made for examinations to test qualifications of persons desiring employment in fields closely connected with public health and for licenses issued to establishments handling foodstuffs. It was recommended that bakeries, canneries and confectioneries be added to the list of such establishments, removing these from the jurisdiction of the department of labor. Other license fees suggested were from individual milk plants from which milk is imported into New Jersey. Regulation of health conditions among persons who work at home for factories was urged as a function of the health department rather than the department of labor; control would be centered in a bureau of homework industries, the cost of which would be distributed among the contractors distributing such work. Among internal changes recommended were restoration of the publication of *Public Health News,* the department's bulletin; combination of the bureau of venereal diseases with the bureau of local health administration, which handles problems concerned with other communicable diseases; restoration of appropriations to provide offices and help for district health officers, and abolishment of the health officer of the port of Perth Amboy.

DISCUSSION

NOMENCLATURE FOR THE ISOTOPES OF HYDROGEN (PROTO- AND DEUTO-HYDROGEN) AND THEIR COMPOUNDS

IN this letter it is proposed that the nomenclature suggested by Urey, Brickwedde and Murphy[1] for the isotopes of hydrogen should not be abandoned, as recently suggested by Rutherford,[2] but modified in such a way as to make it more general. The necessity for such a modification arises when it is desired to name what they refer to as "the nine varieties of water."

The fundamental difficulty of their nomenclature is that it specifies an atomic species by a single name, while by any simple numerical system two independent variables are involved. These may be the atomic number and atomic mass, but in a general system it is much more simple, and less confusing in the end, to use the atomic number and the isotopic number. If P is the whole number closest to the atomic mass, then the isotopic number (I) is given by the relation

$$I = P - 2Z \qquad (1)$$

in which Z is the atomic number. Since as many as 91 elements are now known, and some of these have as many as 11 isotopes, it is obvious that any system which gives an individual name to each isotope, without any reference to the element to which it belongs, can not fail to be confusing. The simplest system is, obviously, one in which numbers alone are used. The use of the isotopic number rather than the atomic mass has several marked advantages. Thus the isotopic numbers are much smaller than the masses, they exhibit the relations between atomic species much more simply, and also the isotopic number of the most abundant isotope of a light element of even number is zero, while that for an element of odd number is one. Only in the exceptional case of the proton is this minus one instead of plus one.

On account of the predilection of human beings for names, rather than numbers, it is perhaps entirely visionary to expect the general adoption of the more logical numerical system, so the discussion which follows presents a few of the numerical designations, and the names which may be supposed to represent them.

Hydrogen of atomic weight 1 is represented by $(1, -1)$, or more simply by 1–1, in which 1 is the atomic and –1 the isotopic number. Since H designates atomic number 1, this may be written $H^{\bar{1}}$ (to represent H^{-1}). In accord with recently suggested usage this is protium, but a more general system of designation is introduced if this is changed to protohydrogen.

The names for the isotopes of hydrogen become *protohydrogen, deutohydrogen* and *tritohydrogen,* though it is not certain that the last has been discovered. It is possible that *deuterohydrogen,* which is somewhat more correct, but longer, may be preferred for the second of these.

Hydrogen of atomic weight 2 is represented by $(1, 0)$, or by H°, or deutohydrogen.

Heavy water with light oxygen is $(1, 0)_2(8, 0)$, or in more ordinary symbols $H^{\circ}{}_2O^{\circ}$, and may be named dideutohydrogen-oxide°, in which ° represents that the oxide contains the zero isotope of oxygen. While this is a slightly mixed system of nomenclature, it seems preferable to that given by the logical extension of the recently suggested system of naming, which gives dideuterium-hekaidekatium. Also proto-deuto-hydrogen oxide[1] is, according to this extension of the present system, protium-deuterium-heptakaidekatium. However, a greater difficulty arises in the present system in that dideuterium-hekakaidekatium represents not only $H^{\circ}{}_2O^{\circ}$, but it also represents the group $-N^2H_2{}^{\circ}$, which contains the recently discovered isotope of nitrogen, isobaric with the zero isotope of oxygen. Thus this system is incapable of distinguishing between isobars.

The compounds

[1] SCIENCE, 78: 602, 1933.
[2] *Nature,* December 23, 1933.

$$H^1\bar{H}^0, \quad NH^1\bar{H}^0, \quad NH^1_2\bar{H}^0, \quad C_6H^1_2\bar{H}^0_4$$

may be designated as proto-deuto-hydrogen, dideuto-ammonia, monodeuto-ammonia and tetradeuto-benzene. Since at present we do not say hydro-benzene, or hydro-ammonia, it is unnecessary to introduce the word hydrogen.

Table 1 gives the formulas of a few isotopic molecules. Those in which the isotopic numbers are used are seen to be much more simple than those with the atomic mass.

TABLE 1

ILLUSTRATIVE FORMULAS FOR MOLECULAR ISOTOPES. I. WITH SYMBOL AND ATOMIC MASS. II. WITH SYMBOL AND ISOTOPIC NUMBER.

I	II
Sulphur Dioxide (18 Molecular Isotopes.)	
$S^{32}O^{16}_2$	$S^0O^0_2$
$S^{33}O^{17}O^{18}$	$S^1O^1O^2$
Carbon Dioxide (12 Molecular Isotopes.)	
$C^{12}O^{16}_2$	$C^0O^0_2$
$C^{13}O^{17}O^{18}$	$C^1O^1O^2$
Carbon Tetrachloride (10 Molecular Isotopes.)	
$C^{12}Cl^{35}_3Cl^{37}$	$C^0Cl^1_3Cl^3$
Tin Tetrachloride (55 Molecular Isotopes.)	
$Sn^{112}Cl^{35}_2Cl^{37}_2$	$Sn^{12}Cl^1_2Cl^3_2$
$Sn^{120}Cl^{35}_3Cl^{37}$	$Sn^{20}Cl^1_3Cl^3$
Benzene (49 Molecular Isotopes: also many isomers.)	
$C^{12}_4C^{13}_2H^1_3H^2_3$	$C^0_4C^{\bar{1}}_2H^1_3H^0_3$

On the whole, it seems that no system of naming the atomic species can be at the same time logical and simple, if numbers are not utilized. In conclusion, it may be reaffirmed that the two best systems aside from those wholly numerical are the use of the (1) symbol of the element plus the atomic mass, (2) symbol of the element plus the isotopic number.

The second is much simpler than the first, and should be adopted. Its only disadvantage is the extremely slight mental effort necessary to comprehend the significance of the isotopic number. While equation (1) gives the best definition of this quantity, it may be noted that the formula for any atomic nucleus may be written $(np)_Zn_I$, in which n represents a neutron and p, a proton, and I gives the number of the isotope. Since for a proton Z is unity, the value of I must be minus one. For any other known nucleus I is always zero, or a positive number from 1 to 54. For most of the individual atoms on earth, or in the meteorites, the value of I is zero. Professor Mulliken has prepared a detailed system of nomenclature for the compounds of hydrogen, which is, on the whole, in agreement with what is suggested in this communication.

The argument has been advanced that each radioactive atomic species has an independent name which does not express the name of the element. Thus Ra^{48} is designated as thorium X, Ra^{50} as radium and Ra^{52} as mesothorium 1. However, the names indicate that thorium X is the X disintegration product from thorium, mesothorium 1 is the first descendent from thorium, etc. That is, the names give the family or series to which the atomic species belongs, which is of primary importance in the study of radioactivity. Since the name deuterium, suggested for the zero isotope of hydrogen, does not indicate that it is a member of the uranium series, such a justification for an independent name has no basis. Thus *deutohydrogen,* or *deuterohydrogen,* is in much better accord with a simple system of designation for the atomic species in general. The term deuton is already in general use for the nucleus of an atom of deutohydrogen, while a proton is the nucleus of an atom of protohydrogen.

Publications received within the last few days indicate that Rutherford's suggestion of the use of the term "diplogen" or double, for deutohydrogen, is being adopted rapidly in England. This term is not suitable for use in chemistry unless a name is also given for $H^{\bar{1}}$, that is for hydrogen of mass 1, which, according to this should be called haplogen, or preferably *haplohydrogen.* The adoption of this system changes the designation of the nucleus of the atom of heavy hydrogen from *deuton* to *diplon.* This system of nomenclature seems as satisfactory, but not more so, than that of Urey, except that it has the disadvantage that it changes the name of the *proton* to *haplon.* It is, of course, possible that an etymologically mixed system may be adopted, such as protohydrogen and diplohydrogen for the atoms, and proton and diplon for their nuclei.

The organic chemist is particularly interested in the nomenclature, since even with only two isotopes of hydrogen and two of carbon, several thousand varieties of a single organic compound can be formed. Even very simple compounds, such as benzene may have several hundred forms. Thus $C^1_4C^0_2H^0_3H^1$ which is only one of the 49 isotopes of benzene, has nine isomers. For large molecules which contain, C, H, O, S, and N, the number of forms may be of the order of a hundred thousand (10^5).

The system which uses the atomic and isotopic numbers to indicate atomic species, needs no extension to include both the negative electron and the positive electron (negatron and positron). Thus the negative electron is $(-1, 2)$, which, by a change of signs becomes $(1, -2)$, which is the positive electron. The neutron is $(0, 1)$, since the general formula for any nucleus is $(np)_z\ n_I$ or $H^0_z\ n_I$ in which n is a neutron, and the atomic number Z for the neutron is zero.

WILLIAM D. HARKINS
UNIVERSITY OF CHICAGO

ISOTOPIC NOMENCLATURE

THERE has been an increasing amount of discussion relative to suitable words and symbols for the designation of isotopes. Already the words "protinium" and "deuterium" have been used to denote the hydrogen isotopes of mass 1 and 2, respectively. Also the formula of ammonium containing one atom of hydrogen of mass 2 has been written NH_2D and $NH_2\overline{H}$.

At present experimental evidence points to the fact that many of the elements are composed of at least three isotopes. Furthermore, it appears to be only a matter of time before many of the isotopes will be prepared in a pure state and in sufficient quantity to examine their properties. In the meantime, however, considerable confusion may arise, assigning to isotopes symbols and names which are not only at variance with common usage but will also tend to create an elaborate nomenclature.

Two examples should serve to make this point clear. There are at present at least 80 isotopes known. First, if each of these isotopes is assigned a name unassociated with its element the memory of the average chemist will be greatly taxed. Second, if we assign a numerically derived name, such as "protinium" or "deuterium," we might call an isotope of mass 86 hakloskyhogdoekostium (ἑκτος καὶ ὀγδοηκοστός) and yet be uncertain, unless the context supplied the information as to whether isotope of mass 86 of strontium or krypton was meant, for both have an isotope of this mass.

It would seem to the writer to be more advantageous for the present to run the risk of being verbose but exact and designate an isotope as follows: Hydrogen of mass 2, or oxygen of mass 17, and use the simple words hydrogen, oxygen, strontium, etc., to designate the usual isotopic mixture found of the element in question. If the amounts of the isotopes have been varied to a marked degree, then write out the percentages of the various isotopes present.

In chemical formulas the use of the symbol of the element together with the suitable number or numbers in exponential position, and with the use of structural formulas to clarify isomeric relationships would still appear advisable, rather than injecting new symbols or signs just at present.

And last but not least it is recommended that a suitable international committee be appointed which would rule upon changes in nomenclature, should the occasion arise, and thereby avoid getting into a confused nomenclature such as the one in organic chemistry, from which we are now being rescued by the Commission on the Reform of the Nomenclature of Organic Chemistry.

J. B. FICKLEN
HARTFORD, CONN.

REACTION TO MOSQUITO BITES FOLLOWING TREATMENT FOR COLD IN HEAD

FOR some years past the writer has been raising mosquitoes for experimental purposes. These have been fed on the forearm, and no ill effects have been observed. There has been practically no swelling or discomfort, and within a very few minutes the slight redness at the site of the puncture disappeared. Recently the writer contracted a severe cold in the head, and on advice, took alkaline salts as a treatment. A teaspoonful of Citro Carbonate of Magnesia was taken every hour for several hours, so that the urine gave an alkaline reaction on litmus paper. At this time the mosquitoes were fed as usual, and within ten minutes, at the site of every puncture, appeared a white swelling, six to ten millimeters in diameter, surrounded by a red aureole and accompanied by an almost intolerable itching. These swellings lasted for about half an hour and gradually disappeared. During the time the system was alkalized, each feeding was followed by the appearance of these swellings, accompanied by intense discomfort. At the time of writing, three weeks after the last dose of Citro Carbonate of Magnesia, the mosquitoes are still being fed, but once more without the occurrence of swellings, discoloration or itching. The mosquitoes, *Aedes egypti,* emerged in December, and the same individuals were used during the whole time covered by these observations. The writer is curious as to the connection between this treatment for cold and the reaction to the mosquito bites which followed.

G. ALLEN MAIL
MONTANA AGRICULTURAL EXPERIMENT STATION
BOZEMAN

MORTALITY AMONG TROPICAL FISH

A HIGH infant and adult mortality rate among different varieties of tropical fish was completely checked by the addition of viosterol to a diet already containing desiccated shrimp, beetle and ground fresh liver. Deeper pigmentation and increased activity were noted. Several fish whose vertebral columns had softened and deformed recovered their rigidity after addition of the viosterol. However, the deformity persisted.

The viosterol and its oily medium were mixed with