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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29 April 1963

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-

30 included Price (*8*), PR-17 (*9*), and probably Giles (*10*).

Strains related to Caldwell (*11*) include the Copenhagen 4331-s strain (*12*) and the California strains (*13*).

Rhinovirus types	*Prototype strain*
(numbers to be assigned)	353 (*14*)
	1059 (*14*)
	1734 (*14*)
	11757 (*14*)
	33342 (*14*)

These new viruses were isolated by the investigators cited, who showed that each fulfilled all the criteria of a human picornavirus (*1, 3, 4*) but that it was distinct antigenically from all previously known types. As indicated, four of the prototype viruses (and related strains presently known) had the properties of echoviruses and five had those of rhinoviruses.

Primary reference antisera for the first 59 enteroviruses, including echovirus 29, are now or will soon be available to qualified research laboratories in small quantities for reference purposes. Specific announcement regarding the availability of these sera will be made by the National Institutes of Health in the very near future.

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Uranyl Ion Coordination

Abstract. *A review of the known crystal structures containing the uranyl ion shows that plane-pentagon coordination is equally as prevalent as plane-square or plane-hexagon. It is suggested that puckered-hexagon configurations of OH^- or H_2O about the uranyl group will tend to revert to plane-pentagon coordination. The concept of pentagonal coordination is invoked for possible explanations of the complex crystallography of the natural uranyl hydroxides and the unusual behavior of polynuclear ions in hydrolyzed uranyl solutions.*

In almost all compounds of hexavalent uranium the presence of the discrete molecular group UO_2 is recognized; this group is linear and has a formal charge of +2. The coordination of this linear group with other oxygen or fluorine atoms was, until recently, said to be generally either fourfold (as in the autunite structures) or sixfold (as in $NaUO_2Ac_3$) about the equator, as cited in most inorganic chemistry texts. Newer crystal-structure evidence indicates that fivefold coordination of UO_2^{+2} is also possible, and, in fact, may be the most common. It seems profitable now to summarize the structural evidence on uranyl coordination and estimate its bearing on certain, as yet unsolved, structure problems.

The classic work of Beintema (*1*) showing the occurrence of square configuration of oxygen around UO_2^{+2} in autunite, $Ca(UO_2PO_4)_2 \cdot nH_2O$, has now been confirmed in detail by precise crystal-structure analyses of the closely related abernathyite, $KUO_2AsO_4 \cdot 3H_2O$ (*2*), and metatorbernite $Cu(UO_2PO_4)_2 \cdot 8H_2O$ (*3*). The early study of the crystal structure of sodium uranyl acetate by Fankuchen (*4*) has been fully confirmed and refined by Zachariasen (*5*), showing an example of sixfold coordination. The first structure showing fivefold coordination with fluorine atoms was that of $K_3UO_2F_5$ (*6*), and with oxygen atoms, uranophane, $Ca(H_3O)_2(UO_2)_2(SiO_4)_2 \cdot 3H_2O$ (*7*). All of the well-established structure types are classified according to coordination in Table 1.

The fivefold coordination common for the uranyl ion is close to a flat pentagon in all the determined structures. The best measurements of the uranium-oxygen distances in the pentagon have been made in a recent refinement in this laboratory (*8*) of the crystal structure of cesium divanadatouranylate, $Cs_2(UO_2)_2V_2O_8$ (Fig. 1), an anhydrous structural analogue of the mineral carnotite, $K_2(UO_2)_2V_2O_8 \cdot 3H_2O$. The U-O distances in the pentagon are 2.28, 2.37, 2.30, 2.24, and 2.40 Å (all $\pm$ 0.03 Å) with an average of 2.32 Å. Deviations of the oxygen atoms from a plane perpendicular to the uranyl axis are not significant within the error of the determination ($\pm$ 0.05 Å). A regular pentagon with a circumscribed radius of 2.32 Å has sides of 2.73 Å, which is a reasonable interatomic distance for two oxygen atoms that are moderately strongly attracted to the central uranium atom. The pentagonal coordination is, therefore, geometrically quite stable.

The uranium-oxygen distance in the flat hexagon coordination is 2.50 Å ($NaUO_2Ac_3$) and the corresponding hexagon edge is also 2.50 Å. This distance is considerably shorter than the usual oxygen-oxygen approach and might be expected to result in a displacement of the oxygen atoms from the equatorial plane. The several structures with the flat hexagon arrangement all have bidentate anion groups in which two oxygen atoms from one group forming one hexagon edge are already drawn very close together by the strong polarizing effect of the anion nucleus. Such short oxygen-oxygen distances are present in CO_3^{-2} (2.25 Å), in NO_3^- (2.10 Å), and in Ac^- (CH_3COO^-) (2.21 Å). A hexagon with threefold symmetry in which alternating edges are 2.2 Å will have the other three edges of length about 2.7 Å (circumscribed radius 2.50 Å). Thus, such groups will fit comfortably in a hexagonal plane about the uranyl group at the proper distance. When the oxygen atoms are not compressed as in an anionic group, they are forced out of the plane to form a "puckered" con-