A new gaseous and combustible form of water

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Abstract

In this paper we present, apparently for the first time, various measurements on a mixture of hydrogen and oxygen called HHO gas produced via a new electrolyzer (international patents pending by Hydrogen Technologies Applications, Inc. of Clearwater, Florida), which mixture is distinctly different than the Brown and other known gases. The measurements herein reported suggest the existence in the HHO gas of stable clusters composed of H and O atoms, their dimers H–O, and their molecules H_2, O_2 and H_2O whose bond cannot entirely be of valence type. Numerous anomalous experimental measurements on the HHO gas are reported in this paper for the first time. To reach their preliminary, yet plausible interpretation, we introduce the working hypothesis that the clusters constituting the HHO gas constitute another realization of a recently discovered new chemical species called for certain technical reasons *magnecules* as well as to distinguish them from the conventional "molecules" [Santilli RM. Foundations of hadronic chemistry with applications to new clean energies and fuels. Boston, Dordrecht, London: Kluwer Academic Publisher; 2001]. It is indicated that the creation of the gaseous and combustible HHO from distilled water at atmospheric temperature and pressure occurs via a process structurally different than evaporation or separation, thus suggesting the existence of a new form of water, apparently introduced in this paper for the first time, with the structure (H × H)–O where "×" represents the new magnecular bond and "−" the conventional molecular bond. The transition from the conventional H–O–H species to the new (H × H)–O species is predicted by a change of the electric polarization of water caused by the electrolyzer. When H–O–H is liquid, the new species (H × H)–O can only be gaseous, thus explaining the transition of state without evaporation or separation energy. Finally, the new species (H × H)–O is predicted to be unstable and decay into H × H and O, by permitting a plausible interpretation of the anomalous constituents of the HHO gas as well as its anomalous behavior. Samples of the new HHO gas are available at no cost for independent verifications, including guidelines for the detection of the new species.
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1. Introduction

Studies on the electrolytic separation of water into hydrogen and oxygen date back to the 19th century (for a textbook on the water molecule see, e.g., Ref. [1a] and for an account on its electrolytic separation see, e.g., Ref. [1b]). More recently, there has been considerable research in the separation of water into a mixture of hydrogen and oxygen gases. These studies were initiated by Yull Brown in 1977 via equipment generally referred to as electrolyzers and the resulting gas is known as "Brown gas" (see patents [2]).

In accordance with these patents as well as the subsequent rather vast literature in the field, the Brown gas is defined as a combustible gas composed of conventional hydrogen and conventional oxygen gases having the exact stochiometric ratio of $\frac{2}{3}$ (or 66.66% by volume) of hydrogen and $\frac{1}{3}$ (or 33.33% by volume) of oxygen.

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In this paper the author (a physicist) presents to the chemistry community for its independent verification various measurements on an apparently new mixture of hydrogen and oxygen hereon referred to as the HHO gas (international patent pending) developed by Hydrogen Technology Applications, Inc., of Clearwater, Florida (www.hytechapps.com). The new HHO gas is regularly produced via a new type of electrolyzer and has resulted to be distinctly different in chemical composition than the Brown gas, even though both gases share a number of common features.

The main scope of this paper is to report, apparently for the first time, new clusters of hydrogen and oxygen atoms contained in the HHO gas, which clusters appear to escape the traditional valence interpretation and constitute one of the novelties of the HHO gas over the Brown gas.

Another objective of this paper is to initiate quantitative studies on the rather unique features of the HHO gas that do not appear to be representable via the conventional quantum chemistry of hydrogen and oxygen gases.

Yet another objective of this paper is to present a working hypothesis to initiate the understanding of the capability by the HHO electrolyzers to perform the transition of water from the liquid to a gaseous state via a process structurally different than evaporation or separation, due to the use of energy dramatically less than that required by said evaporation or separation.

The final objective of this paper is the submission, apparently for the first time, of a new form of the water molecule created by the HHO electrolyzers via the removal of its natural electric polarization and consequential collapse of the two HO dimers, from their conventional configuration with 105° to a new configuration in which the two dimers are collapsed one against the other due to their neutral charge and strongly attractive opposing magnetic polarizations.

Due to the loss of electric polarization, polymerization and other features, the above new form of the water molecule permits a plausible representation of the creation of the HHO gas from liquid water without the evaporation energy. Its unstable character also permits a plausible interpretation on the experimental measurements of all anomalous features of the HHO gas.

Independent verification by interested chemists of the various measurements reported in this paper are solicited, jointly with the conduction of additional much needed tests. Samples of the HHO gas can be obtained at any time by contacting Hydrogen Technology Applications, Inc. at their website www.hytechapps.com.

2. Experimental measurements on the new HHO gas

Under visual inspection, both the HHO gas results to be odorless, colorless and lighter than air, as it is also the case for the Brown gas. Their first remarkable feature is the efficiency E of the electrolyzer for the production of the gas, here simply defined as the ratio between the volume of HHO gas produced and the number of Watts needed for its production. In fact, the electrolyzers rapidly convert water into 55 standard cubic feet (scf) of HHO gas at 35 pounds per square inch (psi) via the use of 5 kWh, namely, an efficiency that is at least 10 times the corresponding efficiency of conventional water evaporation, thus permitting low production costs.

The above efficiency establishes the existence of a transition of water from the liquid to the gaseous state that is not caused by evaporation. By keeping in mind the combustible character of the HHO gas compared to the noncombustible character of water vapor, the above efficiency suggests the existence of new chemical processes in the production of the gas that deserve quantitative studies.

A second important feature is that the HHO gas does not require oxygen for combustion since the gas contains in its interior all oxygen needed for that scope, as it is also the case for the Brown gas. By recalling that other fuels (including hydrogen) require atmospheric oxygen for their combustion, thus causing a serious environmental problem known as oxygen depletion, the capability to combust without any oxygen depletion (jointly with its low production cost) render the gas particularly important on environmental grounds.

A third feature of the gas is that it does not follow the PVT of gases with conventional molecular structure, since the gas reacquires the liquid water state at a pressure of the order of 150 psi, while conventional gases acquire the liquid state at dramatically bigger pressures. This feature suggests that the gas here considered does not possess a conventional molecular structure, namely, a structure in which the bond is of entire valence type.

A fourth feature of the gas is its anomalous adhesion (adsorption) to gases, liquids and solids, as verified experimentally below, thus rendering its use particularly effective as an additive to improve the environmental quality of other fuels, or other applications. This feature is manifestly impossible for conventional gases H_2 and O_2, thus confirming again a novel chemical structure.

A fifth feature of the gas is that it exhibits a widely varying thermal content, ranging from a relatively cold

flame in open air at about 150 °C, to large releases of thermal energy depending on the substance to which the flame is applied to, such as the instantaneous melting of bricks requiring up to 9000 °C.

The measurements conducted by the author at various independent laboratories on the HHO gas can be summarized as follows.

On June 30, 2003, Adsorption Research Laboratory of Dublin, Ohi, measured the specific weight of the HHO gas and released a signed statement on the resulting value of 12.3 g/mol. The same laboratory repeated the measurement on a different sample of the gas and confirmed the result.

The released value of 12.3 g/mol is anomalous. In fact, the conventional separation of water into H_2 and P_2 produces a mixture of $\frac{2}{3}$ HBN_2 and $\frac{1}{3}$ O_2 that has the specific weight $(2 + 2 + 32)/3 = 11.3$ g/mol.

Therefore, we have the anomaly of $12.3 - 11.2 = 1$ g/mol, corresponding to 8.8% anomalous increase in the value of the specific weight. Rather than the predicted 66.66% of H_2 the gas contains only 60.79% of the species with 2 atomic mass units (amu), and rather than having 33.33% of O_2 the gas contains only 30.39% of the species with 32 amu.

These measurements provide direct experimental evidence that the HHO gas is not composed of a sole mixture of H_2 and O_2, but has additional *heavier* species.

Moreover, the HHO gas used in the tests was produced from distilled water. Therefore, there cannot be an excess of O_2 over H_2 to explain the increased specific weight. The above measurement establishes the presence in HHO of 5.87% of hydrogen and 2.94% oxygen bonded together into species heavier than water, as identified below via mass spectroscopy and other analytic measurements.

Adsorption Research Laboratory also conducted scans of the HHO gas via a Gas Chromatographer (GC) reproduced in Fig. 1 establishing the presence in the HHO gas of the following species here presented in order of their decreasing percentages:

(1) A first major species with 2 amu expectedly representing gaseous hydrogen.
(2) A second major species with 32 amu expectedly representing gaseous oxygen.
(3) A large peak at 18 amu expectedly representing water vapor.
(4) A significant peak with 33 amu expectedly representing a new species expectedly of nonmolecular nature.
(5) A smaller yet clearly identified peak at 16 amu expectedly representing atomic oxygen.
(6) Another small yet fully identified peaks at 17 amu expectedly representing the radical OH whose presence in a gas is also anomalous.
(7) A small yet fully identified peak at 34 amu expectedly representing the bond of two dimers HO that is also anomalous for a gas.
(8) A smaller yet fully identified peak at 35 amu that cannot be identified in any known molecule.
(9) Additional small peaks expected to be in parts per million.

It should be added that the operation of the GC detector was halted a few seconds following the injection of the HHO gas, while the same instrument was operating normally with other gases. This anomalous behavior can be best interpreted via an anomalous adhesion of the gas to the walls of the feeding line as well as of the column and other parts of the instruments, an anomalous adhesion confirmed by additional tests reviewed below.

On July 22, 2003, the PdMA Corporation in Tampa, Florida, conducted InfraRed (IR) scans reported in Figs. 2–4 via the use of a Perkin-Elmer IR scanner model 1600 with fixed point/single beam. The reported scans refer to a conventional H_2 gas (Fig. 2), a conventional O_2 gas (Fig. 3), and the HHO gas (Fig. 4).

Inspection of these scans shows a substantial differences between HHO gas and H_2 and O_2 gases. In fact, the latter gases are symmetric molecules, thus having very low IR peaks, as confirmed by scans 2 and 3. The first anomaly of HHO is that of showing comparatively much stronger resonating peaks. Therefore, the indicated IR scans establish that the HHO gas has an asymmetric structure, which is remarkable since the same feature is absent for the conventional mixture if H_2 and O_2 gases.

Moreover, H_2 and O_2 gases can have at most two resonating frequencies each, one for the vibrations and the other for rotations. Spherical distributions of orbitals and other features imply that H_2 has essentially only one IR signature as confirmed by the scan of Fig. 2, while OO_2 has one vibrational IR frequency and three rotational ones, as also confirmed by the scans of Fig. 3.

Inspection of the IR scans for the HHO gas in Fig. 4 reveals additional novelties. First, the HHO scan show the presence of at least nine different IR frequencies grouped around wavenumber 3000, plus a separate distinct frequency at around wavenumber 1500.

These measurements provide experimental evidence that the species with 18 amu detected in the GC scans of Fig. 1 is not water vapor, but a yet unknown bond of two hydrogen and one oxygen atoms.
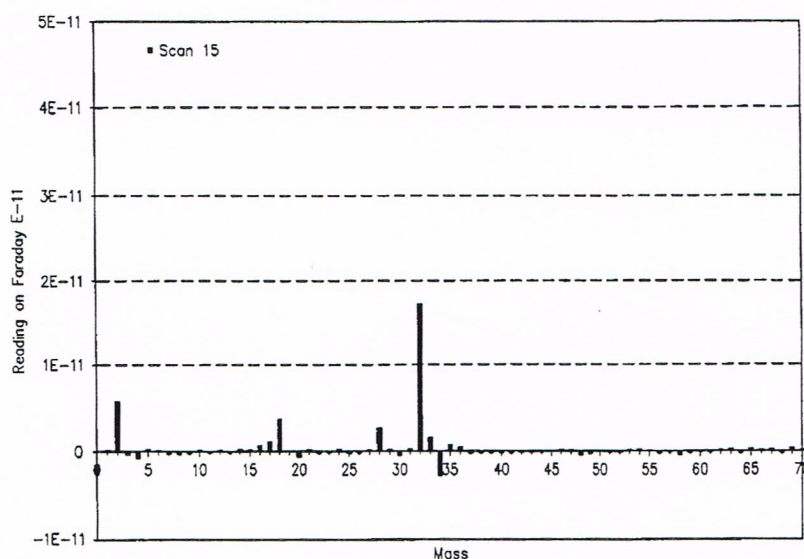
Fig. 1. A view of one of the GC scans on the HHO gas conducted by Adsorption Research Laboratories showing conventional as well as anomalous peaks.
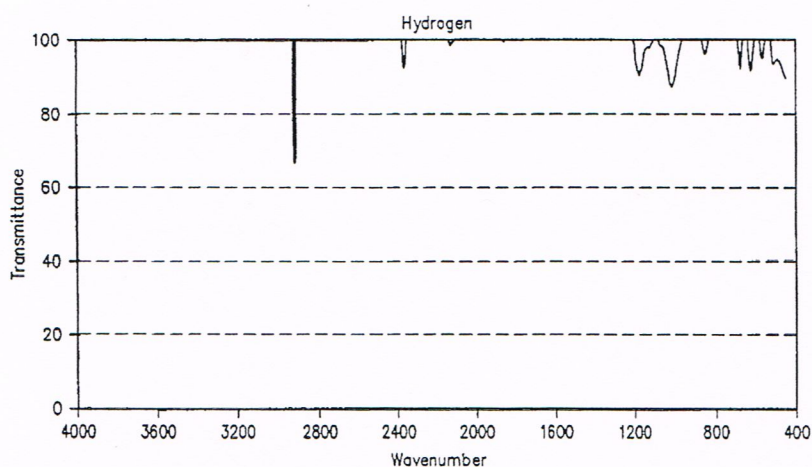

Fig. 2. The IR signature of a conventional H_2 gas made by the PdMA laboratory.

In fact, water vapor has IR frequencies with wavelengths 3756, 3657, 1595, their combination and their harmonics (here ignored for simplicity). The scan for the HHO gas in Fig. 4 confirms the presence of an IR signature near 1595, thus confirming the molecular bond HO, but the scan shows no presence of the additional very strong signatures of the water molecules at 3756 and 3657, thus establishing the fact that the peak at 18 amu is not water as conventionally understood in chemistry.

On July 22, 2003, the laboratory of the PdMA Corporation in Tampa, Florida measured the flash point, first on commercially available diesel fuel, detecting a flash point of 75 °C, and then of the same fuel following the bubbling in its interior of the HHO gas, detecting the flash point of 79 °C.

The latter measurement too is anomalous because it is known that the addition of a gas to a liquid fuel *reduces* its flash point generally by half, rather than *increasing* it as in the above measurement, thus implying the expected flash value of about 37 °C for the mixture of diesel and HHO gas. Therefore, the anomalous increase of the flash point is not of 4 °C, but of about 42 °C.
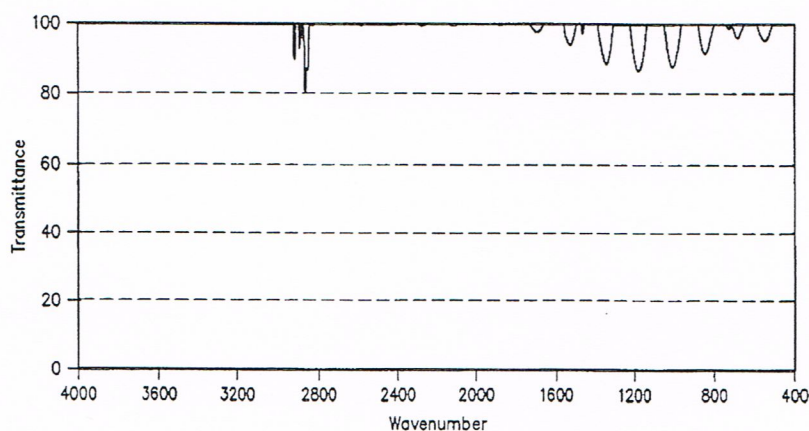
Fig. 3. The IR signature of a conventional O_2 gas made by the PdMA laboratory.
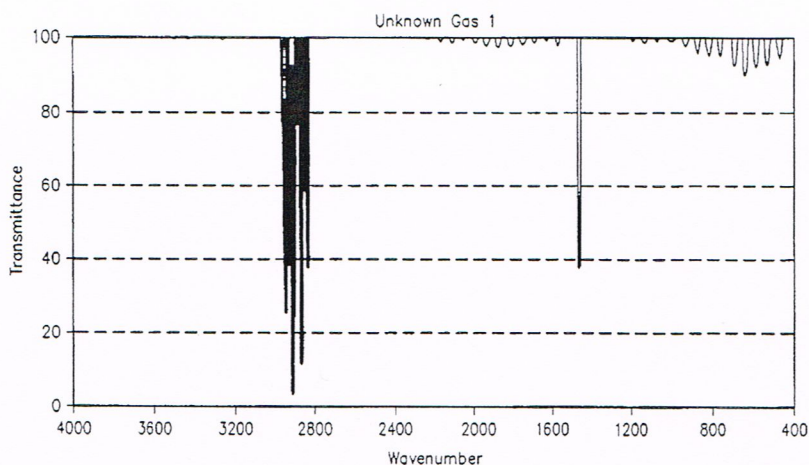

Fig. 4. The IR signature of the HHO gas made by the PdMA laboratory. When compared to the IR scans of Figs. 2 and 3, this scan shows that the HHO gas is not a mixture of H_2 and O_2 gases.

Such an increase cannot be explained via the assumption that HHO is contained in the diesel in the form of a gas (otherwise the flash point would decrease), and requires the occurrence of some type of anomalous bond between the gas and the liquid that cannot possibly be of valence type.

An experimental confirmation of the latter bond was provided on August 1, 2003, by the Southwest Research Institute of Texas, that conducted mass spectrographic measurements on one sample of ordinary diesel as used for the above flash point measurements, here reported in Fig. 5, and another sample of the same diesel with HHO gas bubbled in its interior, here reported in Fig. 6.

The measurements were conducted via a total ion chromatogram (TIC) and gas chromatography mass spectrometry GC-MS manufactured by Hewlett Packard with GC model 5890 series II and MS model 5972. The TIC was obtained via a Simulated Distillation by Gas Chromatography (SDGC).

The column was a HP 5MS 30×0.25 mm; the carrier flow was provided by helium at $50\,°C$ and $5\,psi$; the initial temperature of the injection was $50\,°C$ with a temperature increase of $15\,°C$ per minute and the final temperature of $275\,°C$.

The chromatogram of Fig. 5 confirmed the typical pattern, elution time and other feature of commercially available diesel. However, the chromatograph of the same diesel with the HHO gas bubbled in its interior of Fig. 6 shows large structural differences with the preceding scan, including a much stronger response, a bigger elution time and, above all, a shift of the peaks toward bigger amu values.
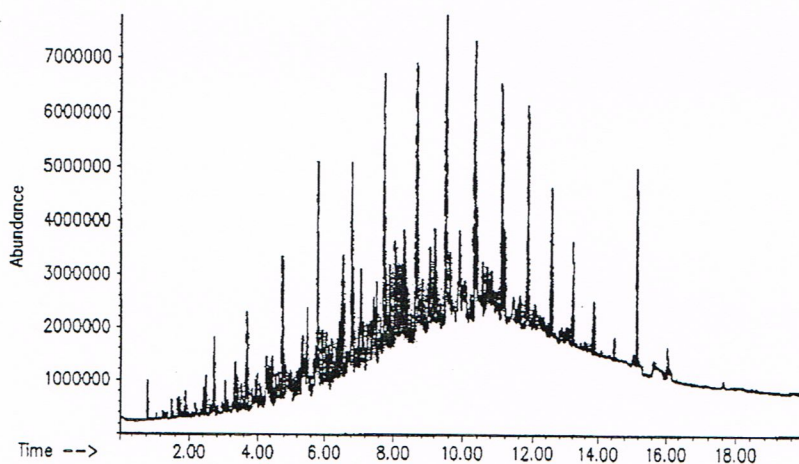
Fig. 5. A TIC of the GC-MS scans of conventionally sold diesel fuel made by Southwest Research Institute.
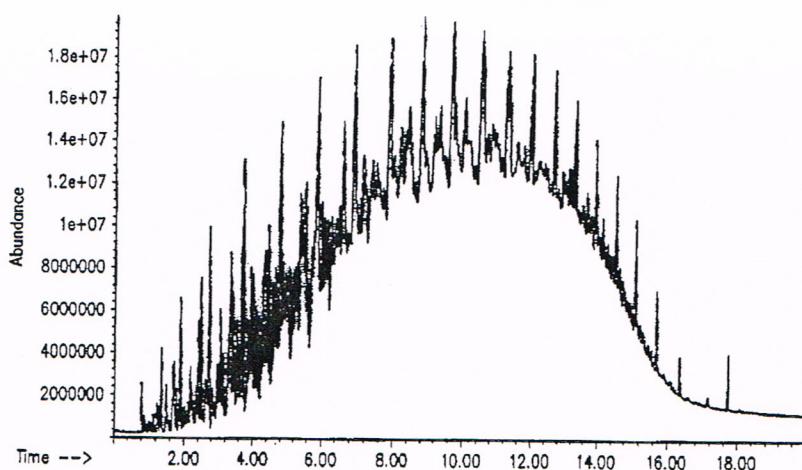

Fig. 6. A TIC of the GC-MS scans made by Southwest Research Institute on the same diesel fuel of Fig. 5 in which the HHO gas had been bubbled through, showing the alteration of the TIC both in shape as well as increased mass, thus indicating a new bond between diesel and HHO that cannot be of valence type (since HHO is gaseous and diesel is liquid. In any case, all valence electrons in both the gas and the liquid are used by conventional molecular bonds).

Therefore, the latter measurements provide additional confirmation of the existence of an anomalous bond between the diesel and the HHO gas, precisely as predicted by the anomalous value of the flash point and the clogging up of GC feeding lines. In turn such a bond between a gas and a liquid cannot possibly be of valence type, since all valence electrons are expected to be coupled in both the liquid and the gas.

Further mass spectrographic measurements on the HHO gas were done on September 10, 2003, at Sun-Labs, of the University of Tampa, Florida, via the use of a very recent GC-MS Clarus 500 by Perkin Elmer, one of the most sensitive instruments currently available to detect hydrogen.

Even though the column available at the time of the test was not ideally suited for the separation of all species constituting the HHO gas, the latter measurements confirmed the preceding results.

In fact, the scan of Fig. 10 confirms the presence in the HHO gas of a basic species with 2 amu representing hydrogen, plus a species with 5 amu that cannot admit any valence or molecular interpretation for the HHO gas even if the species is formed by the spectrometer.
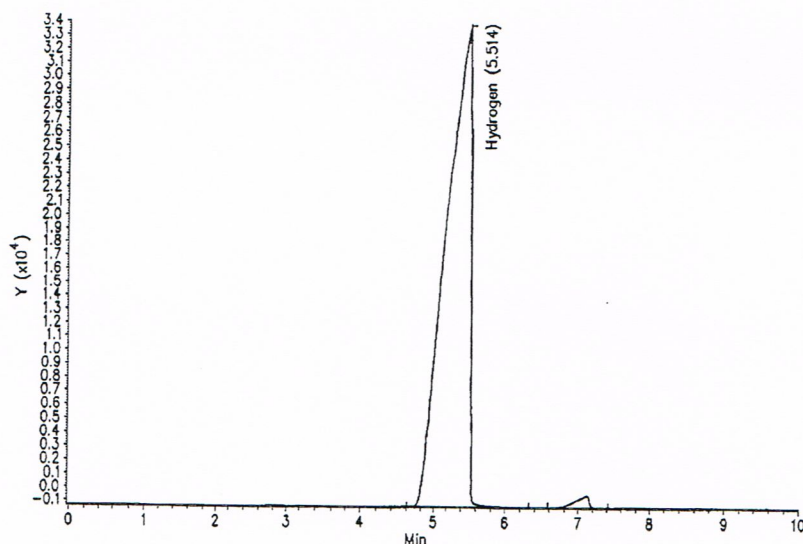
Fig. 7. A TIC of the GC-MS scans on the HHO gas made by Toxic LTD Laboratories showing the H_2 content of the HHO gas.
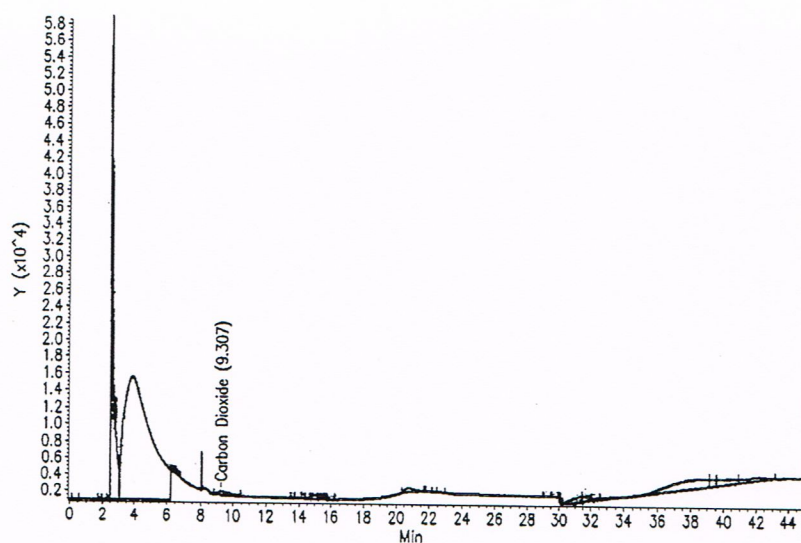

Fig. 8. A TIC of the GC-MS scans on the HHO gas made by Toxic LTD Laboratories showing the peaks belonging to H_2 and O_2, plus anomalous peaks.

In conclusion, the experimental measurements of the flash point and of the scans of Figs. 5 and 6 establish beyond doubt the capability by the HHO gas to have an anomalous bond with liquid fuels, that is, a bond that is not of valence type.

Additional analyses on the chemical composition of the HHO gas were done by Air Toxic LTD of Folsom, California, via the scans reproduced in Figs. 7–9. These scans confirmed that H_2 and O_2 are the primary constituents of the HHO gas. However, the same measure-

ments identify the following anomalous peaks:

(a) A peak in the H_2 scan at 7.2 min elution time (Fig. 7).
(b) A large peak in the O_2 scan at 4 min elution time (Fig. 8).
(c) An anomalous blank following the removal of the HHO gas (Fig. 9), because said blank shows the preservation of the peaks of the preceding scans, an occurrence solely explained via anomalous
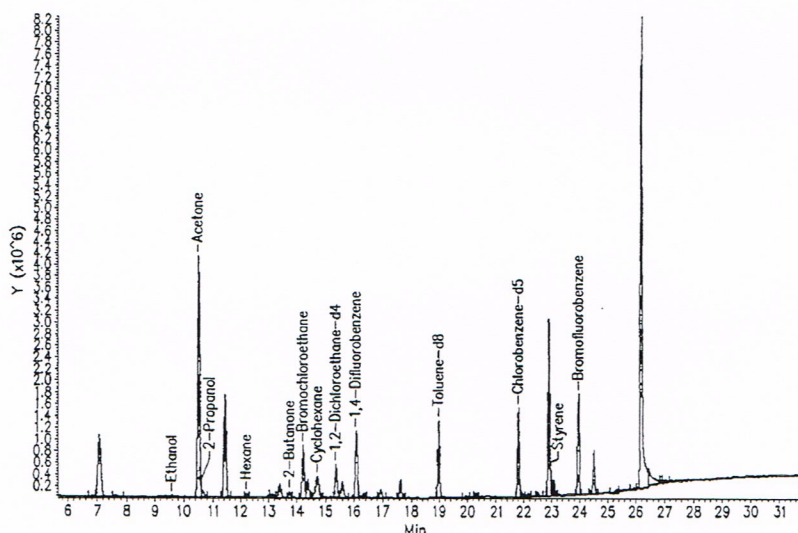
Fig. 9. One of the anomalous blanks of the GC-MS scans made by Toxic LTD Laboratories following the tests of the HHO. The blank is firstly anomalous because only the background should have been detected, thus indicating a bond between the HHO gas and the walls of the instrument, whose most plausible explanation is the magnetic polarization by induction of said walls by a form of magnetic polarization of the species composing the HHO gas. The second reasons for the anomalous nature of the blank is that the substances detected cannot possibly exist in the HHO gas produced from distilled water, thus showing an accretion of bonds to the instrument walls.

adhesion of the HHO gas to the interior walls of the instrument.

The scan of Fig. 11 provides evidence of a species with mass 16 amu that can only be interpreted as atomic oxygen, thus providing additional indication of the presence in the HHO gas of atomic hydrogen as expected from its capabilities, although the species, again, could be separated by the spectrometer due to the expected weak nature of the bond. The latter could not be detected in the preceding scan due to the impossibility of the instrument here considered to detect a species with 1 amu. The same scan of Fig. 11 confirms the presence in the HHO gas of a species with 17 amu and a species with 18 amu detected in earlier tests.

The scan of Fig. 12 establishes the presence in the HHO gas of species with 33 and 34 amu, while the species with 35 amu detected in preceding measurements was confirmed in other scans here not reported for brevity.

The tests also confirmed the blank anomaly, namely, the fact that the blank of the instrument following the removal of the gas continues to detect the basic species constituting the gas, which blank is not reproduced here for brevity, thus confirming the anomalous adhesion of the HHO gas to the interior walls of the instrument.

In summary, the above analytic measurements establish the following properties of the HHO gas:

(I) An anomalous increase in specific weight of 1 g/mol (or 8.8% in volume) establishing the presence in the HHO gas of species heavier than the predicted mixture of H_2 and O_2, thus establishing the presence in the HHO gas of new species composed of H and O atoms that cannot possibly have valence bonds.

(II) The GC scans done by Adsorption Research (Fig. 1) confirm the presence of chemical species in the HHO gas that cannot have a valence interpretation, such as the species with 17, 33, 34, and 35 amu, besides conventional species with 2, 16 and 18 amu, all species independently confirmed by other tests, such as the scans of Figs. 10–12.

(III) The halting of the GC instrument in the scans of Fig. 1 after a few seconds following the injection of the HHO gas, while the same instrument works normally for conventional gases, is experimental evidence for an anomalous adhesion by the HHO gas to the internal walls of the instrument, to such a level of occluding the column and causing the shut down of the scan.

(IV) The large increase of the flash point of diesel fuel following inclusion of the HHO gas also constitutes experimental evidence of anomalous
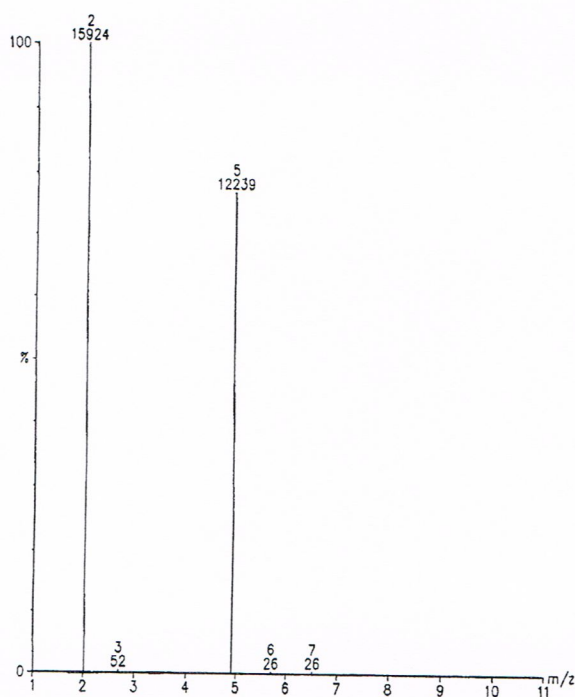
Fig. 10. The scan conducted by SunLabs on the HHO gas confirming the presence of H_2, plus additional anomalous peaks, such as the species at 5 amu, that cannot possibly admit a molecular interpretation.
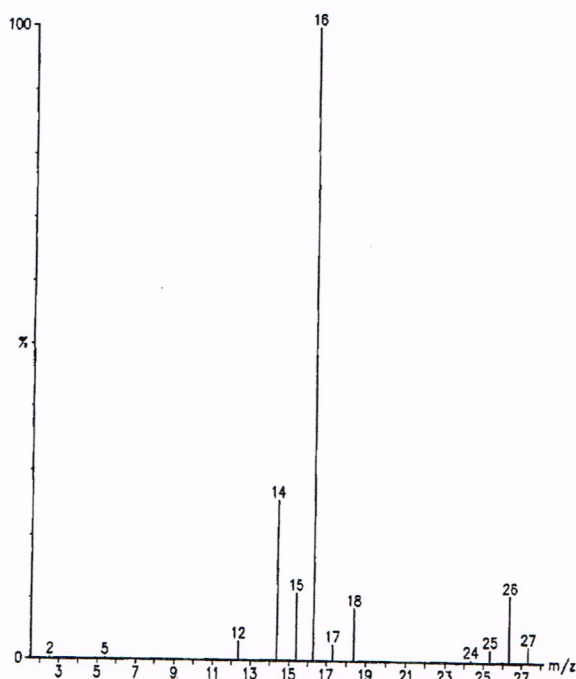
Fig. 11. The scan conducted by SunLabs on the HHO gas detecting a peak at 16 amu that confirms the presence of atomic oxygen in the HHO gas of Fig. 1, plus a peak at 17 amu indicating the presence of traces of the radical O–H, a peak at 18 amu indicating the presence of water vapor all three species also detected in the scan of Fig. 1, as well as additional anomalous peaks at 12, 14, 25, 26, 27 amu that, for the case of the HHO gas produced from distilled water cannot admit a molecular interpretation.

adhesion by the HHO gas, this time, to a liquid fuel that cannot also be of valence type since all valence electrons available in both the liquid and the gas are expected to be paired.

(V) The mass spectrometric measurements on the mixture of diesel and HHO (Figs. 5 and 6) provide additional experimental confirmation of an anomalous bond between the HHO gas and diesel.

(VI) The additional scans of Figs. 7–9 confirm all the preceding results, including the anomalous blank following the removal of the HHO gas, thus confirming the anomalous adhesion of the HHO gas to the internal walls of the instrument.

(VII) The capability by the HHO gas to melt instantaneously tungsten and bricks is the strongest evidence on the existence in the HHO gas of basically new chemical species that cannot possibly have a valance bond, since a mixture of $\frac{2}{3}$ H_2 and $\frac{1}{3}$ O_2 cannot melt instantly tungsten and bricks, as any interested chemist is encouraged to verify.

It should be indicated that a number of species in the HHO gas, particularly those with higher specific weight, are expected to be unstable and, as such, decomposed by the analytic instrument itself. In different terms, by no means GC, IR and other scans should be expected to detect *all* constituents of the HHO gas, since a number of them are expected to be decomposed or altered by the ionization and other processes connected to the scans themselves.

3. Tentative theoretical interpretation of the measurements

With the understanding that any expectation of a complete understanding of the chemical composition of the HHO gas in this first paper is not realistic, and any lack of release of anomalous new measurements due to lack of their final understanding is not scientific, we here submit a working hypothesis for further future studies according to which *the chemical composition of the HHO gas is another realization of the new species of Santilli magnecules* [3].

In this section we first outline the new species of magnecules, and then illustrate the plausibility of the
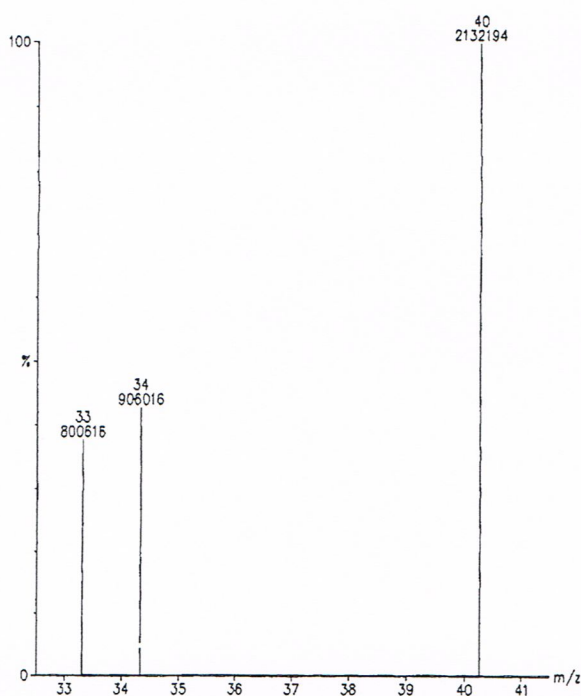
Fig. 12. A sample of various additional scans conducted by SunLabs on the HHO gas detecting anomalous peaks at 33, 34 and 40 amu that cannot possibly have a consistent molecular interpretation. Intriguingly, the peak at 35 amu detected in other tests did not appear sequentially in this scan, and appeared instead in other scans here not reported for brevity, thus indicating that the peaks of this and of the preceding scans conducted by SunLabs are, in actuality, the constituents of the clusters composing the HHO gas, and not the actual constituents themselves.

above hypothesis by showing that it permits a quantitative representation of all anomalous experimental data on the HHO gas, while permitting the identification of a fundamentally novel form of water other than the conventional one.

Evidently, we solicit the formulation of different working hypotheses, under the condition that they are equally quantitative and do not deal with mere nomenclatures on hypothetical valence bonds without a precise identification of the *attractive* nature of the bonding force as well as its numerical value.

To begin, the current environmental problems are not caused by fossil fuels per se, but rather by the strength of their valence bonds that has prevented the achievement of a full combustion for over one century. In fact, hydrocarbons and other pollutants in the exhaust literally are chunks of uncombusted molecules (for which very reason these pollutants are carcinogenic).

A solution was initially proposed in Ref. [5c] of 1998 and comprehensively studied in Ref. [3] of 2001 consisting of a new chemical species, today known as *Santilli magnecules* (in order to distinguish them from the conventional molecules) whose bond is stable, but sufficiently weaker than the valence bond to permit full combustion.

The new species required the identification of a *new attractive force among atomic constituents that is not of valence type as a central condition, thus occurring among atoms irrespective of whether valence electrons are available or not.*

The solution proposed in Refs. [3,5c] was the use of an external magnetic field sufficient to create the polarization of atomic orbitals into toroids (see Fig. 13), as a result of which the orbiting electrons create a magnetic moment along the symmetry axis of the toroid, which magnetic field is nonexisting in the conventional spherical distribution of the same orbitals.

Individual toroidal polarizations are, individually, extremely unstable because the spherical distribution is recovered in nanoseconds following the removal of the external magnetic field due to temperature related effects. Nevertheless, when two or more toroidal polarizations are bonded together by opposing magnetic polarities North–South–North–South– etc. as (see Fig. 16), spherical distributions are again recovered in nanoseconds following the removal of the external magnetic field, but this time such distribution occurs for the bounded pair as a whole.

As indicated earlier, the word "valence" is essentially a nomenclature due to the lack of explicit and concrete identification of the "attractive" force necessary to produce a valence bond (for which reason, Santilli and Shillady proposed in Refs. [5a,b] new structure models of the hydrogen, water and other molecules with an explicitly identified "strongly attractive" valence bond admitting as particular cases various models of Coulomb screenings). By comparison, Santilli identified in the original proposal [5c] the *attractive character* of the magnecular forces as well as its *numerical value*, that was confirmed by Kucherenko and Aringazin [5d] as well as by others [3]. We therefore have the following:

Definition (*Santilli [3,5c]*). Santilli's magnecules are stable clusters consisting of individual atoms (H, O, etc.), dimers (OH, CH, etc.) and ordinary molecules (H_2, H_2O, etc.) bonded together by opposing magnetic polarities originating from toroidal polarizations of the orbitals of atomic electrons.

Various substances with magnecular structures have been identified experimentally to date, among which we indicate MagneGas™ [5e], MagneHydrogen™ [5f], and
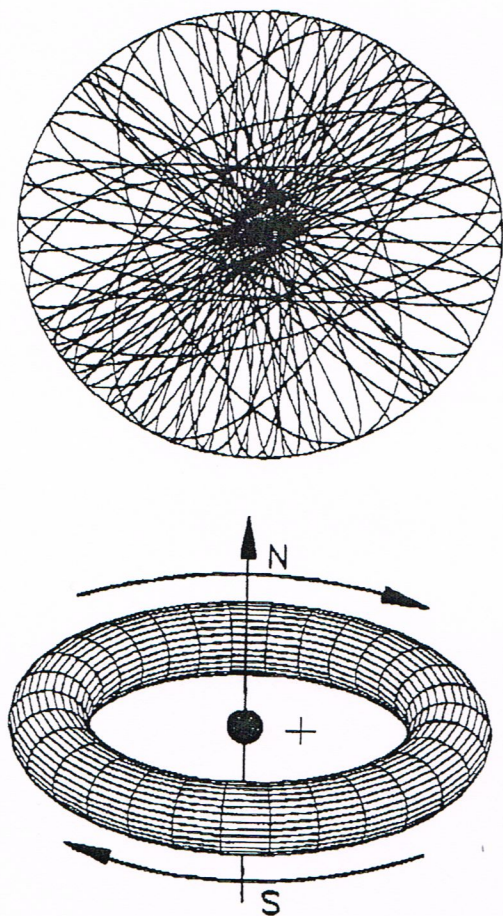
Fig. 13. The top view provides a conceptual rendering of an atomic hydrogen with the conventional spherical distribution of its orbitals that is assumed to be a constituent of the Brown Gas. The bottom view provides a conceptual rendering of the atomic hydrogen at absolute zero degree temperature (thus without rotations) with a toroidal polarization of its orbitals assumed to be a constituent of the HHO gas because permitting a quantitative interpretation of its anomalous features, such as the instantaneous melting of bricks, that cannot be explained via the sole assumption of atomic hydrogen. Needless to say, the toroidal shape of the polarization of the orbitals is a mere conceptual rendering and should not be assumed "ad litteram."

others under industrial development. Their primary features (for which large industrial investments have been made) is the complete combustion without contaminant in the exhaust as well as cost competitiveness over fossil fuels.

The first experimental evidence supporting the magnecular structure of the HHO gas is its capability of instantly melting tungsten and bricks. In fact, such a capability can only be explained via the presence in the HHO gas, not only of atomic (that is, unbounded) hydrogen as depicted in the top of Fig. 13, but also of atomic hydrogen with the toroidal polarization of their orbitals as depicted in the bottom of Fig. 13.

In fact, no instantaneous melting of bricks is possible without the hydrogen contained in the HHO gas rapidly penetrating within deeper layers of the brick structure. Such a rapid penetration cannot be explained with atomic hydrogen, although it can be readily explained via the polarized hydrogen atom of the bottom of Fig. 13.

Besides having a smaller sectional area that favors fast penetration, polarized H-atoms cause an induced polarization of the orbitals of the atoms of the brick, their consequential attraction to the polarized H atoms, and the latter rapid penetration within deep layers of the brick structure. In turn, faster penetration within the lattice of solids implies a bigger reactivity that, in turn, causes a bigger melting temperature.

Moreover, polarized atomic hydrogen as well as oxygen are needed to explain the anomalous adhesion of the HHO gas to internal walls of detection instruments as well as to other substances.

Note that the studies of the Brown gas [2] have indicated the need for *atomic hydrogen*. Therefore, the presence of *atomic and polarized hydrogen* is a novelty of the HHO gas.

Evidently, individual hydrogen atoms cannot maintain their polarization as in Fig. 13 in view of motions caused by temperature, as well known. The only known possibility for maintaining said polarization is that polarized H atoms bond themselves with opposing magnetic polarities as depicted in Fig. 16. In fact, rotations and vibrations due to temperature occur for such bonded H atoms as a whole, while individually preserving said polarization.

In turn, bonds of polarized atomic hydrogen constitute the very basic bond of magnecules, thus supporting the hypothesis of the magnecular structure of the HHO gas.

Note that a conventional hydrogen gas cannot acquire any magnetic polarization because the conventional hydrogen molecules is diamagnetic. However, as established in Ref. [3], the diamagnetic character refers to the hydrogen *molecule* as a whole, because quantum mechanics establishes that each individual hydrogen *atom* of a hydrogen molecule can indeed acquire a magnetic polarization under sufficiently strong external magnetic fields.

The diamagnetic character of the hydrogen molecules, as depicted in Fig. 14, is due to the fact that the individual magnetic polarizations of its H atoms are opposite to each other, and are at such a close mutual distances
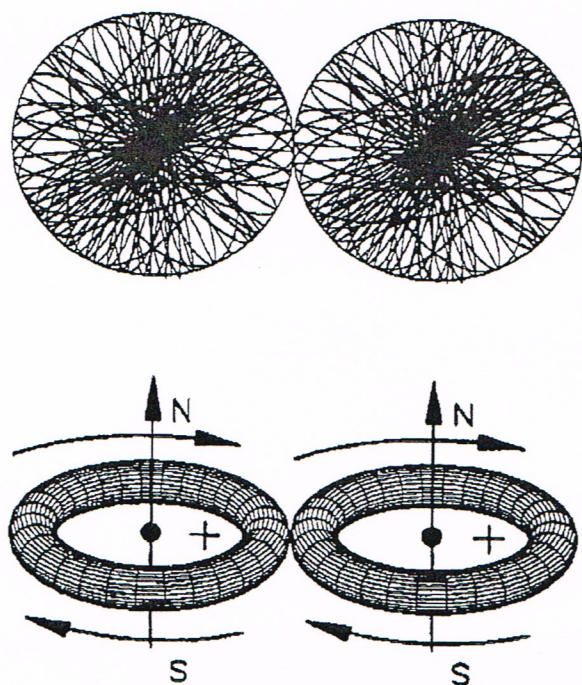
Fig. 14. The top view provides a conceptual (semiclassical) rendering of the valence bond of two H-atoms in a conventional hydrogen molecule. The bottom view provides a conceptual (semiclassical) rendering of the preceding view at absolute zero degrees temperature, according to the strong valence bond of Ref. [3] that permits an exact representation of all characteristics of the hydrogen molecule. In the latter case the strongly coupled valence electron pair characterize OO-shaped orbitals, the only ones representing the diamagnetic character of the molecule [3].

Fig. 15. A conceptual rendering of the conventional interpretation of the species with low atomic weight present in the HHO gas, such as H, H_2 and H_3. The insufficient plausibility of the H_3 as originating from a conventional valence bond has been treated in Ref. [3] since valence bonds are only possible for electron pairs and not for triplets.

to cancel each other when inspected at sufficiently large distances.

Needless to say, the above hypothesis on the polarization of atomic hydrogen also applies to oxygen, the latter being known to be paramagnetic, resulting in atomic oxygen with the spherical distribution of orbitals, polarized atomic oxygen with the polarization of at least the valence electrons, and pairs of bonded polarized oxygen atoms as depicted in Fig. 16.

The first prediction of the magnecular structure of the HHO gas is that the species at 2 and 32 amu detected by mass spectroscopy could, in actuality, be constituted by a mixture of the conventional molecules H_2 and O_2 and a percentage of the same atoms although with the magnecular bond, since the latter are expected to have essentially the same atomic weight than the former.

The separation of hydrogen molecules and magnecules is possible via instruments based on magnetic resonance techniques because the conventional hydrogen molecule is diamagnetic (Fig. 14) while the
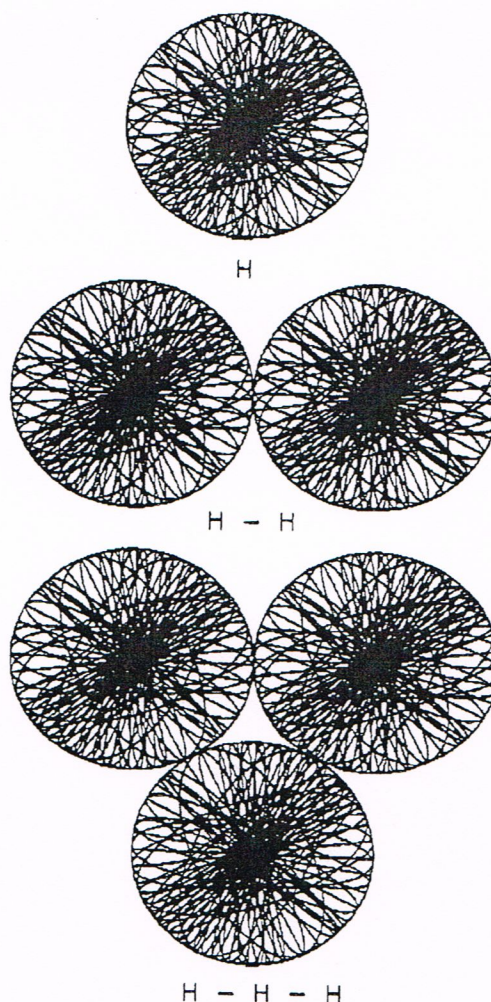
hydrogen magnecule has a distinct magnetic polarity (Fig. 16).

It is easy to see that the magnecular hypothesis on the chemical structure of the HHO gas permits a quantitative interpretation of all anomalous species reported in the preceding section.

Let us denote the conventional valence bond with the usual symbol "-" and the magnecular bond with the symbol "×". According to this notation, $H_2 = H-H$ represents the molecule of Fig. 15 while $H \times H$ represents the magnecule of Fig. 16. Molecular bonds are notoriously restricted to valence pairing, in the sense that no additional atom can be bonded when all available va-
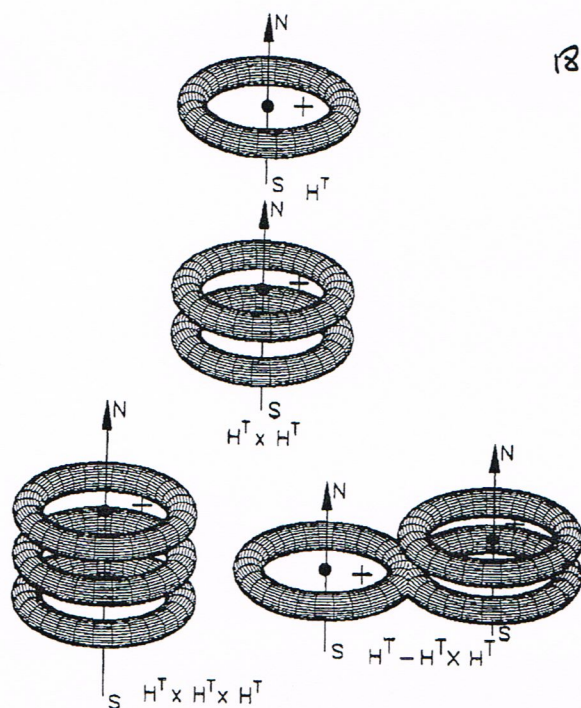
Fig. 16. A conceptual rendering of the magnecular interpretation of the species with low atomic weight present in the HHO gas. The hypothesis herein submitted is that the H_2 content of the HHO gas is partially composed of the conventional molecular species H–H and partially of the magnecular species H × H, while the H_3 species is partially composed of the magnecular species (H–H) × H and partially of the species H × H × H. Note that the bottom views can also be interpreted as the magnecular species H × H × O with 18 amu, H × O × O with 33 amu, O × O × O with 48 amu, (H–H) × O with 18 amu, (O × O) × H with 33 amu and (O–O) × O with 48 amu. Since valence bonds are only possible for electron pairs, while magnecular bonds admit a (reasonably) open number of constituents, the magnecular hypothesis for the structure of the HHO gas permits indeed a plausible interpretation of all its anomalous constituents.

lence pairs are coupled. By contrast, magnecular bonds do not have such a restriction, in the sense that atoms can indeed be added to a magnecule under the sole condition of the availability of opposite magnetic polarizations.

Needless to say, for the HHO gas at ambient temperature and pressure, the stability of the magnecular clusters is inversely proportional to the number of their constituents. As a result, magnecular clusters with relatively low atomic weight are expected to exist in significant percentages, while those with large atomic weight are expected to be present at best in parts per millions.

As a result, the magnecular hypothesis permits the following interpretations of the species composing the HHO gas: the species with 3 amu is interpreted as a com-

bination of the magnecules H × H × H or (H–H) × H; the species with 4 amu is interpreted as a combination of (H–H) × (H–H), (H–H) × H × H, or H × H × H × H, heavier magnecular bonds solely of hydrogen atoms being unstable due to collisions; the species with 17 amu is interpreted as a combination of the traditional dimer H–O and the magnecular bond H × O; the species with 33 amu is interpreted as a mixture of (O–O) × H, (H–O) × O and O × O × H; the species with 34 amu is interpreted as a mixture of (H–H) × (O–O) × (H–H) × H and similar configurations; the species with 35 amu is interpreted as a mixture of (O–O) × (H–H) × (H–H) × H and equivalent configurations (see Fig. 16); and other magnecular species in progressively smaller percentages.

Besides a quantitative interpretation of the chemical structure of all species contained in the HHO gas, as well as of its anomalous thermal content and adhesion, perhaps the biggest contribution of the magnecular hypothesis is a quantitative interpretation of the formation of the HHO gas despite the lack of the needed evaporation or separation energy.

Recall that nature has set the water molecule $H_2O =$ H–O–H in such a way that its H atoms do not have the spherical distribution, and have instead precisely the polarized distribution of Fig. 13 bottom along a toroid whose symmetry plane is perpendicular to that of the H–O–H plane, as depicted in Fig. 17, and established in the technical literature (see, e.g., Ref. [1a]).

It is also known that the H–O–H molecule at ambient temperature and pressure, even though with a null total charge, has a high electric polarization (namely, a deformation of electric charge distributions) with the predominance of the negative charge density localized in the O atom and the complementary predominant positive charge density localized in the H atoms [1a]. This feature causes a repulsion of the H atoms due to their predominantly positive charges, resulting in the characteristic angle of (about) 105° between the H–O and O–H dimers as depicted in Fig. 18.

It is well established in quantum mechanics that toroidal polarizations of the orbitals of the hydrogen atom as in the configuration of Fig. 13 create very strong magnetic fields with a symmetry axis perpendicular to the plane of the toroid, and with a value of said magnetic field sufficient for the creation of the new chemical species of magnecules [3].

It then follows that, in the natural configuration of the H–O–H molecule, the strong electric polarization caused by the oxygen is such to weaken the magnetic field of the toroidal polarization of the H-orbital resulting in the indicated repulsion of the two H-atoms in the H–O–H structure.
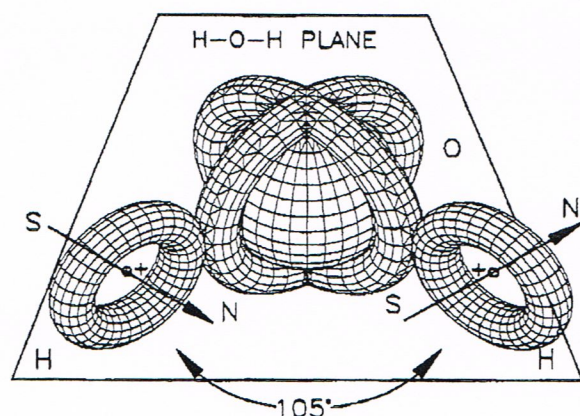
Fig. 17. A conceptual rendering of the conventional water molecule without any electric polarization. This rendering is primarily intended to illustrate the experimentally established feature that the orbitals of the two hydrogen atoms do not have a spherical distribution as in Fig. 13, but have instead a distribution essentially perpendicular to the H–O–H plane (see Ref. [1a,1b] for details) here conceptually represented with a toroid. The strong valence bond needed to achieve the first known exact representation of the experimental data of the water molecule achieved in Ref. [3] requires that the corresponding orbitals of the valence electrons of the oxygen have a corresponding polarized distribution here also conceptually depicted with toroids perpendicular to the H–O–H plane around the spherical core of the remaining electrons of the oxygen atom.
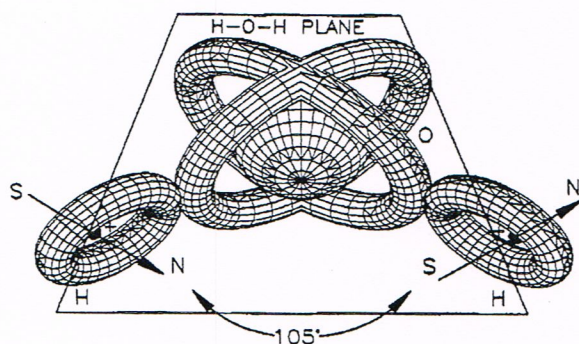

Fig. 18. A conceptual rendering of the conventional water molecule of Fig. 16, this time with the electric polarization as occurring in nature. Note the consequential the predominance of a positive charge in the two hydrogen atoms that is responsible in part for the angle of 105° between the two H–O radicals.

However, as soon as the strong electric polarization of the molecule H–O–H is removed, the strong attraction between opposite polarities of the magnetic fields of the polarized H atoms become dominant over the Coulomb repulsion of the charges, resulting in a new configuration of the water molecule depicted in Figs. 19 and 20 apparently presented in this paper for the first time.
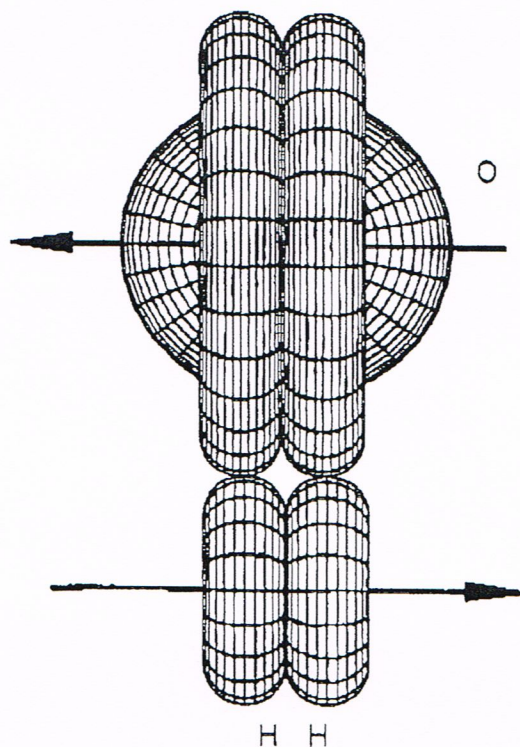

Fig. 19. A conceptual rendering of the central hypothesis submitted for the first time in this paper, namely, the H–O–H molecule in which all electric polarizations have been removed, with the consequential collapse of the two polarized H-atoms one into the other due to their neutral charge and strongly attractive opposing magnetic polarities. This hypothesis permits a quantitative interpretation of the transition of state from liquid to gas achieved by the HHO electrolyzers via processes structurally different than evaporation energy. In fact, unlike the configuration of Fig. 16, that of this figure can only exist at the gaseous state due to the loss of the processes permitting the liquid state, such as hydrogen bridges between pairs of water molecules. It should be noted that the configuration here depicted is unstable and decomposes into atomic oxygen, as detected in the HHO gas, plus the new magnecular species $H \times H$ that has indeed been detected but it is generally interpreted as H–H.

Therefore, a central hypothesis of this paper is that the electrolyzer developed by Hydrogen Technology Applications, Inc., is such to permit the transformation of the water molecule from the conventional H–O–H configuration of Fig. 18 to the basically novel configuration of Fig. 19.

By using the above identified symbols for molecules and magnecules, the conventional water molecule is represented by H–O–H while the new configuration of Fig. 19 is represented by $(H \times H)$–O, where the symbol "-" evidently denotes double valence bond.

The plausibility of the new form of water is supported by the fact that, when H–O–H is liquid, the new
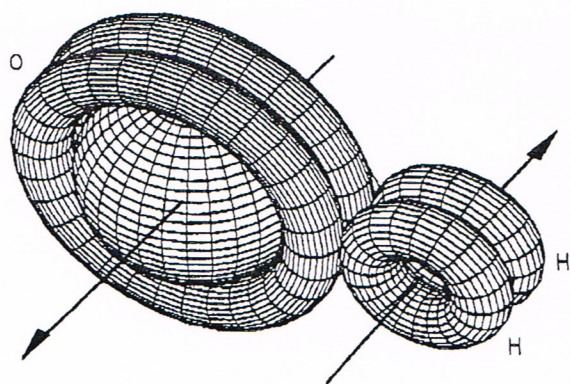
Fig. 20. A conceptual rendering of a perspective view of the central hypothesis submitted for the first time in this paper via Fig. 19, better illustrating the bond via opposing magnetic polarities of the two H-atoms, as well as the unstable character of the configuration due to collision with other species and intrinsic instabilities to be studied in a forthcoming paper.

species $(H \times H)$–O is expected to be gaseous. This is due to various reasons, such as the fact that the hydrogen is much lighter than the oxygen in the ratio 1 to 16 amu. As a result, the new species $(H \times H)$–O is essentially equivalent to ordinary gaseous oxygen in conformity with conventional thermodynamical laws, since the transition from the liquid to the gas state implies the increase of the entropy, as well known.

Alternatively, the loss of electric polarization in the transition from H–O–H to $(H \times H)$–O is expected to cause the loss of the processes permitting the very existence of the water molecule, such as the hydrogen bridges between dimers O–H of different molecules. Transition to a gaseous form is then consequential, thus confirm the plausibility of the new form of water $(H \times H)$–O proposed in this paper.

However, it can also be seen that the new form of water $(H \times H) = O$ is *unstable*, and decomposes in $H \times H$ and O. This decomposition is supported by the clear evidence in the HHO gas of atomic oxygen, as well as of the species with 2 amu that is normally interpreted as being H–H, while we suggest the additional possibility that such a species is, at least in part, $H \times H$.

As indicated earlier, samples of the new HHO gas for independent verifications can be readily obtained by contacting the manufacturer Hydrogen Technology Applications, Inc. at their website www.hytechapps.com. Nevertheless, interested colleagues should be aware of the fact that the experimental detection of magnecules is rather difficult since it requires analytic instruments and methods different than those currently used to detect

molecules. Vice versa, analytic methods so effective to detect molecules generally reveal no magnecules, and this explains their lack of detection since the discovery of molecules in the mid of the 19th century.

An analytic equipment developed for molecules that is also effective for the detection of gaseous (liquid) magnecules is given by a Gas (Liquid) Chromatographer Mass Spectrometer necessarily equipped with InfraRed Detector for gases (GC-MS/IRD) or with Ultra-Violet Detector for liquids (LC-MS/UVD).

Let us recall that large clusters (of the order of hundreds of amu or more) cannot be constituted by molecules when without an IR signature for gases or a UV signature for liquids, because that would require perfect sphericity that is prohibited by nature for a large number of constituents.

The detection of a magnecule requires its identification, firstly, with a peak in the MS that must result to be unknown following the computer search among all known molecules and, secondly, that peak must show no IR or UV signature at its amu value. The latter condition explains the need for a GC-MS (or LC-MS) necessarily equipped with IRD (UVD). In fact, if the same species is tested with an IRD (or UVD) disjoint from the MS, the IRD (UVD) is not generally focused on the selected MS peak at its amu value, resulting in the detection of a variety of signatures of conventional molecular species that, in reality, are the *constituents* of the considered magnecule because having amu values that are a fraction of that of the MS peak.

For additional difficulties in the detection of magnecules, interested colleagues are suggested to consult monograph [3], chapter 8.

In conclusion, the experimental data presented in this paper confirm the existence of a new chemical species whose bond cannot credibly be of valence type. Colleagues may prefer nomenclatures other than "magnecules" to distinguish the new species from molecules, such as "supermolecules" due to its predictably easier reception by the scientific community.

Nevertheless, it is time for chemistry to identify in all the necessary technical details the *attractive* character of conventional valence bond as done, apparently for the first time, by Santilli and Shillady with their new "strong valence bond" [3,5a,b]. Nomenclatures such as "supermolecules" may be preferable on academic grounds, although such a nomenclature would leave the nature of the bond fundamentally unsolved. This author has selected the name of magnecules because of the precise identification of the nature and numerical value of the attractive force causing the bond [3,5c,d].

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