to analyze but considerable fragmentation is likely. A consequence of a high relative velocity between large and small aggregates would be a tendency for the larger objects to sweep up the smaller fairly rapidly and to facilitate growth.

Small nonvolatile coagulates which formed in or moved into regions where much volatile matter condensed would have been trapped in a porous, snow-like mass. Such combinations of volatile and nonvolatile low-density aggregates would account for Whipple's icy conglomerate comet nucleus (*31*). For this reason cometary grains are probably representative of the primordial condensate (*32*).

When solar heating vaporizes the ices of the comet nucleus, single whiskers, small fluffy aggregates, and trapped spherulites are released. Because of their large surface to mass ratio the more whiskery particles would be more readily carried along by the cometary gases and would also undergo greater repulsion by radiation pressure than the spherical or equiaxial particles. The difference between head and tail particles, to which Swings (*33*) called attention, may be primarily in the shape of the grains. This could be tested by observation (*34*).

Aggregates containing many grains which are released by the vaporization of the comet nucleus would spread out along the comet orbit. They would have the porous, fragile structure ascribed to dust ball meteors associated with comets (*30*, chap. *9*; *35*; *36*).

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Antibody Production and Development of Contact Skin Sensitivity in Guinea Pigs of Various Ages

Abstract. *Young adult guinea pigs, 2 months old, showed higher serum antibody titers and greater contact skin sensitivity than those that had reached the average life-span of 2 to 3 years. A transitional response was given by 6-month-old animals.*

Limited information is available on the variation of the immunologic response with aging (*1–7*). In this study male guinea pigs of the inbred strain 13 (*8*), aged 2 months, 6 months, and 2 to 3 years were compared for ability to produce circulating antibody and to exhibit delayed contact sensitivity. Guinea pigs 2 months old may be considered young adults since they have just reached or shortly will reach sexual maturity, while those that are 2 to 3 years old have attained the average life-span of the species (*9*).

Where very large differences between experimental groups are not anticipated, it is helpful to eliminate or reduce to a minimum all factors except the variable under study. Strain 13 guinea pigs have been inbred for many generations and are histocompatible (*8*); therefore variation in response of the animals because of genetic differences is probably minimal. Constant environmental factors were maintained by identical housing and diet.

Animals were injected with a mixture of 6 mg of bovine γ-globulin, to induce circulating antibody, and 1.4 mg of synthetic pentadecylcatechol, one of the active components of poison ivy, to induce delayed contact sensitivity. The mixture was emulsified in complete Freund's adjuvant and injected three times at 6-day intervals. The first injection was administered into the nuchal area, the second into the inguinal-axillary region, and the third into the foot pads. Skin testing was performed by applying 5 μl of an acetone solution of the test compound onto the skin by the method of Dunn *et al.* (*10*). Serum antibody titers were determined by the tanned cell hemagglutination test (*11*) with sheep erythrocytes coated with bovine γ-globulin. Two groups were immunized and tested and the results from appropriate age groups were pooled. Larger numbers of the 2-month-old animals were used since they were more available than the other two age groups.

Table 1 shows the smallest quantity of pentadecylcatechol required to induce an observable skin reaction. All of the 2-month-old animals became sensitive and were the only ones to react to as little as 0.5 μg, while four of the 2- to 3-year-old group and two of the 6-month-old group failed to react. In calculating the probability (*12*) that the mean end points came

Table 1. Effect of age of the guinea pig on the degree of contact skin reactivity to pentadecylcatechol. The quantity of this compound in column 1 is the smallest amount that was effective. The mean end points (in micrograms) for the three age groups were: 2 mo, 1.1; 6 mo, 2.3; 2 to 3 yr, 2.7. Probabilities that mean end points are identical were: 2 mo vs. 6 mo, < 0.001; 2 mo vs. 2 to 3 yr, < 0.001; 6 mo vs. 2 to 3 yr = 0.22.

Pentadecylcatechol-reacting (μg)	No. of guinea pigs		
	2 mo	6 mo	2 to 3 yr
0.5	3	0	0
1.0	16	1	1
2.0	4	6	5
N*	0	2	4

* Negative: animals that showed no reaction at the 2-μg level. To calculate the mean end point this value was assumed to be 4 μg.

from a common population, it was found that the reactivity of the guinea pigs in the older age groups was not statistically different but that the animals of both these groups were significantly less reactive than the 2-month-old animals.

The antibody titers determined from the tanned cell agglutination test are presented in Table 2. The highest titers were found in the sera of 2- and 6-month-old animals, while the 2- to 3-year-old animals gave the lowest titers. Calculation revealed that the mean titers of the two younger groups of animals were probably not different, but that both are significantly different from those of the 2- to 3-year-old animals.

Thus, guinea pigs that are 2 to 3 years old show a lower immunological response to both delayed contact skin sensitivity and to antibody production than do 2-month-old guinea pigs. The 6-month-old animals appear to be transitional in reactivity and show a contact sensitivity similar to that of 2- to 3-year-old animals but give a serum antibody response similar to that of the 2-month-old animals.

Table 2. Effect of age of guinea pig on the titer of antibovine γ-globulin. Geometric mean titers for the three age groups were: 2 mo, 50,200; 6 mo, 54,800; 2 to 3 yr, 24,100. Probabilities that mean titers are identical (calculated from $\log_2$ of titer) were: 2 mo vs. 6 mo = 0.4; 2 mo vs. 2 to 3 yr, <0.001; 6 mo vs. 2 to 3 yr = 0.01.

Maximum serum titer $\times 10^3$*	No. of guinea pigs		
	2 mo	6 mo	2 to 3 yr
8	0	0	0
16	3	2	3
32	6	2	5
64	10	2	1
128	4	2	0
256	0	1	0

* Titers are the reciprocal of the serum dilution.

Other workers (*1–7*) have also observed that old humans and old animals respond to an immunologic stimulus, but the limited data seem to show no unanimity relative to the effect of advancing age. For example, Thomsen (*5*) observed that the injection of horse serum resulted in a reduced anaphylactic sensitivity in old guinea pigs compared with sensitivity in young adults, and Baumgartner (*6*) found that rabbits over 2 years of age produced a lower agglutinin titer to *Bacillus enteritidis* than 6- to 13-month-old animals. However, the response to typhoid vaccine in humans did not differ in individuals 15 to 78 years of age (*7*), and the antibody response in chickens (*4*) did not seem to be affected by age. These results may be due to the different species, but it has been suggested (*4*) that one of the most important variables is the genetic constitution. That the genetic make-up of animals may, in fact, markedly affect antibody response is known (*13*).

In our study, the effects of environment, sex, and genetic constitution have been largely eliminated and the age of the animals, therefore, was the main variable. Whether the results have general application cannot be unequivocally established. However, strain 13 guinea pigs are immunologically competent and have been used by others to study delayed hypersensitivity to tuberculin (*14*) and circulating antibody (*15*). P. R. B. McMaster found no difference in the antibody response of strain 13 and Hartley guinea pigs to thyroglobulin (*16*). Furthermore, the degree of sensitivity to pentadecylcatechol, as measured by the minimal quantity inducing a reaction on the skin, is approximately the same in 2- to 4-month-old Hartley strain guinea pigs (*17*) as in the strain 13 animals reported here.

Little can be said about the reason for the reduced response of old animals. However, there is some evidence that the antibody-producing tissue of old animals does not function as effectively as in younger animals (*3*). Furthermore, it was our impression that after the injection of antigen in adjuvant, the lymph nodes of the 2-month-old guinea pigs showed a much greater enlargement than those of the 2- to 3-year-old animals (*18*).

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Growth-Regulating Chemicals Persist in Plants: Qualitative Bioassay

Abstract. *Scions from untreated tomato plants were grafted on plants treated with 2,4-dichlorophenoxyacetic acid by dipping one leaf in a solution containing 1000 parts per million. Subsequent malformations of the scion shoot and leaves were used as criteria of the presence of this chemical. The chemical or a substance causing similar symptoms persisted in the plant in physiologically active amounts for approximately 60 days.*

The literature concerning the length of time for which 2,4-dichlorophenoxyacetic acid (2, 4-D) may exert morphological effects in plants is very extensive (*1*). The bulk of the evidence indicates that morphological irregularities or distortions in response to the treatment are usually all established within a few days after the application of the chemical (*2*).

On the other hand, morphological irregularities which are brought about in buds may not become evident as long as a year after the application (*3*). Morphological irregularities in the