Reports and Letters

Correlation of Major Vegetation Climaxes with Soil Characteristics in the Sonoran Desert

Soil characteristics determined from samples taken over a 14-mile transect of desert vegetation in southern Arizona have yielded highly significant differences associated with two distinctly different climax vegetation types. The transect is in the Basin and Range Physiographic Province of the inland Southwest and is over alluvial land, a soil taxonomic unit that in this case refers to the unconsolidated alluvium of a desert climate. This type of alluvium, known as fanglomerate, characterizes most of the soils of the Sonoran Desert.

The transect is located on the western slope of the Tucson Mountains, a low desert range west of Tucson, and the adjacent Avra Valley, from approximately 3400- to 2000-feet elevation. The soil samples analyzed were taken to a depth of 3 feet from 16 soil-sample stations along the transect. Since this type of desert alluvium is generally deep and shows little or no profile development, samples were arbitrarily drawn at 6-inch intervals to indicate any specific soil property to a much greater depth than 3 feet.

The lighter and more rocky soil of the higher slopes supports the relatively complex Paloverde-Sahuaro (*Cercidium-Cereus, 1*) vegetation type, whereas the finer soil of the lower slopes and valley supports the relatively simple Creosotebush-Bur Sage (*Larrea-Franseria, 1*) association. These are the two major climax vegetation types of the Sonoran Desert in Arizona, the Paloverde-Sahuaro association constituting a distinct *tree* climax and the Creosotebush-Bur Sage association forming a characteristic *shrub* climax. The *same* macroclimate exists for both climax vegetation types.

A broad ecotone extends along the lower western slope of the Tucson Mountains and the adjacent Avra Valley, varying locally in elevation from approximately 2800 to 2200 feet. The difference in slope of less than 4 degrees between the upper portion of the transect and its lower end is insufficient, as is the elevational difference, to constitute a causal factor in the given vegetational difference.

Standard determinations were made for soil texture (mechanical analysis), moisture equivalent, moisture content, capillary rise, dispersion rate, and salinity. Wilting coefficients were determined by the indirect method of Briggs and Shantz (*2*), inasmuch as the soil samples are variants within a closely related soil group. Results are given in Table 1 for moisture equivalent, wilting coefficient, and moisture content. It is observed that highly significant differences obtain for soil characteristics associated with the two different major vegetation types.

The differences between these soils in pertinent physical and physiological characteristics, such as moisture equivalent and wilting coefficient, are attributable to the significant difference in the texture of these soils. Available soil moisture during the critical dry seasons determines the occurrence of one vegetation type over the other. This is best expressed by the wilting coefficient. The less colloidal, more sandy, and more rocky soil supporting the *Cercidium-Cereus* association has a wilting coefficient of approximately one-half that of the finer soil of the *Larrea-Franseria* association, whereas the values in moisture equivalent and moisture content for the latter are twice those of the former. This means that with a value of 50 percent less total soil moisture, twice the amount of soil moisture is available for plant use in the Paloverde-Sahuaro association than is available in the Creosotebush-Bur Sage association. Intermediate values in these and other soil properties obtain for the broad area of ecotone where one distinct vegetation type first merges and then gives way to the other.

In summary, from analysis of pertinent soil characteristics and their correlation with climax vegetation types of the Sonoran Desert, it is concluded that here specifically different soil attributes characterize, and are intimately associated with, distinctly different and major climax vegetation types existing under the same macroclimate.

Table 1. Statistical comparison of soil characteristics of the two major climax vegetation types of the Sonoran Desert in Arizona.

Soil characteristic	N	*Larrea-Franseria*	N	*Cercidium-Cereus*	*t*	*P*
Moisture equivalent (%)	24	12.2 ± 0.61	24	6.6 ± 0.14	8.9	< .001
Wilting coefficient (%)	24	6.6 ± 0.33	24	3.6 ± 0.08	8.8	< .001
Moisture content* (%)						
Wet (approx. field capacity), summer rainfall season, July	12	9.1 ± 0.90	12	5.5 ± 0.16	7.3	< .001
Dry, postsummer rainfall season, December	12	3.4 ± 0.41	12	1.4 ± 0.09	4.6	< .001

* Moisture content here refers to the amount of water present in a given soil at a given time determined on the basis of a percentage of the oven-dry weight of a given sample at 105°C. For valid comparative purposes, samples were taken simultaneously at different soil stations.

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References and Notes

1. *Cercidium microphyllum-Cereus gigantea* and *Larrea tridentata-Franseria dumosa*, respectively.
2. L. J. Briggs and H. L. Shantz, *Bot. Gazette* 53, 25 (1912).

16 September 1955

Detection of Sex of Fetuses by the Incidence of Sex Chromatin Body in Nuclei of Cells in Amniotic Fluid

Identification of genetic sex on the basis of the incidence of the sex chromatin body observed in the nuclei of oral mucosa smears has recently been described (*1*). The technical concept appears to be directly applicable to the cellular debris in amniotic fluid. Since all such cells are of fetal origin, and since the sex chromatin body incidence is independent of the hormonal milieu (*1, 2*), it should be possible, therefore, to establish the genetic sex of the fetus *in utero* by this method. This has been done.

Amniotic fluid has been obtained from pregnant women by direct aspiration of the amniotic sac with a needle and syringe. This fluid is centrifuged, and the sediment is spread on a slide treated with egg albumen. The slide is immersed at once in equal parts of 95-percent ethyl alcohol and ethyl ether for 2 to 24 hours.

The fixed smears are passed through 70-percent and 50-percent ethyl alcohol

and distilled water for 5 minutes each. They are then stained for 8 minutes in 1-percent cresyl echt violet (*3*) (British Drug House) and are differentiated in 95-percent ethyl alcohol for 3 to 5 seconds. The stained smears are rinsed in absolute ethyl alcohol until nuclear detail is clear on examination under the high dry objective of the microscope. They are then mounted in Permount.

The mounted smears are studied under the oil-immersion objective of the microscope. The sex of the newborn infant has been established on the basis of external physical examination.

Many of the nuclei in amniotic fluid debris are not suitable for identification of the sex chromatin body. Some are markedly pyknotic, while other take the stain poorly or are badly fragmented. White blood cells may also appear in the fluid obtained from patients in labor.

The incidences stated in Table 1 are based only on examination of well-stained healthy nuclei that are assumed to be desquamated from the amnion, skin, or mucosae of the fetus. Such a nucleus with a sex chromatin body is shown in Fig. 1.

Observer 1 counted 100 nuclei in each instance. Observer 2, who studied some of the smears counted by observer 1, counted 50 nuclei. Neither observer knew the sex of the infant or the other observer's results at the time the counting was done.

It will be noted that there is no overlap between the maximum counts on male fetuses and the minimum on females. The means are separated by a gap 4 to 5 times the mean for male fetuses; and the extremes, by a gap 2 to 3 times the male fetus mean. Since there are no erroneous identifications of anatomic sex in the group, these observations are overwhelmingly significant.

The amniotic fluid was obtained at or near full term, with the exception of one instance of fetal death *in utero* of unknown etiology at 32 weeks. The incidence of nuclear pyknosis was increased in this case, but a sufficient number of satisfactorily stained nuclei were found nevertheless.

One smear not included in Table 1 requires comment. It was prepared from amniotic fluid obtained at cesarean section in a patient who was fully dilated

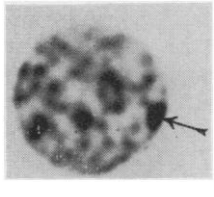

Fig. 1. Nucleus of a cell in a stained smear of amniotic fluid debris (×3300). The arrow points to the sex chromatin body along the nuclear membrane.

Table 1. Incidence of sex chromatin body in amniotic fluid cell nuclei.

	Observer 1			*Observer 2*		
	No.	Range (%)	Mean (%)	No.	Range (%)	Mean (%)
Males	14	6–17	10	6	6–22	13
Females	16	49–71	59	6	42–70	54

with ruptured membranes and a fecal fistula in the vaginal vault. The fluid was grossly contaminated with maternal feces. The smear includes many polymorphonuclear leukocytes and unstained digested vegetable matter. It was originally counted by observer 1 as having 54 percent of nuclei with the sex chromatin body and later by observer 2 as 22 percent. A third observer found a count of 20 percent. The fetus was a male. The count by observer 1 was made at 2 A.M.

Decisions on which nucleus to count and which to ignore in these amniotic fluid smears will vary from time to time, from observer to observer, and will depend in part on the quality of the stained smear and the density of the cell populations. In the present study, frequent consultation between observers on the appearance of individual nuclei served to limit the range of these variables, but the operation of chance produced some variation between two counts on the same smear (*4*). It is, therefore, not to be expected that repetition of these observations by others will produce results of an identical order of magnitude. The counts obtained on oral mucosa by Marberger *et al.* have lower means but the same wide separation between the means without overlap (*1*). The likelihood of finding a count on a genetic male that even approaches the lowest count on a genetic female is virtually nil by either method, provided that the absolute size of the counts is determined by conditions held constant for any group of counts made.

That the smears must be obtained and read for this purpose under ideal conditions is emphasized by the exceptional case cited in a foregoing paragraph. The unusual amount of debris of maternal origin in this amniotic fluid with a fecal fistula and late labor with ruptured membranes resulted in a smear that was misread by a fatigued observer.

It has been assumed that the infants identified as female after birth do not include any instances of gonadal agenesis who might be genetic males.

The techniques of exfoliative cytology have been applied to the determination of genetic sex of the fetus *in utero* by the incidence of the sex chromatin body in the cellular debris of amniotic fluid.

The mean incidence of this body in the nuclei found in the fluid of female fetuses is several times that found in male fetuses, and the minimum incidence in females in this series is approximately twice the maximum incidence among male fetuses. There are no erroneous determinations. This result is highly significant.

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References and Notes

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2. M. L. Barr, *Anat. Record* 121, 387 (1955); K. L. Moore, M. A. Graham, M. L. Barr, *Surgery Gynecol. Obstet.* **96**, 641 (1953); *Anat. Record* 121, 422 (1955).
3. M. L. Barr and E. G. Bertram, *Nature* **163**, 676 (1949).
4. E. G. Bertram, instructor in anatomy at Marquette University School of Medicine, provided valuable advice in the technique of staining these smears.

28 December 1955

Reagent for Differentiation of 1,4- and 1,6-Linked Glucosaccharides

Buchan and Savage have employed a mixture of aniline, diphenylamine, and phosphoric acid as a spray reagent for the detection and estimation of sugars on paper chromatograms (*1*). In applying this reagent to characterize the end products of enzymic degradation of starchlike substrates, we have observed variations in the color of oligosaccharide spots on paper chromatograms. Further investigation with known 1,4- and 1,6-linked glucosaccharides (*2*) revealed that these differences correlated to a certain extent with variations in the structure of these compounds.

Those saccharides in which the carbon-4 hydroxyl proximal to the reducing end of the molecule was combined in glucosyl linkage yielded blue to purple colors, whereas those saccharides in which this hydroxyl was uncombined yielded slate, green, or yellow spots, depending on the concentration of the substance per unit area of the paper chromatogram (Table 1). Aso and Yamauchi (*3*) have recently observed independently that the color of the reaction products of other