viduals fared. In making significance tests, I adhered to the probabilities given in Kendall's tables. Small N's do, however, make for easier acceptance of the null hypothesis.

3) The host of correlational studies on mental defectives, superior children and adults, and other groups more or less homogeneous must bear the same criticism. IQ's in my study running from somewhat below average to very superior seem to me to cover a rather wide range. Nevertheless, McNemar is right; restrictions of range may limit correlation.

4) It was a search of the literature that prompted me to make my study and submit it for publication. Among 235 items in one of several bibliographies I have available on the subject, only seven are truly relevant items (*2–8*). In the more extended report from which my *Science* article was abstracted, I stated that the significant correlation between the Binet and Goodenough was to be expected (*9–11*). Wallin (*12*) and Hamilton (*13*) had group comparisons similar to many in the literature. Cohen and Collier (*14*) I overlooked for some reason; I am sorry, for their work is closest to mine in several ways. Manolakes and Sheldon (*5*) likewise used two of the tests I employed, but their restriction of possible IQ's (which they carefully pointed out) tended in the opposite direction from mine, that is, toward maximizing correlation. In my search of the literature, however, I found many studies but few that evidenced interest in the individual *qua* individual.

The differences among an individual's IQ's may be wide; if the correlational results of my study are accepted, such differences may be significant. I did not intend to make a contribution to the problem of the "constancy of the IQ," although I sincerely thought that I was making a contribution in terms of different IQ's for the same person. The lack of comparability of IQ's is sad for any one person. With nearly all of my counselees, however, I employ at least two intelligence tests, primarily as a measure of some of their capacities against the background of the standardizing group in each case.

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16 August 1954.

Serial Cultivation of Normal Human Embryonic Cells Directly on Glass*

Normal human cells from the tissues and organs of a 3½-mo old fetus, obtained at sterilization by total hysterectomy of a psychopathic patient, have been successfully adapted to a glass surface without clot. Three of the cell strains have yielded a tenfold increase in cell count every 5 to 6 days and have undergone 10 transfers.

Clot cultures of skin, muscle, spinal cord, thymus, lung, kidney, spleen, and placenta were prepared in Carrel flasks. The fresh tissue was cut into 1-mm cubes and imbedded in 0.5 ml of chick plasma and 1.0 ml of the culture medium, composed of 40 percent human cord serum, 8 percent chick embryonic extract (diluted 1:1 with Tyrode's solution), 5 percent saline containing 50 units of penicillin and 50 μg of streptomycin per milliliter, and 47 percent Tyrode's solution. An additional milliliter of the culture medium was introduced after clotting had occurred. Proliferation of all cell strains permitted subculturing at 3-wk intervals, and the outgrowth was reimbedded in plasma clots.

Adaptation to a glass surface was accomplished at 9 wk. Two cultures of each of the cell strains were removed from the Carrel flasks, and the dense outgrowth of new cells was dissected from the central tissue mass and from the surrounding clot. These cell fringes (three from each flask) were placed in a 15-ml centrifuge tube with 5 ml of a 0.25 percent trypsin-Tyrode's solution. The tissue was broken up by pipetting and incubating at 37°C for 5 hr. This treatment allowed complete digestion of the clot and liberation of the cells as a suspension. The trypsin-Tyrode's solution was removed after low-speed centrifugation for 5 min. The cells were washed twice with Tyrode's solution, centrifuged again, suspended in 2 ml of the culture medium, and transferred to duplicate Carrel flasks for each cell strain. No cell count was made at this first transfer. The remaining two cultures of each strain were subcultured and imbedded in plasma clots as controls.

The cells adhered to the glass within 24 hr. The original inoculum was heavy, which necessitated the first transfer at 3 days. The trypsin-Tyrode's solution was used to remove the cells from the glass surface of the flask. Digestion of necrotic material and liberation of the cells as a suspension were accomplished after ½ hr of incubation, and the cells were again washed and transferred as described in the preceding paragraph. At this stage, and subsequently, growth was estimated by counting the cells in a hemocytometer chamber. Growth was very rapid in three of the cell strains, and transfers were made every 4 to 5 days with an approximate tenfold increase in cell count each period. The plasma-clot cultures of the same strains doubled in radial outgrowth in 2 to 3 wk. The five remaining cell strains showed a great variation in the rate of growth on the glass surface. Transfers have

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been made to larger flasks and have shown a cell increase similar to that in Carrel flasks.

This method of adaptation of cell growth to a glass surface has been successfully repeated on additional clot cultures of the same embryonic tissue as well as on normal human adult tissue, previously cultured for 2½ yr in clots. Studies are in progress on cell differentiation, histology, nutrition, and chemical analysis of the cells.

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Electron Microscope Observations of the Formation of Aluminum Phosphate Crystals with Kaolinite as the Source of Aluminum

In connection with phosphate fixation by soil minerals, it has been shown that phosphate treatment diminishes the kaolinite x-ray diffraction pattern (*1*) and that various aluminum phosphates are the end-products of phosphate-induced kaolinite decomposition (*2*).

By means of the electron microscope, we have observed the progressive formation of aluminum phosphate crystals concurrent with the decomposition of crystals of kaolinite suspended in various phosphate solutions (*3*). In the potassium phosphate system, x-ray diffraction analysis revealed the presence of a compound identical to one shown by analysis (*4*) to be $KOH(Al)_2(PO_4)_2 \cdot 1.7H_2O$, which is similar to minyulite. In the sodium system, x-ray diffraction analysis revealed the presence of a compound identical to product 12 of Haseman *et al.* (*2*) shown by analysis to be $H_{1.7}Na_{1.2}Al_{2.0}Fe_{0.004}(PO_4)_3 \cdot 2.7H_2O$, which is similar to taranakite.

The kaolinite employed was the material passing a 2-mm sieve from our standard W1176 obtained from the McNamee Mine, near Langley, S. C. A 0.1-g sample was treated with about 15 ml of 1.0*M* KH_2PO_4 (*p*H 4.3) and another with 1.0*M* NaH_2PO_4 (*p*H 4.3). In order to hasten the reactions, the samples were placed on a steam hot plate at a temperature of about 90°C.

At time intervals indicated in Figs. 1 and 2 (and oftener), each sample was washed five times with distilled water by the centrifuge method, and then a portion of the sample was removed for electron microscope examination. The remainder of the sample was treated with a fresh phosphate solution of the same composition as before. When electron microscope observations indicated that all of the original kaolinite had been transformed into the new crystalline (phosphate) phase, the samples were again washed five times with distilled water and once with acetone, dried, and x-rayed by the powder method.

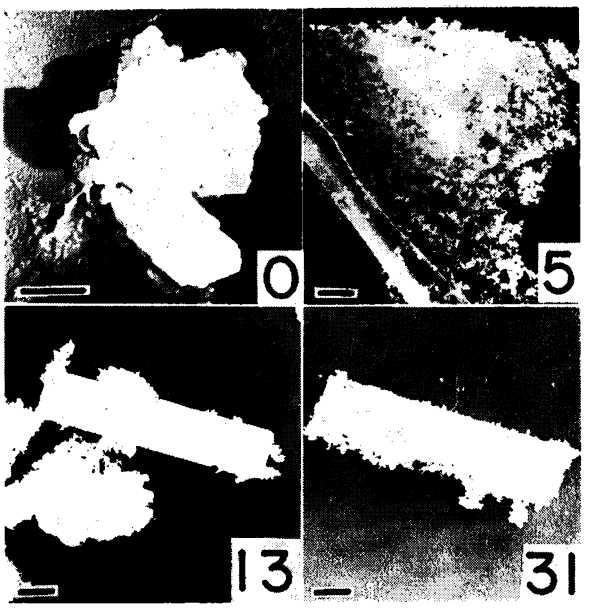

Fig. 1. Electron micrographs of kaolinite treated at 90°C with 1.0*M* KH_2PO_4 at *p*H 4.3 for 0, 5, 13, and 31 days at the end of which minyulite-like crystals had formed as determined by x-ray diffraction (*7*). Line indicates 1μ.

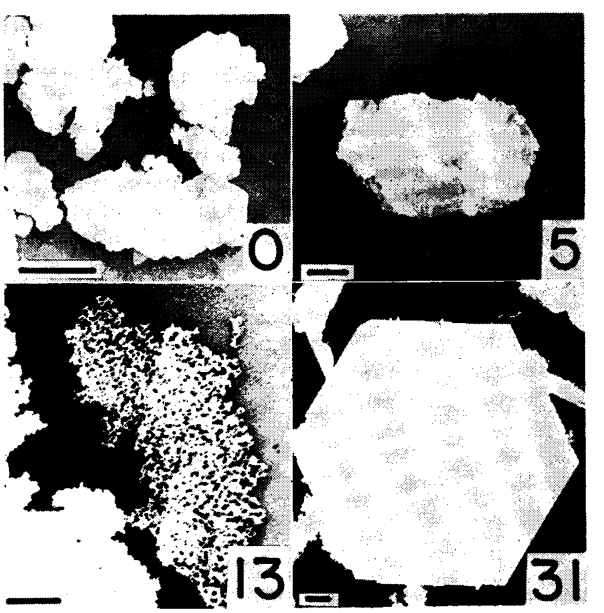

Fig. 2. Electron micrographs of kaolinite treated at 90°C with 1.0*M* NaH_2PO_4 at *p*H 4.3 for 0, 5, 13, and 31 days at the end of which taranakite-like crystals had formed as determined by x-ray diffraction (*7*). Line indicates 1μ.

By use of the electron microscope, we were able to observe the gradual dissolution of the original kaolinite crystals (left at first as a fleecy residue) concurrent with the progressive formation of the new phosphate phase (Figs. 1 and 2). One might think that the large hexagonal crystal in Fig. 2, 31 days, is