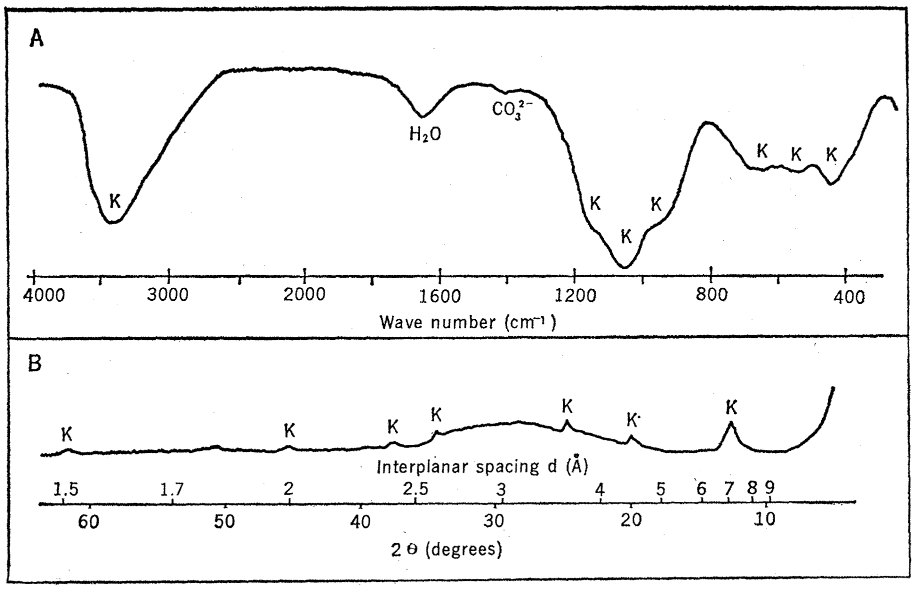

Fig. 2. (A) Infrared spectrum and (B) x-ray diffraction pattern of a synthetic koalinite ($pH = 7$ and SiO_2/Al_2O_3 ratio in solution = 2).

Al_2O_3. Gibbsite has been synthesized previously only in alkaline solution (*7*) or in dialyzed media (*2*). However, geological and pedological observations are in accordance with our results (*8*).

As an intermediate product of kaolinite formation, bayerite was also synthesized at an acid *p*H. Bayerite is known to form at $pH = 10$ according to the Bayer procedure (*2, 9*).

Finally, at ratios of SiO_2 to Al_2O_3 from 1 to 10 we have synthesized a prekaolinite. Although the product is not well crystallized because its aging period was only 1 month, the x-ray diffraction pattern and infrared spectrum show its existence (Fig. 2).

The results emphasize the possible importance of the acids from the organic matter of the soil in the removal of aluminum. The mobilization process in soil formation called "cheluviation" (*10*) is well known. The organic acids aid in promoting silicate hydrolysis by the formation of soluble complexes, mainly with aluminum. As an example, we know that this process occurs in the genesis of podzols; the eluvial horizon is impoverished in Al_2O_3, and at the end of the evolution a pure silica residue remains. The aluminum organic complex can migrate to the B horizon and then under acid conditions kaolinite and gibbsite are formed.

Let us now consider the aluminum hexacoordination problem. The reported experimental results show clearly that the presence of aluminum in a fulvic acid complex is essential to the formation of the aluminous octahedral layer in sixfold coordination. This previous hexacoordination makes possible an easy synthesis of kaolinite and gibbsite. The crystalline structure of gibbsite is composed of oxygen in hexagonal close packing with aluminum located in the holes (only two out of three available positions). This gibbsitic structural layer is necessary to the formation of kaolinite because it unites with a tetrahedral layer of silica.

On this basis a mechanism for the process of kaolinite formation can be suggested. When the *p*H of the ternary system consisting of $Si(OH)_4$, the aluminum–fulvic acid complex, and H_2O in acid medium is changed, colloidal aluminum hydroxide begins to precipitate slowly. This hydroxide may be formed by a competitive reaction among the organic ligands and the hydroxyl ions leading to a pregibbsitic structure; later, by a surface reaction, monomeric silica can be adsorbed. In this way, a tetrahedral layer of silica is "soldered" over an octahedral layer of aluminum, with the result that a 1 : 1 clay mineral, kaolinite, is formed. This proposed mechanism is in accordance with the ideas of DeKimpe and his co-workers (*1*), of Caillere and Henin (*11*), and of Gastuche and his co-workers (*2*) about the role of the octahedral layer in the formation of clay minerals.

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Maize from an Adena Mound in Athens County, Ohio

Abstract. *The discovery of a carbonized ear of maize in an Adena burial mound at Athens, Athens County, Ohio, is the first indisputable evidence of Adena maize horticulture. The mound contained typical middle Adena features, including a bark prepared burial, and has yielded charcoal radiocarbon dated at 280 B.C. ± 140 years.*

Salvage excavation of two Early Woodland burial mounds on a hilltop at the south edge of the city of Athens, Athens County, Ohio, has produced the first indisputable evidence of maize in an Adena component. The smaller mound, Daines Mound 1, was completely excavated during the summers of 1964 and 1965. Daines Mound 1 yielded an assemblage of typical Adena material, none of which was suitable for radiocarbon dating.

Excavation of the larger mound, Daines 2, was begun in 1965. A carbonized ear of maize was discovered here (Fig. 1). The specimen lay on the unprepared mound floor, 5 feet from the northern edge of the excavation. Most of the remaining portion of mound 2 was excavated during the summer of 1966, in an attempt to establish its age. Significant traits uncovered, which identify the site as middle Adena, are the presence of a prepared clay base and a bark-covered extended burial. The few flint artifacts recovered are all from the mound fill, mostly Archaic point types but including one ovate base Adena stemmed point.

Charcoal taken from the mound floor was radiocarbon dated at 280 B.C. ± 140 years (*1*), which accords well with the archeological evidence available from the excavation.

The ear of maize from Daines Mound 2 is a small, ten-rowed ear of "Tropical Flint," still partly enclosed in the inner husk. The ear greatly resembles Tropical Flint maize available from Hopewellian sites in the eastern United States (*2*). The earliest known occurrence of such Hopewellian maize is that from the Newman site, Moultrie County, Illinois, dated at 50 B.C. ± 140 and 80 B.C. ± 140 years (*3*). Reports of maize from Kentucky rock shelters have been dismissed as possible occurrences of Adena maize because the finds have been limited to the upper levels of the sites, which represent later, younger components (*4*).

Dragoo (*5*) observed that as yet no maize had been discovered in unquestionable association with an Adena

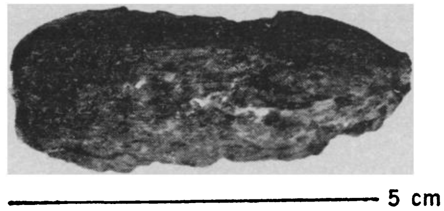

Fig. 1. Ear of "Tropical Flint" maize from base of Daines Mound 2, Athens, Athens County, Ohio (Photo courtesy of H. C. Cutler and L. W. Blake).

component. The presence of maize at Daines Mound 2 indicates that maize agriculture was present in the Adena phase, though this unique occurrence allows no conclusions regarding the extent and importance of maize within Adena.

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3 December 1970

Ribosomal RNA Synthesis and the Multiple, Atypical Nucleoli in Cleaving Embryos

Abstract. *The rate of ribosomal RNA synthesis per nucleus in cleaving sea urchin embryos is similar to the rate at later embryonic stages. The multiple, atypical nucleoli, present in early embryos and usually attributed to decreased ribosomal RNA synthesis, are beginning stages of nucleolar formation. Full nucleolar development requires more time than the brief interphase of the rapidly dividing cells.*

It has been reported that synthesis of ribosomal RNA (rRNA) cannot be detected until the end of blastula stages of sea urchin, amphibian, and certain other embryos; this suggests that rRNA synthesis is decreased or repressed during early stages of development in these embryos (*1*). We have discovered that DNA-like RNA accumulates so much more extensively in early sea urchin embryos than in late embryos that newly synthesized rRNA would not have been detected even if synthesis of rRNA were occurring in early embryos at the rate per nucleus observed in late embryos (*2*). We now report experiments designed to detect and measure the rRNA synthesized during cleavage and to clarify the nature of the atypical nucleoli (*3*) previously thought to be related to a repression of rRNA synthesis during cleavage.

The rate of synthesis of rRNA was measured during cleavage in *Strongylocentrotus purpuratus* embryos that had been incubated at 18°C from 2 to 12 hours of development [from first cleavage until the beginning of blastula stage (*2*)] with either [^{32}P]phosphate or [^{3}H]adenosine to label their RNA. The ^{3}H- and ^{32}P-labeled RNA's were purified by phenol extraction (*2*) and centrifuged separately on sucrose gradients (Fig. 1). The radioactive RNA had the expected heterogeneous size distribution, with no peaks of radioactivity associated with the optical density peaks of 18*S* and 28*S* ribosomal RNA. The radioactive RNA from the embryos incubated with [^{3}H]adenosine was used to measure the absolute amounts of RNA synthesized because the specific activity of the ribose adenosine triphosphate (ATP) precursor pool could be determined by the very sensitive luciferase assay (*2, 4*). The RNA labeled with ^{32}P was processed to purify the rRNA because the distinctive base composition of rRNA could be used to determine the amount of radioactive rRNA in the purified preparation.

The average specific radioactivity of the ribose ATP pool during the period of incubation with [^{3}H]adenosine was measured as described (*2, 4*) and was 1.60×10^{14} count/min per mole of ATP. If rRNA was synthesized at 8×10^{-16} g/hour per nucleus, the rate measured in pluteus (*2*), the amount of ^{3}H radioactivity that would have been incorporated into 28*S* ribosomal RNA could be calculated from this specific activity of the ATP. This amount of ^{3}H is plotted as a small hatched area in Fig. 1 and would account for 6 percent of the radioactivity in the fractions at the peak of 28*S* rRNA optical density. This much radioactivity in the rRNA of the embryos labeled with ^{32}P would amount to 94 count/min of ^{32}P per microgram of total rRNA.

The amount of ^{32}P really incorporated into 28*S* rRNA was measured by purifying the small amount of radioactive rRNA from the radioactive DNA-like RNA in the peak of 28*S* ribosomal rRNA. A methylated albumin kieselguhr (MAK) column eluted with a very shallow salt gradient separates rRNA from DNA-like RNA if the RNA's are approximately the same size (*2*). The RNA from a single fraction of a sucrose gradient is similar in size. When run on the MAK column, most of the radioactivity in the 28*S* RNA fractions from the sucrose gradient eluted after