#### What the World Is Made up Of

When We Get Down to the Constitutions of the Atom It Begins to Look as if the Only Fundamental Thing Is Electricity — What Atoms, Molecules, Electrons and lons Are.

By Garrett P. Servias

I am asked by a reader to write an article on "atoms, melecules, electrons and ions." These names appear so frequently now in newspapers, magazines and books that everybody ought to have an elementary knowledge of the things for which they stand. Some of them were never heard of in schools which people now in middle life attended. Atoms is an old word conveying an old idea, viz., that of the existence of ultimate, indivisible particles of which all things are composed. It is easy to see how the notion of atoms arose. You find that everything can be divided and split up into smaller and smaller particles. The finest particles of dust into which a rock might be divided may be separately invisible without a microscope. But both

dust into which a rock might be divided may be separately invisible without a microscope. But both experience and reason indicate that that is not the end of the division, but that the dividing process may be almost without limit.

The question then arises, is there actually a limit? Can matter be reduced to particles so small that further division is impossible? Even the ancient Greek philosophers concluded that there was such a limit, and they called the final, indivisible particles "atoms," i. e., things that cannot be cut, but without undertaking to say just how small they were.

were.
This idea lived through the ages, springing up again after every tem-porary recession of man into bar-barism and ignorance, and at last

porary recession of man into ourbarism and ignorance, and at lastit became one of the corner stones
of modern science. The late Lord
Kelvin made a celebrated calculation of the probable size of an atom.
He, so to speak, put it on the viewing-stage of the microscope of the
imagination by means of a graphic
comparison.
"Imagine," he said, "a raindrop
or a globe of glass as large as a
pea to be magnified up to the size
of the earth, each constituent atom
the used the word molecule, but we
may substitute atom for our present
purpose) being magnified in the same
proportion. The magnified structure
would be more coarse grained than
a heap of small shot, but probably
less coarse grained than a heap of
cricket balls." More recent calculations give the diameter of the smallest atom as about one-three-hundredwillight of an inch. The largest st atom as about one-three-hundred

toons give the diameter of the shallest atom as about one-three-hundred-millionth of an inch. The largest kind may have many times that. With the atom it was until recently supposed that sub-division ceased. It was adopted as the "chemist's unit," and practically remains so still, although, as we shall see, the theory of its indivisibility has proved to be erroneous. The great service that the conception of ultimate atoms has rendered to chemistry is in making clear the difference between elementary and compound substances, and rendering it possible to study-the laws of chemical action. Every substance made up of only one kind of atoms is an "element," About eighty-three chemical elements are now known; consequently there are eighty-three different kinds of atoms.

of atoms.

Molecules are groups of atoms, so

that a molecule is larger than an atom of the same kind of substance. There are two sorts of molecules, viz., those which consist of only one kind, or species, of atoms, and those kinds united together. The first sort consist of atoms of different united together. The first sort lecules is found only in ele-ry substances, and the second

For the sake of clearness it is best, for ordinary purposes, to think of molecules only as the constituent particles of compound substances. Being composed of atoms of different kinds, when such molecules are broken up the compound substance formed of them loses its identity, and the separated atoms go back into their elements. into their elements.

Water, for instance, is a com Water, for instance, is a comound substance, each of whose
molecules consists of one atom of
he element oxygen combined with
wo atoms of the element hydrogen.
When water is chemically decomoused, its individual molecules are
oroken up and from each of them
is released one atom of oxygen and
wo atoms of hydrogen, but there
he ordinary process of decomposiion ceases and we cannot make another division by breaking up the

Within quite recent times, how-ever, it has been discovered that the apparantly indivisible and unbreak-

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able atom really consists of much carry, or consist of, charges of nega- escape of some, or the scattering of charged body immersed in the air iravelling with it, which are kept ment for the Kaiser. Any punish- worth Brown, Chancellor New Yor

able atom really consists of much smaller particles revolving around a certer, or nucleus, and they are because of some, or the seathering of the atoms of radium, and a few other cognate carries, or nucleus, and these smaller particles which make up the atom are called electrons. The average diameter of these excessively minute things has been calculated as about one-one-hundred-thousandth of the atom and in the atom and they are becaused the control of the control o

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