withstanding the profound differences between them, are indiscriminately referred to as "variables"; and the two concepts have actually been confused. For instance, numerous attempts (*5*) have been made to define gas pressure as a symbol that may be replaced by any value of pressure, thus as a numerical variable, p, whose scope is the range of what herein has been called the fluent p. But a fluent is not determined by its range. Could Boyle have connected pressure and volume on the basis of mere information about the ranges of p and v? It was by transcending these ranges and referring to the domains, namely, by comparing $v(\gamma)$ and $p(\gamma)$ for the same sample γ, that he discovered $v(\gamma) = 1/p(\gamma)$ (in proper units) for any γ of a certain temperature or, without reference to a sample variable, $v = 1/p$. Neither formulation involves numerical variables. Boyle's Law connects specific fluents.

Analogously, constant fluents have been identified with their numerical values even though what primarily interests the physicist in gravitational acceleration clearly is the fact that g is its value for any α rather than the number g as such.

Numerical variables and variable quantities belong to worlds that are not only different but nonisomorphic. The former are interchangeable, the latter are not:

$$x^3 - 4y^2 = (x + 2y) \cdot (x - 2y) \text{ and}$$
$$y^3 - 4x^2 = (y + 2x) \cdot (y - 2x)$$

for any x and y are tantamount. But $x - y = 3$ and $y - x = 3$ are different straight lines and $w = log\ v$ is incompatible with, and not tantamount to, $v = log\ w$.

Only the consistent maintenance of all these distinctions makes it possible to formulate mathematical analysis as well as its applications to science as a system of procedures following articulate rules (*6*).

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References and Notes

1. Compare K. Menger, "The ideas of variable and function," *Proc. Natl. Acad. Sci. U.S.* 39, 956 (1953) and "On variables in mathematics and in natural science," *Brit. J. Phil. Sci.* 5, 134 (1954). A paper "Random variables and the general theory of variables" is in print *Proc. 3rd Berkeley Symposium Math. Statistics* (1955). A systematic exposition of the new theory of variables is contained in K. Menger, *Calculus. A Modern Approach* (Ginn, Boston, 1955).
2. The term *gas sample* means gas in a specific container at a definite instant.
3. Depending on whether a physical, a postulational, or a pure plane is under consideration, a "point" is a physical object (for example, an ink dot in a paper plane), or an undefined object satisfying certain assumptions, or an ordered pair of numbers.
4. Even if, following the suggestion of some mathematicians, one called all consistent classes of quantities "functions," one obviously would need a special term for "functionally connecting functions" such as *log*.
5. Compare, for example, R. Courant, *Differential and Integral Calculus* (Interscience, New York, 1954), vol. 1, p. 14.
6. Compare K. Menger, *Calculus. A Modern Approach* (Ginn, Boston, 1955).

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Prenatal Diagnosis of Sex Using Cells from the Amniotic Fluid

In most mammals, including human beings, males normally have the sex chromosome constitution XY, and females the sex chromosome constitution XX (*1*). It has been shown in a variety of tissues in human beings and some other species (*2*) that there is a sex difference in the percentage of cells with chromocenters, especially those at the nuclear membrane; this presumably is due to this difference in sex chromosome constitution in males and females. A determination of the percentage of cells with chromocenters can therefore give, in sexually normal individuals, a diagnosis of sex.

The present study was undertaken in order to show whether, in human beings, such a diagnosis can be made before birth, not only for aborted fetuses from which pieces of tissue can be removed for examination, but also for viable fetuses by an examination of cells from the amniotic fluid. In order to establish whether amniotic fluid contains cells suitable for diagnosis, fluid was taken before delivery by puncture of the membranes from women in the ninth month of pregnancy. The fluid was centrifuged, and the cells were smeared on slides, fixed in alcohol-ether, and stained with Feulgen and fast green (Fig. 1).

Our analysis has shown that cells suitable for the diagnosis are present, and an examination of 35 cases in the ninth month, which include those reported previously (*3*), has given 35 correct diagnoses of the sex of the fetus.

It therefore seems that this method is particularly reliable, especially since there appears to be no theoretical objection to it. The only apparent exception that occurs to us at present is the rare case of an intersex in which the sexual phenotype does not correspond to the sex chromosome constitution. When one is collecting the amniotic fluid it is, of course, essential to avoid contamination with cells from the mother.

Amniotic fluid can be obtained from viable human fetuses from 12 weeks to term (*4*). We have found, from an examination of the fluid obtained from viable human fetuses in the sixth and seventh months, that a prenatal diagnosis of sex can be made at these stages. We have also found suitable cells in the fluid of an aborted 8-week-old human embryo.

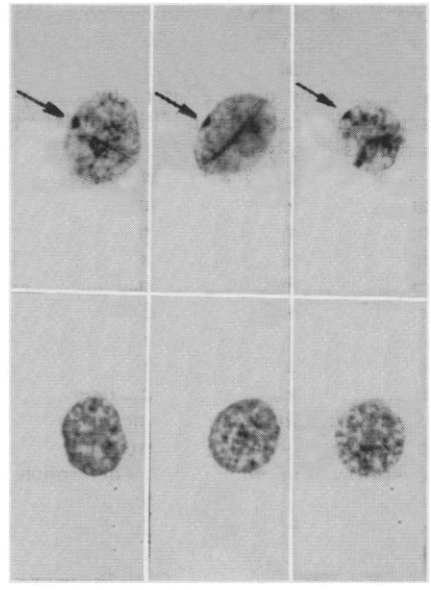

Fig. 1. Photomicrographs of cells from the amniotic fluid (× 1500). (Top row) Nuclei with a chromocenter at the nuclear membrane; from female human fetuses in the ninth month. (Bottom row) Nuclei without a chromocenter; from male human fetuses in the ninth month.

It may be possible to apply this method for the prenatal diagnosis of sex to domestic animals.

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