important byproduct of the clay conversion. Goethite and limonite form concretions, hardpan, and pervasive mottling and coloration in most exposures of Citronelle and in many other surface clays. In the Citronelle Formation at Mascotte and throughout the Bone Valley Formation this iron comes from weathered clays. Initially the green clay becomes mottled by red specks which are seen under the electron microscope to be goethite needles of sub-micron size within montmorillonite aggregates. As kaolinization advances the goethite pervades the rock. Subsequent bleaching and reconcentration along fractures and plant root zones obscure the origin of goethite. Its relation to clay weathering, however, is evident during initial alteration (Fig. 2). Chemical analyses (Table 1) show that the ferric-rich clay of the region is a sufficient source of all the secondary iron. Perhaps much of the unfossiliferous red and orange, kaolinitic Citronelle and mineralogically similar latosols throughout Florida and adjacent states may have originated by weathering of marine montmorillonitic sediments.

The widespread conversion of montmorillonite to kaolinite has important geomorphic consequences. This process of supergene groundwater leaching initiates the breakdown and removal of clay (*11*). The loss of much silica and some montmorillonite considerably increases the porosity and permeability of the clayey quartz sands, an effect abetted by the cementing action of new crystal formation and by loss of swelling property. Additional void space develops by groundwater translocation of clay, a process manifest in the secondary films of kaolinite (clay cutans) which line fractures and floor cavities (*6, 12*) throughout the weathered section. The mutually enhancing effects of clay degradation and clay translocation in the mature soil zone eventually remove the intergranular clay to create a residual quartz-sand mantle (*11*) which has been interpreted as a marine Pleistocene terrace in many areas. Where montmorillonite is still present high in the section the loose sand mantle is thin (*13*).

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## Rhinoviruses: A Description

This paper was drawn up at the request of the Virus Subcommittee of the International Committee on the Nomenclature of Bacteria and Viruses in order to clarify its decision that certain viruses recently isolated from colds and similar diseases in man should be gathered into a subgroup of the picornaviruses to be called rhinoviruses.

The name rhinovirus will include certain viruses which are similar to but distinct from enteroviruses and which form a subgroup of the picornaviruses, already defined by the International Committee. The rhinoviruses have previously been called by their discoverers and others, coryzaviruses (*1*), enterovirus-like viruses (*2*), ERC viruses (*3*), muriviruses (*4*), rhinoviruses (*5*), and Salisbury strains (*6*). The first one to be isolated (*7*) was classified as ECHO 28 (*8*).

Estimates of the particle diameter have been obtained by ultrafiltration and vary from 15 to 30 m$\mu$ (*3, 9, 10*). The shape and subunit structure are under investigation.

Analysis of purified virus has not been reported, but the apparent hydrated density is about 1.3 (*9*) which suggests that the infectious particle is nucleoprotein; multiplication of many strains is not inhibited by 5-fluorodeoxyuridine which inhibits the synthesis of DNA; infectious RNA has been extracted from one strain (*3*).

Virus survives storage for weeks at 4°C and indefinitely at −70°C. Strains remain infectious after being frozen and dried.

All strains are ether-stable, but completely or almost completely inactivated by holding at *p*H 5 or 3 for a period of 1 to 3 hours (*3, 9, 11, 12*). They are generally more stable at 50°C than are enteroviruses and are partially or, in some hands, completely stabilized by 1*M* $MgCl_2$.

Either of the following tests will demonstrate that a rhinovirus is acid-labile. (i) Virus in tissue culture fluid is mixed with an equal volume of 0.1*M* sodium citrate–citric acid buffer *p*H 4, and another portion is mixed with the same volume of 0.1*M* sodium phosphate buffer *p*H 7. The mixtures are held at 37°C for 1 hour, diluted with an equal volume of 0.5*M* phosphate buffer *p*H 7.2, and then diluted 1:5 or more in medium and titrated for infectivity. (ii) In an alternate procedure virus in tissue culture fluid is mixed with nine volumes of Eagle's medium without sodium bicarbonate (final *p*H 3.0) and another portion is mixed with nine volumes of Eagle's medium prepared with 0.01*M* tris buffer (final *p*H 7.2 to 7.4). The mixtures are held at 20° to 25°C for 3 hours and then titrated for infectivity.

The lowest dilution of virus held at an acid *p*H should not infect any culture, whereas a dilution of the control virus suspension at least ten-fold higher than this should infect all cultures inoculated. Thus, when calculated by the method of Reed and Muench (*13*) a hundred fold or greater reduction in titer is observed.

The published results of tests with human and animal sera indicate that there are many serotypes, apparently over 30 (*3, 10, 11, 14*). In order to confirm these results and to establish agreed prototypes the International Reference Laboratories are preparing antisera in goats with viruses purified by limit dilution or by picking plaques (*15*). These antisera will be tested

with prototype enteroviruses as well as the rhinoviruses under study. Until these sera are available and tested, responsible investigators may obtain ampoules containing the viruses (frozen and dried) under study from either the Common Cold Research Unit, Harvard Hospital, Salisbury, Wilts., or the Laboratory of Infectious Diseases, NIAID, NIH, Bethesda, Maryland.

Certain viruses (M strains) can be isolated in or adapted to monkey kidney cells (rhesus, cynomolgus, or vervet); others can only be isolated in tissue cultures of human embryo kidney cells or human diploid cell strains (*1, 6, 16*). In both simian and human cultures they produce a cytopathic effect resembling that produced by typical enteroviruses. In general the growth of rhinoviruses in human embryonic kidney cells is optimum and the cultures are most sensitive when they are rolled and the medium is maintained between *p*H 6.8 and 7.3 and at a temperature of about 33°C (*17*). These conditions are not as critical when human diploid cell strains are used (*1, 2*). Most strains of virus can be adapted to transformed cells such as KB or HeLa, but sublines of these cells vary greatly in their sensitivity to the virus. The multiplication of certain strains is inhibited by 2-(α-hydroxybenzyl)-benzimidazole, but most are unaffected (*18*).

Epidemiologic studies indicate that these viruses can cause common colds in adults and children (*1, 2, 16*). In addition a number of strains have produced colds in volunteers (*19*). Virus is found in the nose and throat, but very rarely in the feces. One strain has been found in the upper respiratory tract of calves (*20*).

So far antibodies against strains isolated from man have not been found in sera collected from animals, but they have been found in sera collected from adults and children living in all continents of the globe (*21*).

The size, density, ether stability, and cytopathic effects of members of these two groups of viruses do not differ significantly; in both, the nucleic acid is RNA. They all belong in the picornavirus group (*22*). Rhinoviruses commonly cause upper respiratory disease and are found in the nasal and pharyngeal secretions and very rarely in the feces. In primary monkey or embryonic human kidney cultures, rhinoviruses grow better at slightly lower temperatures and *p*H than enteroviruses. However, it is not possible or desirable to distinguish them from enteroviruses on the basis of the disease they cause or the cultures in which they grow, since from time to time, enteroviruses of serotypes which usually appear in the feces can produce upper respiratory tract disease, and optimal conditions of growth may be altered by laboratory manipulation. However, it is desirable to separate rhinoviruses from enteroviruses because typical members of each group vary in so many ways. This separation is best made by means of the acid-stability test which has now been studied in five laboratories and seems to give clear-cut results even when used in several modified forms; in this test rhinoviruses are inactivated in fluids with a *p*H between 3 and 5 and enteroviruses are not. These results may often be supported by determining whether the virus can produce a cytopathic effect in stationary cultures of primary monkey or embryonic human kidney at 37°C at *p*H 7.6; generally speaking, rhinoviruses grow poorly in such cultures and enteroviruses grow well (*23*).

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## Picornaviruses: Classification of Nine New Types

The small, ether-insensitive viruses containing RNA cores were recently brought together as the Picornavirus Group by an international body of virologists meeting in Montreal at the International Congress on Microbiology (*1*). In keeping with that action, the Committee on Enteroviruses (*2*) has been renamed the Panel for Picornaviruses, operating under the Board for Virus Reference Reagents, National Institute of Allergy and Infectious Diseases, National Institutes of Health.

The human picornaviruses are divided into the enteroviruses (poliovirus, coxsackievirus, and echovirus subgroups) and the rhinoviruses. The definition of the enteroviruses has recently been brought up to date (*3*), and in the accompanying article the same is done for the rhinoviruses (*4*).

The panel has recently reviewed the work on candidate prototypes and accepted nine as new picornavirus types. Four of these are echovirus types 29 to 32. Five are acid-labile (*p*H 3 to 5) and are considered as new rhinovirus types. It is planned that they will be assigned rhinovirus type numbers through the international mechanism now in operation through the World Health Organization Reference Laboratories for Respiratory and Enteroviruses.

The new viruses that are now recognized are:

| *Echovirus type* | *Prototype strain* |
|---|---|
| 29 | JV-10 (*5*) |
| 30 | Bastianni (*6*) |
| 31 | Caldwell (*11*) |
| 32 | PR-10 (*9*) |

The Frater strain (*7*), related to Bastianni (*6*), was first recognized as a new type, but the Bastianni strain was selected as the prototype strain because of its broader antigenicity. Other candidate strains which were typed as echovirus-