

# *AquaFuel*, An Example Of The Emerging New Energies And The New Methods For Their Scientific Study

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## **Abstract**

In this paper we initiate systematic studies on the novel methods needed for quantitative scientific studies of the emerging new forms of energy, by using as a representative example the new combustible gas called AquaFuel, discovered and patented by William H. Richardson, jr., whose rights are now owned by Toups Technology Licensing, Inc. (TTL), of Largo, Florida. In essence, AquaFuel is a new energy converter capable of transforming Carbon and water into a new combustible gas via the use of a suitable electric discharge. We show that AquaFuel can be produced easily, safely and rapidly in large amounts, has novel physical and chemical characteristics, and exhibits greatly reduced emission pollutants as compared to fuels currently used. We then review nine basic experimental measures currently under study by TTL which are necessary for a scientific appraisal of AquaFuel. We outline the limitations of quantum mechanics and chemistry for the treatment of *new* forms of energies, namely, energies which by definition should be *beyond* said theories. We point out the availability of broader theories specifically constructed for the study of new energies and point out available applications. Detailed studies on the origin of the AquaFuel energy and its energy balance will be presented at a later time upon completion of the systematic experimental and theoretical studies currently under way. These results are expected to be significant for various other forms of new energies.

# 1 The Basic Process Underlying AquaFuel

AquaFuel is a new combustible gas discovered and developed by William H. Richardson, jr, which is covered by the patents listed in Refs. [1]. Its rights are now owned by Toups Technology Licensing, Inc. (TTL), a U. S. corporation in Largo, Florida, which is continuing its development. Starting from the three basic elements of nature, Hydrogen, Oxygen and Carbon, AquaFuel is produced during an electric discharge across an arc between carbon electrodes immersed in distilled, fresh or salt water.

The patented process is basically different from electrolysis. In fact, in electrolysis, water must be complemented with electrolyte to carry the charges from the negative to the positive poles of the power source. In AquaFuel charges are instead stimulated by a sufficient voltage difference. In the latter case, no addition of electrolyte chemicals is needed to create a conducting path. As we shall see, this property of AquaFuel is important to minimize pollutants in the various applications.

According to currently available scientific knowledge, the main process underlying AquaFuel is constituted by Carbon atoms breaking loose under discharge from the carbon electrodes and forming particular bonds with the water constituents, Oxygen and Hydrogen. The resulting new molecules cool as they bubble up to the water's surface where they are collected and stored for various usages. The resulting combustible gas is called AquaFuel.

# 2 Description of Equipment

As in Figure 1, a one-gallon fishbowl is three-quarters filled with distilled, tap or salt water. Copper tubing conducts 24 volts continuous current (DC) to the tips of two 0.25 diameter Carbon rods composed of 99% pure graphite, which are immersed in said water, one of whose tips is extended into a large diameter Carbon block.

The electric arc tunnels thru the water from the tip of the Carbon rod to the large Carbon block. The AquaFuel gas cools while bubbling to the water's surface where it is collected with an inverted funnel.

The electric arc produces a local temperature of the order of 5,000 °F. The process dissociates the water molecules by forming a local high temperature plasma composed of generally ionized atoms of Carbon,

For a picture of AquaFuel (photo by Rob Jaeger and Ken Lindfors) visit

the web site [http://www.toupstech.com/html/toups\\_-\\_aqua\\_fuel.html](http://www.toupstech.com/html/toups_-_aqua_fuel.html). Note the thin Carbon rod and the large Carbon block and the bubbling of the gas thru the water and its clean burning at the top.

Hydrogen and Oxygen, which are subjected to a number of physical and chemical processes. The final product is given by the recombination of said elements into a number of new molecules that cool down in the water surrounding the discharge as they bubble to the collection equipment.

AquaFuel can be most efficiently produced via the use of continuous current (DC) in the arc. The use of alternating current (AC) in the arc is also possible, although with a reduced production rate.

The AquaFuel equipment is an energy converter because it converts the energy originally available (electricity, Carbon and water) into different forms of energy.

In addition, the AquaFuel equipment is a new energy converter because its underlying processes are basically novel, as shown later on.

This paper deals only with the excellent characteristics of AquaFuel as a combustible gas without any consideration at this time of the ratio between the input and output energy which will be considered in a future paper upon completion of the needed experimental measures.

### 3 Description of AquaFuel

The actual structure of AquaFuel as well as its main physical and chemical characteristics are still essentially unknown at this writing on scientific grounds because the needed experimental measures are still in progress (see Sect. 5).

The various studies completed until now have identified the following main characteristics:

- 1) AquaFuel is lighter than air, because it continues to rise in atmosphere;
- 2) AquaFuel does not self-combust because of its low content of Oxygen (estimated at about 1% );
- 3) AquaFuel is expected to be composed of H<sub>2</sub>, CO, Oxygen and a number of hydrocarbons;
- 4) AquaFuel can run existing internal combustion (IC) engines with minor modifications in the carburetor;
- 5) AquaFuel has an astonishingly low pollutant content in its exhaust when compared to other fuels, such as gasoline, methane, coal, etc. ;

- 6) No pollution control equipment is needed for burning AquaFuel;
- 7) Engine oils remain much cleaner when burning AquaFuel because of less pollutants discharged during operation, thus lasting longer and reducing engine oil disposal;
- 8) The main gas produced in burning AquaFuel is carbon dioxide as it is the case of methane, whose precipitation into a solid form is under study;
- 9) AquaFuel is a stable, permanent gas, not like the mixture of Hydrogen and Oxygen emitted from ordinary electrolysis;
- 10) AquaFuel can be stored in ordinary tanks either as a gas or in its liquid form;
- 11) AquaFuel can be produced in any desired amount, whether small or large, and anywhere, whether on land or at sea;
- 12) AquaFuel is cheaper, simpler and more practical to produce than other fuels, such as gasoline, methane or pure Hydrogen;
- 13) The AquaFuel technology can be used for recycling waste, such as sewer or rubber tires;
- 14) The AquaFuel technology can also be used to cleanse the air from pollutants;
- 15) AquaFuel uses much less Oxygen than other forms of fuels because of its high internal content of Oxygen in various compounds, thus providing a significant contribution to the reduction of the largest environmental problem of today: the apparent depletion of over 10% of Oxygen already occurred so far in our atmosphere, and its exponential increase due to the excessively large number of automobiles and airplanes all using Oxygen;
- 16) AquaFuel has a light, yet very characteristic and peculiar odor, which is an intrinsic characteristic not due to impurities or additives. This odor has considerable practical and safety values because other gases which are naturally odorless require the addition of odor via chemicals for safety purposes.

## 4 Available Measurements

Some of the most impressive aspects of AquaFuel are the simplicity, safety and rapidity of its production. As an indication, preliminary measures under verification indicate that the use of 36 V in the arc permits the production in one minute of 30 liters of AquaFuel at ordinary pressure. The same production increases exponentially with voltage, thus permitting the rapid production of AquaFuel anywhere needed.

Engine tests of AquaFuel were performed on a small IC engine at the Briggs & Stratton Test Center by comparing the new fuel to gasoline. It was established that AquaFuel requires only five parts of air to one part of fuel due to its large content of Oxygen bonded in various forms. By comparison, other gases such as methane require from ten to fifteen parts of air to one part of gas.

The results of the Briggs & Stratton test are as follow:

	Gasoline	AquaFuel	
RPM	3060	3060	
Torque	3.45	3.20	
HP	2.05	1.86	
Oil Temp.	227 F	165 F	
Exhaust	751 F	637 F	
Hydrocarbons	2436 ppm	185 ppm	(parts per million)
CO%	4.343	.039	
CO2%	12.086	14.695	
Oxygen %	0.544	7.100	
Hydrocarbon	13.367	0.001 g/hr	(grams per hour)
Nitrogen Ox.	5.921	0.002 g/hr	
CO	421.141	0.002 g/hr	

The g/hr figures for CO are most impressive. The engine running on AquaFuel would have to operate for over 210,000 hours to equal the amount of CO produced in 24 hours while being fueled by gasoline.

Equally impressive is the presence of 7.1% of Oxygen in the exhaust which is evidently important to maintain the Oxygen balance in our atmosphere. This is a clear indication that AquaFuel is not a lean mixture, but a mix with excess power.

A preliminary analysis of the chemical composition of AquaFuel was conducted by NASA with the following results:

Hydrogen	46.483
Carbon Dioxide	9.329
Ethylene	0.049
Ethane	0.005
Acetylene	0.616
Oxygen	1.164
Nitrogen	3.818
Methane	0.181
Carbon Monoxide	38.370
Total	100.015

The above analysis does not conform to the performance of AquaFuel and other experimental evidence. First, the total BTU content of the gas is less than 300 according to the above data, while the Briggs test shows almost 90% of the torque and horsepower on AquaFuel as compared to that of the same mass of gasoline. Also, the presence of free Hydrogen in the combustion chamber in the amount indicated by NASA would produce Nitrogen Oxide in an amount much greater than that measured by Briggs & Stratton.

Moreover, comparative permeability tests conducted with AquaFuel and other gases have established a behavior which disproves the presence in AquaFuel of 46% Hydrogen, as claimed by NASA.

The test was performed by filling up similar balloons with Hydrogen, CO, Acetylene, Helium and AquaFuel. The time needed to fully deflate the balloons back to their original static state was measured as follows:

Hydrogen	Two hours.
CO	Eight Hours.
Acetylene	Two days.
Helium	One week.
AquaFuel	Three to six months.

As the gases leaked out of the AquaFuel balloon, the diameter was reduced by about 10 %. The other gases still in the balloon were flammable months into the test. The AquaFuel balloon-test was conducted three times.

In view of the above and other evidence, the chemical analysis by NASA cannot be considered conclusive, e.g., because of the destruction of the original structures during testing.

Other tests on the chemical structure of AquaFuel have also been done, but they have been all inconclusive. As an example, tests indicating high

Nitrogen content are in contradiction with the evidence that much Nitrogen in the mix would render the fuel a cold burner.

The ratio between the input and output energy is basically unsettled at this writing. In fact, all measures of input and output energies are under way thus being unavailable at this writing in a final form.

Nevertheless, the presence of additional sources of energy, via stimulated nuclear transmutations cannot be excluded at this writing because of a number of direct or indirect indications, such as that on the *explosion of water mist* measured since the early part of this century. These issues require specific experimental measures (see Sect. 5) and theoretical studies (see Sect. 6).

All these inconclusive aspects, which have been studied until now by conventional analytic means, indicate that AquaFuel has new characteristics beyond existing knowledge. For instance, the compound with atomic weight 14 which is claimed to be Nitrogen could in reality be a new composite molecule. A similar situation could occur for other data.

## 5 Ongoing Experimental Measures

The most important experimental measures on AquaFuel of current primary interest to TTL are listed below. Suggestions and/or participations by interested colleagues would be appreciated.

1) Measure the energy content of AquaFuel per unit volume in BTU or other units. It should be indicated that a number of measures of BTU via conventional means have failed to provide any scientific answer for various reasons. As an example, readings of BTU compared to methane were inconclusive because the former burns with about half of the air (Oxygen) requirement of the latter, thus voiding the scientific value of any measure without due thermodynamical consideration of the different air intakes. Similar unsettled results occurred with other measures. Innovative means for the needed measures are therefore under study.

2) Measure the individual isotopes in AquaFuel originating from distilled water. These measures are requested for AquaFuel produced from distilled water and 99% pure graphite so that the initial ingredients are known. The measures should then identify both the atomic number  $A$  (total numbers of protons and neutrons) as well as the nuclear charge  $Z$  (total number of protons) for each constituent of AquaFuel. Note that the identification of

all atomic numbers  $A$  alone is grossly insufficient for an in depth scientific understanding of AquaFuel because of possible unsettled alternatives on  $Z$  for some of the expected  $A$ , as it will be explained in the next section. Measures conducted until now via gas chromatography and other conventional means have been inconclusive for various reasons. First, because it was not clearly resolved whether certain values of  $A$  refer to pure elements, or to clusters of them and, second, because of the inability to jointly identify the values of  $Z$ .

3) Measure the chemical composition of AquaFuel originating from distilled water. Upon identification of the individual isotopes, or jointly with the same, the next major measures requested by TTL are the identification of the chemicals that actually compose AquaFuel. Again, various tests done until now have resulted to be without final scientific value, e.g., because they were on based on personal beliefs by the experimenter disproved by evidence. As an example, the belief that AquaFuel is primarily composed by Hydrogen has been disproved by comparative tests on the permeability of Hydrogen and AquaFuel, and similar unsettled occurrences resulted in other measures.

4) Measure the chemical composition of AquaFuel originating from water inclusive of waste to be recycled. This additional knowledge is essential for the industrial application of AquaFuel as a means of recycling contaminated liquids. Various specific cases of recycling are under consideration for measures.

5) Identify the chemical structure of the exhaust following combustion. This additional knowledge is essential to understand the thermodynamics underlying the use of AquaFuel.

6) Identify the physical characteristics of AquaFuel, such as specific density. A knowledge of these characteristics is evidently a necessary pre-requisite for indepth scientific studies on AquaFuel.

7) Identify compressibility of AquaFuel to the liquid state. A knowledge of the physical characteristics of temperature, pressure, etc., for the compressibility of AquaFuel to the liquid state is needed, as an evident pre-requisite for its storage in tanks.

8) Identify the structure of the electric discharge in AquaFuel. It is generally believed that electric discharges are composed of an intense flow of individual electrons. As explained in the next section, there are reasons to suspect that this is not necessarily the case for AquaFuel because of the alternative possibility already established in superconductivity that the electric discharge could be composed by an intense flow of electron pairs. The possible detection of the latter is evidently important, not only for an indepth



scientific study of AquaFuel but, also, as a foundation of a new technology.

9) Optimize AquaFuel. On the achievement of at least the most important measures identified above, an important objective of TTL is the maximization of the characteristics of AquaFuel depending on the application at hand, such as the optimization of the energy/BTU content for combustion, the minimization or elimination of harmful by-products in recycling applications, etc.

## 6 Applications of AquaFuel

The applications of AquaFuel as a combustible gas which have been identified until now are truly numerous and can be divided into three classes:

APPLICATIONS OF CLASS I: FUEL. In this class we note:

I.1) Motor fuel because of the remarkable reduction of pollutants in the exhaust, high energy content, better safety, and other aspects indicated earlier;

I.2) Heating fuel for homes and industries, for the same reasons;

I.3) Cooking fuel, because clearly preferable over methane and other gases;

I.4) Industrial fuel for a variety of uses, such as for the furnaces of the steel industry and others;

I.5) Emergency fuel, for instance, for the continuation of service in a broken pipeline of natural gas;

And others.

APPLICATIONS OF CLASS II: SERVICE. In this class we note:

II.1) Production of electricity for various industrial and consumer uses;

II.2) Recycling of liquid waste such as sewage;

II.3) Recycling of solid waste such as rubber tires;

II.4) Environmental clean-ups;

II.5) Desalination;

and other uses.

APPLICATIONS OF CLASS III: PROCESSING. In this class we note:

III.1) Separation of water;

III.2) Production of new chemicals;

III.3) Production of gases;

and other possibilities currently under study.

In summary, AquaFuel is a new combustible gas with undeniably less pollutant when compared to other fuels of current uses, it is very simple to be rapidly produced in large volumes, and it exhibits features which are clearly beyond pre-existing theories. As such, AquaFuel not only has many valuable characteristics and applications available now, but also constitutes a sound platform for systematic research leading to new technologies.

## 7 The New Methods Needed For Scientific Studies Of New Energies

Quantitative scientific studies of new forms of energy in general, and of AquaFuel in particular, require the consideration of all possible or otherwise expected profiles, including studies within the context of particle physics, nuclear physics, chemistry, thermodynamics, superconductivity, and other disciplines.

Rather than being a drawback, this occurrence is important because the conduction of in depth, mathematical, theoretical and experimental studies on new forms of energy is expected to permit the understanding of their origin, which is an evident pre-requisite for the improvement of their efficiency in a systematic scientific way, rather than via the current empirical process of endless *trials and errors*.

It should be indicated from the outset that the use of conventional theories, such as Quantum Mechanics and Chemistry, has not permitted a scientific resolution of the various issues one way or the other, and has only caused unresolved controversies (see, e.g., the related articles on AquaFuel and other topics in Refs. [2]).

It is today well established that the sole use of these theories has no longer a final scientific value for new energies. In fact, these energies, to be truly *new*, by definition and conception, have to be *beyond* said conventional theories. This is due to the fact that quantum mechanics and chemistry have well defined limitations, while the processes underlying new energies clearly go beyond these limitations.

Unfortunately, the limitations of quantum mechanics and chemistry are *the best kept secrets of the trade* in the sense that they are known to true experts in the field, but never disclosed during Ph.D. classes or in orthodox technical papers. In fact, the very admission of these limitations is a de facto

admission of the need for more adequate theories, and this is notoriously against established interests.

A systematic study of these limitations has been recently made available by this author in monographs [4]. As a nontechnical outline, we here mention that quantum mechanics and chemistry have a structure which is linear (i.e., only dependent on the first power of the wavefunctions), local (i.e., solely defined for a finite set of isolated points) and potential (i.e., only admitting action-at-a-distance interactions derivable from a potential energy).

As a consequence, quantum mechanics and chemistry can only represent systems as being composed of point-like particles with action-at-a-distance interactions. As an example, the valence electrons of the molecules used in new forms of energy (e.g., the water used by AquaFuel) are represented in contemporary quantum chemistry as dimensionless points.

Though of unequivocal scientific value, this is evidently only an approximation of nature because, in the physical reality, all particles, including the valence electrons, have an extended wavepacket of the order of  $10^{-13}$  cm.

When the particles are at the (relatively) large mutual distances of an atomic structure ( $10^{-8}$  cm – which is 10,000 times bigger than the size of the wavepackets of the electrons), their extended character can be effectively ignored and the resulting theories are exact.

The best known example of the exact validity of quantum mechanics is the atomic structure. In fact, quantum mechanics has represented in a numerically exact way the totality of experimental data on the structure of the Hydrogen atom.

The best known example of the limitations of quantum mechanics and chemistry is the study of the two Hydrogen atoms composing the Hydrogen molecule because:

- 1) Quantum chemistry cannot represent the strongly attractive force between the two atoms since they are neutral, thus implying null average Coulomb forces among the atoms;

- 2) Quantum chemistry has been unable to represent throughout this century 100% of the binding energy of the Hydrogen molecule;

- 3) Quantum chemistry cannot explain why the Hydrogen and water molecules have only two atoms, since it has been proved to admit an arbitrary number of atoms;

- 4) Quantum chemistry cannot permit meaningful thermodynamical studies on reactions based on the Hydrogen and water molecules because the 2% of binding energy which is not accounted for is deceptively small, since it

corresponds to about 950 Kilocal/mole while an ordinary reaction requires about 20 Kilocal/mole;

5) Thermodynamics predicts a behavior of the Hydrogen and water molecules under electric and magnetic fields dramatically against experimental evidence (e.g., the capability for the molecule to be magnetized like an ordinary ferromagnet); and other shortcomings.

The origin of the above shortcomings is in the structure of molecules themselves, where we have valence electrons which can interact at mutual distances of the order of the size of their wavepackets, which is a distance 108 times smaller than the atomic distances. Under the latter conditions the extended size of the wavepacket of the particle is no longer ignorable, thus implying a clear limitation of quantum mechanics and chemistry.

In fact, the deep overlapping of the wavepacket of particles implies new interactions which are technically called nonlinear (in the sense of depending on powers of the wavefunctions bigger than one), nonlocal (in the sense that they are extended over the volume of wave-overlappings which cannot be evidently reduced to finite number of isolated points), as well as nonpotential (in the sense of being of contact / zero-range type for which the notion of action-at-a-distance potential has no mathematical or physical meaning of any type).

As such, the representation of the deep overlapping of the wavepackets of valence electrons as well as of other nuclear events is beyond any credible hope of quantitative treatment via quantum mechanics or chemistry on conceptual, mathematical and physical grounds.

To put it explicitly, any treatment of truly new forms of energy via quantum mechanics and chemistry is not scientific if considered as of *final* character because these disciplines approximate everything as *points*, thus being unable to represent in any credible way the main mechanisms which are at the very foundation of the new energies.

Comprehensive studies on the structural generalization of quantum mechanics for quantitative treatments of nonlinear, nonlocal and nonpotential interactions at short distances were initiated by R. M. Santilli at Harvard University back in 1978 under support from the U.S. Department of Energy [3]. The studies were then continued by an increasing number of scientists, and have resulted in over 10,000 pages of published research, including about one thousand papers published in numerous mathematics and physics journals all over the world, some 20 advanced (post Ph. D.) monographs and about 40 volumes of proceedings of international conferences held in the

USA and Europe (see monographs [4]). As a result of these collegial efforts Hadronic Mechanics has today reached operational maturity (see the recent 104 page long memoir [5]).

The new mechanics was called by Santilli Hadronic Mechanics to characterize the description of strongly interacting particles, such as the nuclear constituents, collectively called *hadrons*, under conventional long-range potential, as well as short-range, nonlinear, nonlocal and nonpotential interactions. It should be indicated that Hadronic Mechanics is the only mechanics available today for the consistent treatment of the new nonlocal and nonpotential interactions due to deep wave-overlappings. Other generalized theories have well-known physical inconsistencies, such as the inability to have unique and invariant numerical predictions.

Note that Hadronic Mechanics coincides with quantum mechanics at large distances. Moreover, Hadronic Mechanics preserves all conventional quantum laws, such as Pauli's exclusion principle, Heisenberg's uncertainty law, etc., and only realize them in a more general way.

The only differences occur at distances of the order of  $10^{-13}$  cm. As a result, Hadronic Mechanics has achieved Einstein's historical *completion* of quantum mechanics with new, generally small contributions at short range.

Hadronic Mechanics has permitted the construction of a broadening of quantum chemistry called Hadronic Chemistry [12] (also called *isochemistry* for certain technical reasons). Again, quantum and hadronic chemistry coincide everywhere except at short distances where the new chemistry includes the nonlinear, nonlocal and nonpotential effects which are absent in the older theory.

A main feature of the Hadronic Mechanics and Chemistry which is important for all new forms of energy, including AquaFuel, is that:

When two particles couple themselves in a singlet at short distances (one with spin up and one with spin down) the new nonlinear, nonlocal and nonpotential forces due to deep wave-overlappings are so attractive to overcome possible repulsive Coulomb forces, and permit new bound states at short distances which simply cannot be conceived - let alone treated - by quantum mechanics and chemistry.

The sphere with radius  $1 \text{ fm} = 10^{-13}$  cm in which Hadronic Mechanics and Chemistry have the novel effects is called hadronic horizon. In the outside of the hadronic horizon conventional quantum mechanics and chemistry hold, while in its interior the broader hadronic mechanics and chemistry hold. Conventional physical laws (such as Pauli's exclusion principle, total conser-

vation laws, etc.) hold everywhere including in the interior of the hadronic horizon.

If particles have opposite charges, they naturally penetrate such a horizon (when in singlet coupling and under a number of other conditions, such as the conservation of energy and other total quantities) by therefore activating the new effects rather spontaneously. This is the case of electrons and positrons which naturally attract each other and can apparently form a new bound state at short distance (in addition to the known electronium at large distances) commonly known as the neutral  $\pi$ -meson [3].

On the contrary, if particles have the same charges, they can penetrate the hadronic horizon only under the assistance of an outside trigger, namely external conventional interactions which favor the particles to move toward each other against their repulsive Coulomb force. This is the case of the coupling of the valence electrons in molecular bonds in which the *trigger* is given by the nuclei of the molecules which, being positively charged, attract the the valence electrons to such short distances to permit their bond [12].

Systematic studies of the physical laws of new forms of energy as predicted by hadronic mechanics and chemistry are under way [11]. We outline below some of the advances permitted by the new theories which are playing a basic role in these studies. In fact, hadronic mechanics and chemistry have permitted:

1) The first theoretical representation of the bond of two identical electrons in the Cooper pair of superconductivity [6]:

$$e + e + \text{trigger} \rightarrow \text{CP} \quad (\text{Cooper Pair at } 10^{-8} \text{ cm}) , \quad (1)$$

which is in excellent agreement with experimental data in superconductivity, where the *trigger* is given by the Cuprate ions (see Refs. [6] for technical details, including the clear emergence of nonlinear, nonlocal and nonpotential effects as a necessary condition for the attraction).

The scientific scenario can be here identified in a way so clear to un-mask possible nonscientific postures in favor of old theories for personal gains.

On one side, physical reality establishes that electrons can bond themselves, not only in the Cooper pair (where the bond is so strong that the coupled electrons have been detected to tunnel together through a potential barrier), but also in the Helium (where the two orbital electrons often travel bonded together rather than isolated), as well as in ball lightning (in which electrons bond together in very large numbers as per incontrovertible

evidence, this time visible by the naked eye).

On the other side, quantum mechanics and chemistry simply cannot represent this physical reality at the level of individual electron pairs because of the Coulomb repulsion (they do provide a representation but only at the statistical level of an ensemble of pairs which is absolutely not the issue here, since we are referring to specific differential equations of structure clearly exhibiting an attraction for one single and individual pair of electrons [6]).

Ergo, quantum mechanics and chemistry have limitations which cannot be denied as a condition for scientific credibility. The moment these limitations are admitted, and only then, the door is open to truly basic advances.

Hadronic Mechanics and Chemistry do indeed permit a quantitative-numerical representation of the *attractive* force between the *identical* electrons in the Cooper pair, the Helium, the ball lightning and other events in excellent agreement with experimental data [6].

By no means these results are expected to be unique because a beauty of real science is its polyhydric character. Studies with alternative approaches are not only welcome but actually solicited, provided that they achieve similar results in an invariant form.

2) A new model of the Hydrogen molecule with the first explicitly attractive force between neutral atoms due to the pairing of the valence electrons into a hadronic bound state at short distances called *isoelectronium* [12],



where the trigger is in this case given by the positive nuclei of the Hydrogen molecule.

Hadronic Mechanics and chemistry have resolved all the shortcomings of quantum chemistry indicated earlier, by reaching for the first time: an explicit attractive force among the neutral atoms of the molecular bond due to the short range bonding of the valence electrons into a single state; a representation of 100% of the experimental data; a quantitative explanation of why only two Hydrogen atoms are admitted in the molecule; and other advantages over quantum chemistry.

3) A new model of the water molecule which resolves at least some of the existing problematic aspects [12]. The reader should be aware that despite the conduction of studies since the initiation of science, the structure of water remains vastly known at this writing.

In fact quantum chemistry: a) does not admit a significant attractive

force among the neutral atoms composing the molecule (the esoteric forces currently believed to yield the bond, such as the exchange or van der Waal forces, have been rigorously proved to yield very small, thus insufficient attractions); b) has been unable to represent 100% of the experimental data on the binding energy, electric and magnetic moments and other aspects; c) has been proved to admit admit an arbitrary number of Hydrogen atoms in flagrant disagreement with evidence; d) cannot permit meaningful thermodynamical studies due to the excessively large error in thermodynamical units recalled earlier; e) predicts a behavior of water under magnetic and electric fields which is in dramatic disagreement with experimental evidence (e.g., it has been proved via the use of quantum electrodynamics that water under a magnetic field should acquire a net North-South polarity as for an ordinary ferriomagnet, in gross disagreement with experimental evidence); and possesses other, generally unknown insufficiencies.

It is evident that, under all these insufficiencies, no study of new forms of energy using water, such as AquaFuel, SkyGas, water explosions, etc., can be considered as *final*.

It is evident that the true scientific evidence is the limitation of quantum chemistry for truly scientific studies of these new forms of energy.

Again, once these limitations are admitted, the door is open to basic advances. Hadronic Chemistry resolves the above insufficiencies by permitting a deeper (although never *final*) understanding of water [12]. Other approaches are welcome and encouraged.

4) The first theoretical representation of the synthesis of the neutron as occurring in stars at their formation, namely, from protons and electrons only (because at their formation stars are solely made up of Hydrogen) according to the reaction [7]



The above reaction verifies all known physical laws. Nevertheless, its rate (cross section) according to quantum mechanics is very small and, therefore, the reaction is believed not to have practical value. Hadronic mechanics recovers the above low rate for all energies, except at a specified threshold energy in which the rate of reaction (3) has a large peak.

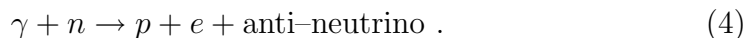
Note that quantum mechanics cannot represent the neutron as a bound state of a proton and an electron only because of a host of inconsistencies all resolved by the Hadronic Mechanics and Technologies.

We should finally note that, though preliminary and in need of indepen-



dent re-runs, an experimental verification of synthesis (3) was successfully conducted in Brasil [8].

5) The first theoretical representation of the stimulated decay of the neutron [9] according to the reaction

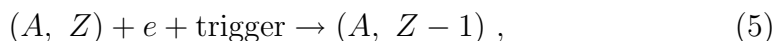


Again, the above reaction verifies all known physical laws. Quantum mechanics predicts that its rate is very small for all possible energies of the photon, thus having no practical value. Hadronic Mechanics and Technologies recover this feature, but predict the existence of a large peak in the rate of reaction (4) at a specific resonating frequency, thus permitting the stimulated decay of the neutron in a form suitable for industrial applications.

It should be noted that the proton is stable and, as such, cannot be stimulated to decay according to current knowledge. On the contrary, the neutron is naturally unstable. The identification of means for its stimulated decay is, therefore, only a matter of time.

We should finally note that, though preliminary and in need of independent re-runs, an independent experimental verification of synthesis (3) was successfully conducted in Greece [10].

6) Stimulated nuclear transmutations due to an electron capture by certain nuclei [11]. Nature establishes the existence of the spontaneous electron capture (EC), a process in which a given nucleus  $(A, Z)$  with total number of protons and neutrons  $A$  and total number of protons  $Z$  (the nuclear charge) absorbs one electron from the environment or from the peripheral atomic cloud. During this process the atomic number  $A$  evidently remains the same, but  $Z$  decreases by one unit because we have the synthesis of one neutron from a proton and an electron as per reaction (3), thus resulting in the nuclear reaction

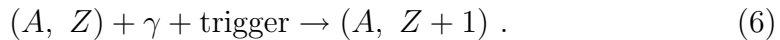


where the trigger represents all the conditions needed to allow the reactions, such as the energy missing in order to verify the basic principle of conservation of the energy.

Since the above reaction occurs spontaneously in nature (under the right circumstances), Hadronic Mechanics and Technologies predict that it can be stimulated under suitable conditions.

Note that transmutation (5) is predicted at a sub-nuclear level, that is, it should be studied as a process in the interior of one-nuclear constituent, because the same transmutation is not possible when studied at the nuclear level, that is, at the level of a nucleus as a collection of protons and neutrons.

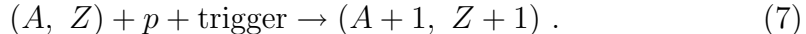
7) Stimulated nuclear transmutations due to neutron decay [11]. If reaction (4) occurs in nature for an isolated neutron, it must evidently occur also when the same neutron is a member of a nuclear structure, resulting in the stimulated nuclear decay



Note, again, that the above stimulated nuclear transmutation can only occur at one, single, fixed resonating frequency, and can only occur at the sub-nuclear level, rather than at the level of a nucleus as a collection of protons and neutrons.

8) Stimulated nuclear transmutations due to proton capture [11]. Physical evidence establishes that two identical electrons can bond themselves into one single state, the Cooper pair in superconductivity, Eq. (1). A similar occurrence exists in the bond of the valence electrons in molecular structures, Eq. (2). It is evident that this physical reality is independent of the charge and the mass. As a result, the experimental evidence on the Cooper pair is de facto evidence on the expected existence of a similar occurrence for protons.

Hadronic Mechanics and Technologies therefore predict that, evidently under certain conditions, one proton can indeed bond itself to a nucleus despite their repulsive Coulomb forces, according to the reaction



We merely have an occurrence equivalent to the experimentally established creation of ball lightning, which is constituted by individual electrons bonding themselves to a large number of identical electrons. According to quantum mechanics, the creation and growth of such ball lightning is not allowed because of the Coulomb repulsion. Yet the phenomenon exists in the physical reality. Therefore, to do science, we have to accept physical evidence and modify the theory to reach its quantitative interpretation, rather than trying to adapt physical evidence to pre-existing theories. Hadronic Mechanics and technologies do precisely that, by surpassing pre-existing theories to accommodate experimental facts.

The case on one proton bonding itself to a nucleus under the necessary conditions is fully equivalent in all respects to the accretion of ball lightning. The sole difference is that the proton is heavier than the electrons and the charges of reaction (7) are positive, rather than negative. The important point is that the underlying physical laws are exactly the same.

9) New thermochemical reactions [6]. It is evident that the availability of a new model of molecular bonds in general, and of the structure of water in particular, imply new chemical features and reactions which, as it is the case for stimulated nuclear transmutations (5), (6) and (7), simply cannot be predicted, let alone treated via quantum chemistry. One of these predictions which has already been verified experimentally is a novel behavior of the water and new chemical reactions under electric and magnetic fields with consequential release of new forms of energy.

It is evident that all the above new advances 1) – 9) are potentially applicable to new forms of energy, including AquaFuel, and they will likely identify new technologies.

The theoretical research under way therefore contemplates the systematic application of the above new advances to various aspects of new energies including:

A) Particle physics, such as the possibility that electric discharges are made up of isoelectronium pairs, rather than individual electrons as currently believed until now;

B) Nuclear physics, such as the expected nuclear transmutation due to stimulated electron capture, decay of the neutron from the intense light in the discharge, accretion of protons in the completely ionized plasma, etc.;

C) Chemistry, such as possible new chemical bonds and new chemical reactions with related release of new energies that are inconceivable for quantum chemistry;

D) Thermodynamics, such as the new energy calculations which are not possible at the moment due to the excessive error indicated earlier;

E) Superconductivity, because an electric discharge is the ideal limit case of superconductivity;  
and other aspects.

We hope to report in Infinite Energy the most salient advances on the above research for the benefit of all new forms of energies.

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## References

- [1] W. H. Richardson, jr., US Pat 5,435,274 "Electrical power generation without harmful emissions", July 25, 1995; US 5,692,459 "Pollution free vehicle operation", Dec 2, (1992); patents pending.
- [2] Infinite Energy no. 9, 1996; no. 10, 1996; no. 11, 1996; no. 13 1997; and no. 14, 1997; International Journal of Hydrogen Energy no. 21, Feb 1996 p 142 in H. Roger Hind's column "News and Views"
- [3] R. M. Santilli, in Hadronic J. no. 1 and 2, (1978).
- [4] R. M. Santilli, Elements of Hadronic Mechanics, Vols. I and II, Ukraine Academy of Sciences, Kiev, second edition, (1995).
- [5] R. M. Santilli, Found. Phys. Vol. 27, 625, (1997).
- [6] A. O. E. Animalu, Hadronic J. no. 17, p. 379 (1995). A. O. E. Animalu and R. M. Santilli, Intern. J. Quantum Chemistry 29, 175 (1995).
- [7] R. M. Santilli, JINR Comm. no. E4-93-352, Dubna, Russia; and Chinese J. Syst. Eng. & Electr. (patent pending).
- [8] C. Borghi et al. (Russian) J. Nuclear Physics Vol. 56, 147, (1993).
- [9] R. M. Santilli, in the Proceedings of International Symposium on Large Scale Collective Motion of Atomic Nuclei, G. Giardina et al., Editors, World Scientific, Singapore (1997) (patent pending).
- [10] N. F. Tsagas et al., Hadronic J. Vol. 19, 87 (1996).

- [11] R. M. Santilli, "Physical laws of the emerging new energies as predicted by hadronic mechanics and chemistry", I, II and III IBR preprints RMS-003, 004 and 005 (1998)(patent pending).
- [12] R. M. Santilli and D. Shillady, "Ab initio isochemistry", I and II, IBR preprints 1998 submitted for publication. R. M. Santilli and D. D. Shillady, Hadronic J. vol. 21 (1998), in press.