captured while it was attached to a floating siphonophore, *Velella*. E. L. Nakamura (*8*) in 1952 captured three small female argonauts, each of which was attached to the exumbrella of a medusa (*Pelagia placenta* Haeckel) which was drifting near the surface of the water. Bruun *et al.* (*9*) reported similar observations from the Indian Ocean. These reports suggest that pelagic octopods of the families Tremoctopodidae and Argonautidae are not strong swimmers and rest by attaching themselves to buoyant coelenterates. Such close association might lead to immunity from the coelenterate toxin and to the acquisition of the tentacle fragments by *Tremoctopus*. No coelenterate fragments were found, however, on a number of argonauts which were examined.

The behavior of holding *Physalia* fragments has been observed only in young *Tremoctopus*, and it is not known whether it persists in the adult. Voss (*10*) has stated that *T. violaceus* may exceed 5 feet in total length and in his collection he has (*11*) a preserved 4-foot egg-bearing female. These reports of large-sized specimens indicate that a female of 72 mm total length is almost certainly immature. Two immature males, 30 mm in total length, with the hectocotylized arm still within a sac, are in the collection of the Biological Laboratory, Honolulu, and each is carrying *Physalia* fragments on its dorsal arms.

Various other marine animals are known to employ coelenterates or their stinging cells as defensive weapons. Among these are hermit crabs; brachyuran crabs, which carry an anemone in each cheliped; and flatworms and nudibranchs, which carry coelenterate nematocysts in their dorsal filaments. *Tremoctopus* appears to be unique in its use of such potent tissue as the nematocysts of *Physalia* and, if my hypothesis is correct, in employing such tissue as an offensive as well as defensive weapon. It is perhaps unique also in its use of only parts of coelenterates as weapons. This may imply an ability to determine when replacement is necessary.

EVERET C. JONES
U.S. Bureau of Commercial Fisheries, Biological Laboratory, Honolulu, Hawaii

References

1. H. Troschel, *Arch. Naturgesch.* **32**, No. 1, 41 (1857); L. Joubin, *Ann. Inst. Oceanogr. Paris* **7**, Fasc. 1 (1929).
2. A. Naef, *Fauna e Flora del Golfo di Napoli, 35 Monogr. 1 Th., Bd. 1, lief. 2* (1923).
3. E. D. Wangersky and C. E. Lane, *Nature* **185**, 330 (1960).
4. C. L. Hubbs and R. L. Wisner, *Calif. Fish Game* **39**, 127 (1953).
5. K. Kato, *Proc. Imp. Acad. Tokyo* **9** (1933).
6. S. S. Berry, *Bull. U.S. Bur. Fish.* **32**, 282, Figs. 8 and 9 (1912).
7. P. A. Zahl, *Natl. Geograph.* **101**, 185 (1952).
8. E. L. Nakamura, personal communication.
9. A. F. Bruun *et al.* Eds., *The Galathea Deep Sea Expedition, 1950–1952.* (Macmillan, New York, 1956).
10. G. L. Voss, *Bull. Marine Sci. Gulf Caribbean* **6**, 85 (1956).
11. ———, personal communication.

19 November 1962

Racial Differences in Skin Resistance

Abstract. *In two laboratories utilizing different age subjects and recording techniques, Negro subjects had higher skin resistance than a comparable white population. There was no difference in other autonomic variables or autonomic reactivity. Reasons for this racial difference may offer a better physiological explanation for galvanic skin resistance.*

In the course of investigating other problems, we noted, separately, that the basal skin resistance of Negro subjects is uniformly higher than that of comparable white subjects. Though a much younger sample was studied in St. Louis, and different type electrodes, electrode paste, and electrode placements were employed, the consistency of the results obtained in the two laboratories suggested that a more detailed analysis of possible racial difference should be made and a joint report submitted. The results from the St. Louis study are presented first.

One hundred seventy-four children (65 white boys, 22 Negro boys, 55 white girls, 32 Negro girls) between the ages of 83 and 92 months of age (most within 1 month of their seventh birthday) from the 7-year anoxia follow-up study were used (*1*). Each child was brought into the laboratory and asked to rest in bed. Recording electrodes were attached to the first and third fingers of the right hand. These electrodes were made of zinc, approximately 15 mm in diameter, backed with dental cement, and were taped over corn pads filled with zinc sulfate electrode jelly. This method was adapted from one recommended by Lykken (*2*). The recorder utilized a Wheatstone bridge with 50-μa current supplied through the electrode. The output of the bridge was recorded on a Grass polygraph.

Levels of skin resistance were taken at the end of each 2 minutes during a 10-minute resting period. The average of the five measures taken during the resting period is the measure used in this analysis.

The mean and standard deviations of the resting resistance levels are presented in Table 1. Test for significance was by analysis of variance. The F ratio for race was 34.26, df = 1/170, $P < .001$; for sex the F was 5.51, df = 1/170, significant at the .025 level. The race by sex interaction was not significant.

In San Diego, 42 subjects (16 Negro men, 5 Negro women, mean age 23.05; 16 white men, 5 white women, mean age 22.90) were examined. The white subjects were selected to be comparable in age to the Negro subjects. The age range was from 18 to 39.

All variables were recorded simultaneously on a 12-channel Offner Type R Dynograph at a paper speed of 25 mm/sec. The equipment was instrumented for the recording of six channels of the electroencephalographic trace (EEG), one channel each of heart rate, respiration rate, skin and room temperatures, and skin resistance. Skin and room temperatures were recorded on the same channel. The remaining two channels were used for recording stimulus onset and subject response.

The EEG, galvanic skin response (GSR), skin temperature and respiration instrumentation and recording procedures were similar to those used and reported in detail by Wenger (*3*) and Johnson (*4*). Zinc electrodes, 2 cm in diameter, encased in a plastic cup, were used for GSR. Palm-to-palm recordings were made and contact with the skin was made with an agar zinc sulfate electrode paste. A current of 40 μa was impressed through the electrodes. The gain of the Wheatstone bridge was calibrated so that 1 mm equaled a 1000-ohm resistance change.

Resting skin resistance, EEG amplitude, heart rate, respiration rate, and skin temperature were recorded after a 15-minute pre-experimental period. Spontaneous GSR activity was measured over a 10-minute period at the beginning of the record. A spontaneous GSR response was recorded if a 1-mm,

Table 1. Skin resistance values for white and negro children in the St. Louis study. Numbers are average resistance values in kilo-ohms.

Whites		Negroes	
Male (N, 65)	Female (N, 55)	Male (N, 22)	Female (N, 32)
Mean			
170.75	168.94	210.09	309.93
Standard deviation			
67.15	67.66	111.79	60.72

1000-ohm deflection was noted which was not associated with a demonstrable external stimulus.

The EEG amplitude was the average of the height of the waves measured from the left parieto-occipital lead at each 1-second interval for 10 seconds of artifact-free record. Resting heart rate was based on the average of the five fastest beats in a 10-second interval. The same 10-second interval was used to obtain skin resistance, skin temperature, and respiration, the average time (peak to peak) of three respiratory cycles. The section for analysis was selected from a stable, artifact-free, 5-minute period of the record.

Autonomic reactivity was the change in skin resistance, heart rate, respiration, and skin temperatures produced by the unexpected sounding of a door bell buzzer located behind the subject. The buzzer was on for 5 seconds.

As in the St. Louis study, there was a significant difference in skin resistance, $t = 6.21$, $p < .001$, between the Negro and white subjects. The mean resistance level for the white subjects was 171,000 ohms compared with 373,000 for the Negro subjects. Only three of the Negroes had skin resistance below 200,000 ohms while 14 of the white subjects had resistances below 200,000 ohms. Sixteen of the Negroes, in contrast to no white subject, had resistance above 400,000. Nine of the Negro subjects had resistances above the 500,000 ohms limit of the scale and their basal resistance level is unknown. There was no significant difference in EEG amplitude, heart rate, respiration rate, skin temperature, spontaneous GSR activity, diastolic and systolic blood pressure, and manifest anxiety. There was likewise no difference between the two groups with respect to autonomic reactivity, including GSR, to the buzzer. The mean ohm decrease to stimuli was 30,000 ohms for Negro subjects and 28,000 ohms for white subjects. As there was a difference in prestimulus level, percentage change scores were also computed. The mean percentage change was 11 for the Negro subjects and 15 for the white subjects. The difference between percentages was not significant for this sample. Six Negro subjects' resistance was beyond the limits of the scale and if a response was present it could not be measured.

The finding of high skin resistance in the 7-year-old Negroes casts doubt on the possibility that the high skin resistance in the adult Negro is due to different life and work experiences. Difference in psychological or situational anxiety also does not appear to be significant. In the San Diego sample there was no difference on the manifest anxiety scale nor did the two groups differ on any of the other autonomic variables, especially EEG amplitude, which is often used as a measure of arousal or activation. Skin color per se likewise does not appear to be the important factor. The melanin-producing cells, which give the darker skin color, are located in the basal layers of the epidermis, stratum malpighii, and not in the stratum corneum where 80 percent of the skin resistance is supposed to be.

Two other possibilities exist. The thicker stratum corneum of the Negro may be the determining factor or there may be a possible difference in number of active eccrine sweat glands. These possible explanations are currently under investigation in a collaborative study with the Dermatology Service of the Naval Hospital.

These results indicate that race must also be included in the growing list of variables that determine the value of skin resistance. That this variable has not been reported to date is surprising but may be due in part to the fact that most GSR research has been done in our predominantly white college campus laboratories.

Whether difference in skin resistance will be present in other racial groups is not known. Data from nine subjects of Mexican or Spanish parents in the San Diego study, however, had a mean resting resistance of 271,000 ohms, which is higher than that of the white subjects but lower than that of the Negro subjects. Robert Malmo (personal communication) in scanning some recent data, noted that skin resistances of certain dark-skinned subjects (for example, subjects from India) were very high relative to those of the white subjects in his experiment. Further study of skin resistance in other races certainly seems warranted (*5*).

LAVERNE C. JOHNSON
Navy Medical Neuropsychiatric Research Unit, San Diego, California
NORMAN L. CORAH
Washington University School of Medicine, St. Louis, Missouri

References and Notes

1. Effects of perinatal anoxia 7 years after birth. This work was supported by National Institute of Mental Health grant No. B-2449. Principal investigators: E. J. Anthony and J. A. Stern (1960–1962).
2. D. T. Lykken, *J. Comp. Physiol. Psychol.* **52**, 629 (1959).
3. M. A. Wenger, B. T. Engle, T. L. Clemens, *Behav. Sci.* **2**, 216 (1957).
4. L. C. Johnson, *USN Med. NP Res. Unit San Diego, Rept 62-6*, (1962).
5. The San Diego study was done at the U.S. Naval Hospital, San Diego, and was supported by the Bureau of Medicine and Surgery under research task MR 005-12-2304. We appreciate the assistance of John A. Stern in expediting the joint submission of these two studies.

2 November 1962

Somatic Instability Caused by a Cysteine-Sensitive Gene in Arabidopsis

Abstract. *A recessive gene immutans* (im) *is responsible for abnormal chloroplast development which results in variegation in* Arabidopsis *plants. Somatic mutability is simulated, though only functional disorder is involved. Cysteine and low temperature favor normal function, while homocysteine interferes with chloroplast development without producing an adverse effect on the growth of the mutant.*

Among the numerous x-ray induced variegation mutants in the mouseear-cress, *Arabidopsis,* was found, immutans (im) which has a phenotype not unlike those known to be controlled by unstable genes in other species (*1*). The mosaic patterns produced in the plants by this mutant range from nearly *albina* with widely scattered small specks of green to a condition in which the reverse situation prevails (Fig. 1). In the white tissues the chloroplasts fail to develop normally and their growth is arrested before differentiation is completed.

The mutant is temperature sensitive. If the plants are cultured on a glucose-agar mineral medium (*2*) at a constant temperature between 20° and 25°C with continuous illumination the cotyledons are either green or variegated and the rosette leaves exhibit relatively few,