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a point in the space of four dimensions chosen so that no meeting of the various lines occur.

A body of four dimensions is bounded by what corresponds to faces in the body of three dimensions —*i. e.*, by a certain number of bodies of three dimensions, in such a way that all these different bodies lie in different spaces; and every one of these is bounded by planes, every plane by edges, and every edge by vertices.

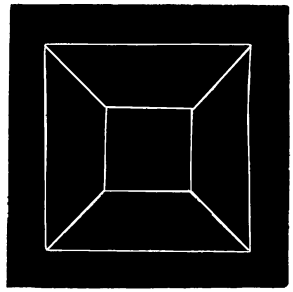

Fig. 1.

In Fig. 2 is given a perspective view of the projection of the so-called 8-cell, one of the regular bodies in four-dimensional space. We observe in the figure eight hexahedrons (counting also the one which includes all the others); these are the projections of the three-dimensional bodies (cells) which bound the four-dimensional body.

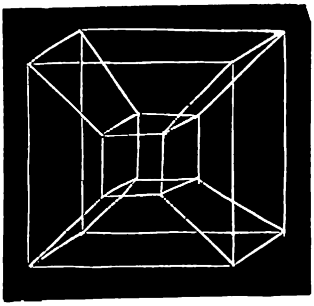

Fig. 2.

In the lecture itself, a set of wire models belonging to the mathematical department of the University of Chicago was shown to illustrate the projections into space of three dimensions of all six regular four-dimensional bodies.

The University of Chicago, October, 1902.

DEPARTMENTS.

SOLUTIONS OF PROBLEMS.

ALGEBRA.

148. Proposed by **R. D. BOHANNAN, Ph. D., Professor of Mathematics, Ohio State University, Columbus, O.**

If $\dfrac{x}{a+\alpha}+\dfrac{y}{b+\beta}+\dfrac{z}{c+\gamma}=1$, $\dfrac{x}{a+\beta}+\dfrac{y}{b+\beta}+\dfrac{z}{c+\beta}=1$, $\dfrac{x}{a+\gamma}+\dfrac{y}{b+\gamma}+\dfrac{z}{c+\gamma}=1$, show, without solving, that $x+y+z=a+\alpha+b+\beta+c+\gamma$.

Solution by **JAMES McMAHON, A. M., Professor of Mathematics, Cornell University, Ithaca, N. Y.**

There is probably a misprint in the first equation. It should be

$$\frac{x}{a+\alpha}+\frac{y}{b+\alpha}+\frac{z}{c+\alpha}=1.$$

The form of the three given equations shows that α, β, γ are the three roots of the equation

$$\frac{x}{a+s}+\frac{y}{b+s}+\frac{z}{c+s}=1,$$

in which s is regarded as the unknown. On clearing of fractions, and arranging in the form of a cubic equation in ε, it is seen that the sum of the three roots is $-(a+b+c)+(x+y+z)$.

Hence $\alpha+\beta+\gamma=-(a+b+c)+(x+y+z)$, and $x+y+z=a+\alpha+b+\beta+c+\gamma$.

NOTE. It may be of interest to state that if each letter be squared the result expresses the distance of any point from the origin in terms of ellipsoidal curvilinear coördinates.

156. Proposed by B. F. FINKEL, A.M., M.Sc., Professor of Mathematics and Physics, Drury College, Springfield, Mo.

$(z+x)a-(z-x)b=2yz....(1)$; $(x+y)b-(x-y)c=2xz....(2)$; $(y+z)c-(y-z)a=2xy....(3)$. Find the values of x, y, and z by the method of linear simultaneous equations.

Solution by G. B. M. ZERR, A.M., Ph. D., Professor of Chemistry and Physics, The Temple College, Philadelphia, Pa.

Let $x=\frac{1}{2}(b+c)u$, $y=\frac{1}{2}(a+c)v$, $z=\frac{1}{2}(a+b)w$.

$\therefore (a-b)w+(b+c)u=(a+c)vw....(1)$.

$(b-c)u+(a+c)v=(a+b)uw....(2)$.

$(c-a)v+(a+b)w=(b+c)uv....(3)$.

We might eliminate v, w and get an equation of the fifth degree in u. We will, however, proceed as follows: Add (1), (2), (3), then

$$aw(2-u-v)+bu(2-v-w)+cv(2-u-w)=0.$$

This is the case when $u=v=w=0$; or $u=v=w=1$; or $u=0$, $w=v=2$; or $v=0$, $u=w=2$; $w=0$, $u=v=2$.

The first two sets of values satisfy the conditions.

$\therefore x=y=z=0$; $x=\frac{1}{2}(b+c)$, $y=\frac{1}{2}(a+c)$, $z=\frac{1}{2}(a+b)$.

NOTE. This is exercise 31, page 224, Systems of Linear Simultaneous Equations, of Fisher and Schwatt's *Higher Algebra*, and has given teachers of algebra throughout the country considerable trouble. Solving the equations for a, b, and c, we readily find that

$$a=-x+y+z,$$
$$b=x-y+z, \text{ and}$$
$$c=x+y-z.$$

$\therefore x=\frac{1}{2}(b+c)$, $y=\frac{1}{2}(a+c)$, $z=\frac{1}{2}(a+b)$, as one set of values for x, y, and z. EDITOR F.

Also solved by *L. C. WALKER*.