulcers in each rat, injected or uninjected (with or without subsequent shocking), after subjection to immobilization stress. TSC, thiosemicarbazide.

Injected with TSC		Not injected	
Shock	No shock	Shock	No shock
Experiment			
1	4	9	7
1	4	3	4
0	3	3	3
0	2	2	2
0	1	0	1
0	0	0	1
0	0	0	1
0	0	0	0
0			
0			
Replication			
0	3	6	6
0	2	4	4
0	1	1	3
0	1	1	0
0	1	1	0
0	1	1	0
	0	0	0
	0	0	0
		0	

Direct substantiation of the hypothesis relating the GABA system to the phenomenon of early stimulation would require demonstration that the phenomenon does not result from stimulation during the critical period if GABA and GAD concentrations are raised to adult levels immediately at birth; and, conversely, that the critical stimulation period can be prolonged by concomitant prolongation of the period during which GABA and GAD are at low concentrations. Technical problems associated with biochemical manipulations in the newborn that do not induce experimentally confounding stimulation so far preclude this direct approach. As a first approximation, however, an alternative test of the hypothesis was made by examining the resistance to stress of adult animals that had been raised with a minimum of stimulation and then stimulated during a period when GABA concentrations were reduced by injection of thiosemicarbazide, which reduces concentrations in the central nervous system by blocking synthesis of pyridoxal phosphate, the cofactor necessary for the normal function of GAD in the synthesis of GABA (*3*).

The first experiment used, in groups balanced as to sex, 34 albino rats derived from the Berkeley-Pacific strain but born and raised in our laboratory; 31 similar rats were used for subsequent replication. The rats were raised

in an air-conditioned room separate from the main rat colony. Extraneous auditory stimuli were minimized and light-darkness cycles were controlled by a time clock. After weaning at 21 days of age the animals were transferred to individual cages and were not handled again before the experimental manipulations.

The experimental treatment used a two-by-two factorial design, with thiosemicarbazide and shock stimulation as the two variables; thus there were four groups: drug–shock, drug–no shock, no drug–shock, and no drug–no shock. At 60 days of age the animals were randomly assigned to the experimental groups. The two drug groups were injected intraperitoneally with 2.0 mg of thiosemicarbazide per kilogram of body weight. Fifteen minutes later, rats in the drug-shock group received a shock session consisting of 30 shocks presented randomly during 30 minutes; each shock was of 0.6 ma for 0.75 second, delivered through the floor rods of the shocking box by a shock scrambler. Rats in the no drug–shock group underwent similar shocking. Fourteen days later all animals were subjected to immobilization stress by being taped firmly to a board for 48 hours without food or water; all were then killed and their stomachs were examined for ulcers.

It is clear from the data from experiment and replicate (Table 1) that the combination of thiosemicarbazide and shock stimulation very markedly increased resistance to stress; this effect is clearly produced by the combination and not to any extent by either treatment alone. If one considers only the number of animals in the groups showing any ulcers at all, the drug-stimulation group differed from the control groups at the 1-percent level by a chi-square test. There were no differences according to sex.

These studies support the hypothesis that stimulation at a time when concentrations of GABA and GAD are low (as in early infancy) produces prolonged increase in resistance to stress. The question of whether the phenomena observed were in fact mediated by the GABA system, however, requires more careful determination of the biochemical effects of thiosemicarbazide and much more selective manipulation of the enzyme systems concerned. The relevance of our data to the early stimulation phenomena is only inferential. The data per se are clearly of interest, however, as demonstrations of effective manipulation of the stress-resistance mechanism in the adult animal. The effectiveness of this procedure in modifying measures of emotionality other than resistance to stress-induced gastric ulceration remains to be determined.

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Zoological Classification System of a Primitive People

Abstract. *The Fore people of the New Guinea Highlands classify all animals in one of nine higher categories ("tábe aké"), and these are further subdivided into lower categories ("ámana aké"). There are 182 lower categories for vertebrates alone. The nearly one-to-one correspondence between Fore ámana aké and species as recognized by European taxonomists reflects the objective reality of the gaps separating sympatric species. In 90 percent of the cases, when a species of animal unknown to the Fore is presented for naming, it is called by the name of the Fore species considered its closest relative by zoologists. The origin of Fore classification is probably utilitarian.*

Observers have frequently remarked on the ability of primitive peoples to distinguish and to name many of the plants and animals in their environment. If one is to obtain more than a list of *nomina nuda* in a foreign language, analysis of a non-European classificatory system requires identification of the species named in order to provide an adequate basis for comparison with European scientific classification. A zoological expedition sent to the Eastern Highlands of New Guinea in 1965 to collect vertebrates and to conduct field observations for the American Museum of Natural History provided a favorable opportunity for studying the remarkably detailed classificatory systems evolved by several groups of Highland natives. This report deals with the Fore language group, whose members live near Okapa Patrol Post, 64 km southeast of Goroka, and who were brought under government control in the 1950's. They are best known for a unique degenerative disease of the central nervous system, kuru, which is still incurable, is virtually restricted to the Fore, and is responsible for up to half of their deaths (*1*). While a large part of their diet consists of cultivated vegetables (mainly sweet potatoes) supplemented occasionally by domesticated pigs, the Fore still utilize wild plants and animals extensively for food as well as for decoration and materials. Berndt (*2*) describes aspects of Fore culture. Since there is some variation in animal names from village to village, this discussion will be confined to results obtained from the inhabitants of one North Fore village, Awande (elevation, 1915 m).

Three methods were used to study Fore zoological classification. (i) Upon arrival at Awande, I asked individual Fore men to describe and name all the animals with which they were acquainted. Many of the resulting descriptions were sufficiently detailed that a zoologist acquainted with the fauna of New Guinea could recognize the identity of the species in question. (ii) After the collection of specimens had begun, individual men were brought to the collecting table and asked to name all the specimens and to provide information about habits and voice. (iii) While taking censuses of wildlife and making field observations in the jungle, I took men with me and had them name species we encountered and the bird songs we heard. In this way, descriptions of 192 kinds of animals and a list of 188 Fore names were obtained. The scientific identity of these animals was eventually determined by comparison with specimens in the American Museum of Natural History and the Harvard Museum of Comparative Zoology. While no attempt was made to obtain individual plant or invertebrate names, the list of Fore names for vertebrates should be nearly complete. With respect to birds, the group which I studied most intensively, I feel confident that there is no bird occurring regularly at Awande for which the Fore do not have a name.

The Fore classificatory system was