Rabbits injected with homologous rabbit ribosomes developed similar hematological, pathological, and serological changes after the 69th day. Rabbits given serum from these animals demonstrated the same phenomena as the recipients of anti-rat ribosome serum.

Tolerance should have been acquired by these animals to antigens of ribosomes, erythrocytes, leukocytes, and serum proteins. All of them are constantly present in large amounts and are available to immunologically competent cells and they can not therefore be classified as foreign antigens. These results therefore seem to warrant the claim of having achieved true autoimmunization. Reproduction of similar pathology in animals receiving serum or gamma globulin fractions containing autoantibodies provided evidence of a causal role for the circulating antibodies.

Antibodies for ribosomes, yeast, soluble RNA (*10*), and ribosomal protein (*11*) were demonstrable in anti ribosome serum and by skin tests. A relationship between antibodies for ribosomes, soluble RNA, and autoantibodies was shown by absorption. Inhibition tests indicated their specificity was for nucleotides, nucleosides, and bases, suggested that the mechanism of this autoimmunization involved these structures. Support for this theory was obtained from preliminary results with rabbits injected with soluble RNA in adjuvant, who developed practically all the aspects of animals immunized with ribosomes, while animals injected with ribosomal protein had few of the changes, and their sera reacted minimally with ribosomes. Rat liver nuclei stimulated production of antibodies to nuclei but no autoimmunization. Autoimmune human disease may possibly represent a response to nucleotides and nucleosides of viral or bacterial nucleic acids or to nucleic acids released from tissue under conditions, which perhaps like adjuvant, allow preservation of these configurations as antigens (*12*).

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References and Notes

1. S. Raffel, *Immunity* (Appleton-Century-Crofts, New York, 1961), p. 555.
2. B. Waksman, *Intern. Arch. Allergy Appl. Immunol.* **14** (Suppl.), 1 (1959).
3. F. M. Burnet, *Science* **133**, 307 (1961).
4. R. E. Billingham, L. Brent, P. B. Medawar, *Nature* **172**, 603 (1953); L. D. Felton, G. Kauffmann, B. Prescott, B. Ottinger, *J. Immunol.* **74**, 17 (1955); M. W. Chase, *Proc. Soc. Exptl. Biol. Med.* **61**, 257 (1946).
5. Obtained from Dr. George C. Webster and Richard P. Sutter; see J. B. Lingrel and G. C. Webster, *Biochem. Biophys. Res. Commun.* **5**, 57 (1961).
6. The histological observations on the brains of the rabbits were made by Dr. Leopold Liss, departments of pathology and psychiatry, Ohio State University Medical School and Columbus Psychiatric Institute and Hospital.
7. A. B. Stavitsky and E. R. Arquilla, *J. Immunol.* **74**, 306 (1955).
8. H. E. Wilson, M. S. Rheins, S. A. Naegli, W. George, *J. Lab. Clin. Med.* **53**, 854 (1959).
9. Obtained from Pentex Inc., Kankakee, Ill.
10. R. Monier, M. L. Stephenson, P. C. Zamecnik, *Biochim. Biophys. Acta* **43**, 1 (1960).
11. R. P. Sutter, thesis, Ohio State University (1961).
12. Acknowledgment is made to Dr. Charlotte Winnemore, Columbus Red Cross Blood Donor Center for supplying the blood used in this work. This investigation was supported by grant E-1162 from the National Institute of Allergy and Infectious Diseases.

19 February 1962

Pigment Effector Cells in a Cnidarian

Abstract. Chromatophore complexes are described in the siphonophore *Nanomia cara*. The dispersion and concentration of pigment are related to variation in light intensity and do not appear to be endogenously influenced. The pigment, possibly an ommochrome, has an absorption maximum at 465 to 470 mμ.

Color change in animals is brought about by movement of pigment in specialized effector cells, the chromatophores. Five groups of animals, namely, echinoderms, annelids, mollusks, crustaceans, and vertebrates, are well known to possess this capacity (*1*); another case, generally overlooked, is that of certain Ctenophora (*2*). I am now able to report the occurrence of pigment effector cells in a member of the phylum Cnidaria, the siphonophore *Nanomia cara*.

Patches of pigment have often been described in physonectid siphonophores and in the case of *Nanomia* spp. the distribution of pigment is held to have taxonomic value (*3*). It has always been supposed that this pigment is immobile. Observations at the Friday Harbor Laboratories of the University of Washington in June 1961 showed, however, that the appearance of the patches changes in response to changes in light intensity (Fig. 1). During the day the pigment is dispersed and wide, often reticular, and patches of scarlet are visible to the naked eye; at night the pigment is concentrated into compact, plum-colored masses. A specimen with dispersed pigment, when placed in the dark, shows the fully concentrated condition within 45 minutes. Redispersion on exposure to subdued daylight takes place in about the same period. Strong light, such as the spot of a microscope lamp, brings about some degree of concentration. It is not known whether there is any form of endogenous control over the movement of pigment, but on various grounds this seems unlikely. Chromatophores kept in dim light, showing the partially dispersed condition, were exposed for 30 minutes to epinephrine (1 part in 10^5) and acetylcholine (1 part in 2×10^4), but no tendency to dispersion or concentration was detected in either case.

The patches vary in size. The small patches covering the male gonophores are probably single chromatophores. Larger patches such as those on either side of the velum in the nectophores are multicellular or syncytial complexes ("chromatosomes," *4*) representing up to 20 or 30 cells. The cells occupy an intraepithelial position within the ectoderm. Study of living material and of FWA-fixed ester-wax sections cut at 5 μ and stained with iron haematoxylin, reveals no cell membranes separating nuclei in the complex, but proof of syncytial organization will have to await studies with the electron microscope.

In color, the pigment resembles some carotenes and carotenoproteins but it

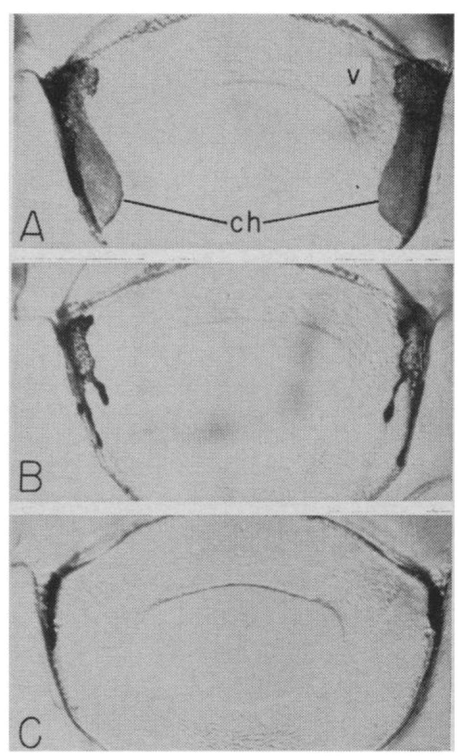

Fig. 1. Chromatophore complexes (*ch*) on either side of velum (*v*). *A*, pigment dispersed. *B*, same specimen, after 25 minutes in dark. *C*, another specimen, pigment fully concentrated.

is insoluble in lipid solvents, even after heat denaturation. It is extracted rapidly by $1N$.HCl, formic acid, and ammonia solutions down to 5 percent, but it is stable in neutral aqueous media with the exception of strong oxidizing and reducing agents, which cause fading. Generally, these reactions suggest an ommochrome or related substance (*5*). Tests on paraffin sections, however, show no redox-reversible color change such as the changes that characterize many (but not all) ommochromes. Fluorescence tests have not been carried out. The extract in HCl is stable and shows a single absorption maximum at 465 to 470 mμ. It may be noted that ommochromes occur in the eyes of planktonic crustacea on which *Nanomia* feeds. Orange-and-red pigment is often seen in food undergoing digestion and in waste matter ejected from the palpons, and it is possible that the pigment in the chromatophores is derived from that in the food.

The ecological significance of the chromatophores is uncertain. *Nanomia* is bioluminescent, and the regions emitting light are distributed in the nectophores and possibly elsewhere in a pattern resembling the color pattern by day. However, there is no evidence of functional connection between the two systems. It can be shown that *Nanomia* is phototropic, responding to light by swimming, but again the distribution of photosensitive areas involved in the swimming response does not follow chromatophore distribution. Whatever the significance of the color change itself, the distribution of the patches of pigment strongly suggests a form of disruptive coloration. When the chromatophores are dispersed the outline of the siphonophore is broken up into scattered pinpoints and patches of color, resembling a cloud of plankton. At night, the scattered sites of light emission give the same effect, at any rate to the human eye (*6*).

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References and Notes

1. J. A. C. Nicol, *The Biology of Marine Animals* (Pitman, London, 1960), chap. 12.
2. C. Chun, *Fauna Flora Golfes Neapel* **1**, 142 (1880).
3. A. K. Totton, *'Discovery' Rept.* **27**, 54 (1954).
4. G. H. Parker, *Animal Colour Changes and Their Neurohumours* (Cambridge Univ. Press, London, 1948), p. 4.
5. A. Butenandt, E. Bickert, H. Kübler, B. Linzen, *Z. Physiol. Chem.* **319**, 238 (1960).
6. I am grateful to Dr. Mary Griffiths for help with the absorption spectrophotometer and to Mrs. Margaret Connell for referring me to Chun's observation cited above (*2*).

20 April 1962

Bovine Thyroid Iodine-131 Concentrations Subsequent to Soviet Nuclear Weapon Tests

Abstract. The iodine-131 concentration in thyroids of cattle slaughtered in Reno, Nevada, was measured during and following recent atmospheric nuclear weapon tests by the U.S.S.R. The iodine-131 concentration rose rapidly to a maximum and then declined with an apparent half-life of 7 days after conclusion of the test series. The average dose to bovine thyroids from this test series was estimated to be 17 rads.

The accumulation of iodine-131 in the thyroid gland of domestic ruminants has been reported subsequent to previous atmospheric nuclear weapon tests (*1*) and nuclear reactor accidents (*2*). Van Middlesworth (*1*) has enumerated the unknown factors determining the maximum uptake of I^{131} by cattle thyroid glands subsequent to nuclear weapon tests. Because I^{131} has a relatively short half-life (8 days), an increase in concentration should indicate recent releases of fission products and interpretation should be uncomplicated by older fallout debris as are measurements of fission products of longer half-life. Although major emphasis has been on long-lived fallout contaminants such as strontium-90 and cesium-137, increased attention has recently been focused on short half-life fallout, particularly I^{131} (*3*).

For our study thyroid glands were removed at slaughter from cattle in a commercial meat packing plant (*4*). The only selection practiced was that we did not sample very young animals. Although individual animal histories were not obtained, it is estimated that at least 90 percent of the animals sampled spent the last 60 days within 100 miles of Reno, Nevada, and in the rain shadow of the Sierra Nevada mountains. Measurements of the I^{131} content of a 4.0 ± 0.1 g sample of thyroid tissue, dissected free of extraneous tissue, was made as previously described (*1, 5*). All samples were counted by use of two separate counting systems and the results were averaged. All samples collected on a given day (four to

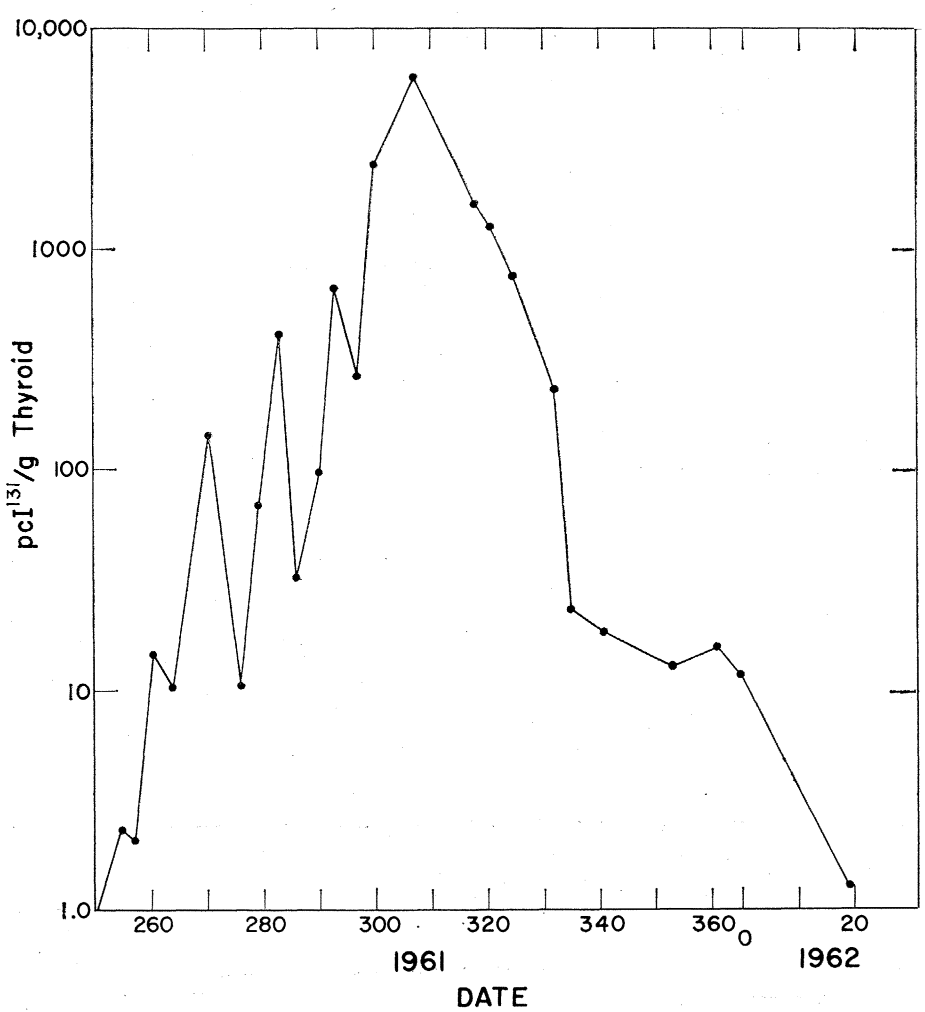

Fig. 1. Bovine thyroid I^{131} concentrations from 7 September 1961 to 20 January 1962 The date is indicated as the serially numbered day of the year.