In March 1991 Research Professor Yull Brown and Peter Griffiths Founder CEO spent some months in Peking, People's Republic of China to arrange a manufacturing cooperation with China North Industries Corporation. During this time Research Professor Yull Brown conducted a demonstration of the effectiveness of Brown's Gas in reducing the radioactivity levels of radioactive materials. From this initiative scientific research to explain the reactions was stimulated internationally.

These developments have been recorded in a video that can be viewed at this link Browns Gas HHO: Transmutation of Radioactive Materials : Testimonial by Daniel Haley1992.

Subsequently Research Professor Yull Brown briefed Dr. Andrew Michrowski, President Planetary Asssociation for Clean Energy on the processes involved which led to the publication of the below Congress Paper in 2000.

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Advanced transmutation process

and its application for the decontamination of radioactive nuclear wastes

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Abstract: *There are deviations to the standard model of radioactive atomic nuclei decay reported in the literature. These include persistent effects of chemical states and physical environment and the natural, low-energy transmutation phenomena associated with the vegetation processes of plants. The theory of neutral currents is proposed by Nobelist* ***O. Costa de Beauregard*** *to account for the observed natural transmutations, also known as the Kervran reaction. "Cold fusion" researchers have also reported anomalies in the formation of new elements in cathodes. This body of knowledge provides the rationale for the observed and successful and developed advanced transmutation processes for the disposal of nuclear waste developed by* ***Yull Brown*** *involving a gas developed by him with a stoichiometric mixture of ionic hydrogen and ionic oxygen compressed up to 0.45 MPa. The radioactivity in samples decreases by up to 97%, rapidly, simply and at low cost.*

Current model of decay

Since the discovery of natural radioactivity, it was generally believed that radioactive processes obeyed orderly, simple decay rate formulae and that nuclear processes operated completely independent of extra nuclear phenomena such as the chemical state of the system or physical parameters such as pressure or temperature. A solid body of scientific literature describes a small percentage variation of the order of 0.1 to 5% in the decay constant under a variety of chemical and physical conditions. [5, 6, 8, 10, 11, 21, 24]

The standard definition of half-life or half-decay time is the time taken by a given amount of a particular radioactive substance to undergo disintegration or decay of half of its atoms. Measured half-lives vary from less than a millionth of a second to billions of years in the case of Uranium. There are 4 modes of decay, three are named after the first three letters of the Greek alphabet, i.e., *alpha*, *beta* and *gamma* and the fourth is the recently discovered *proton decay.*

By way of review, for the Bohr-Rutherford model of the atom, the nucleus is composed of the heavy particles or hadron or the proton and the neutron, and is surrounded by a cloud of electrons (or light particles or leptons) the number of which depends on the atomic number (for neutral atoms) and also the valence state (for ionized atoms). *Alpha* particles are Helium nuclei, $_4He^2$ consisting of two protons and 2 neutrons; *beta* particles are electrons (negative charge) and positrons (positive charge) and *gamma* rays that are in the short wave length of the electromagnetic radiation band; the proton is a hadron. *Alpha* particles and protons are strongly interacting particles, as are all hadrons.

The current model of *beta* decay is that an inter nucleon neutron spontaneously decays into a proton and an electron (or *beta* particle and an anti-electron neutrino, $n_o \rightarrow p. + e. + \nu c.$ A neutrino is a zero-rest mass spin 1/2 particle that conserves momentum in the decay process. There are many pure beta emitters throughout the periodic table; Carbon $_{14}C$ and deuterium are two examples. Beta particles penetrate substance less deeply than gamma radiation but are hundreds of times more penetrating than alpha particles. *Beta* particles can be stopped by an inch of wood or by a thin sheet of aluminum foil, for example. The energy of most emitted alpha particles are stopped by a piece of paper and the most energetic gamma rays require a thick piece of lead or concrete.

Electromagnetic radiation emission from atomic processes can be in the x-ray energy range and nuclear in the x-ray and gamma ray energy range.

It is believed that all radioactive atomic nuclei decay spontaneously without prior cause at a specific and steady decay rate that differs for each radioactive isotope. Some precise measurements of half-lives have been made which show deviations of the standard type decay curves that appear to depend on non-nuclear variable conditions in origin and structure.

Past measurements of variations in the decay constant $N = Noe^{-\lambda\pi}$ with $T_{1/2} = 0.693/\lambda$ are based on crude instruments from some 70 years ago. Later, with more sophisticated electronics, the value of λ of the decay of Beryllium $_7Be$, was first shown in 1949 to deviate by 0.1% between atomic Be and molecular BeO. In 1965, the λ of Niobium, $_{90}Nb$, is altered by 4% between the metal and the fluoride form, as discussed by **G. Emery**. **H. C. Dudley** reported on studies that have varied decay characteristics of twelve other radionuclides according to changes in the energy states of the orbital electrons, by reason of pressure, temperature, electric and magnetic fields, stress in monomolecular layers and other physical atomic conditions. [10]

The alteration of decay rates by non-nuclear processes may not be truly random and would seem to require a new theoretical model. As these decays occur, the term nuclear may need to be expanded to include reactions and processes involving the entire atom and even multi-atom crystal matrix forms rather than just mass-energy changes in only the nucleus. [19, 23, 24]

observed deviations from accepted decay laws

Not too well known is a quite prodigious body of work on the persistent effects of chemical states and physical environment on the deviation from the accepted decay law of nuclear decay rates.

Theoretical as well as experimental research has been conducted. [5, 6, 8, 10, 11, 22, 24] In 1947, **R. Daudel** and **E. Segré** predicted that under certain conditions a dependence of the decay constant on the chemical and physical environment of the nucleus should be observable; subsequent to these predictions such a dependence was experimentally observed (with **R. F. Leinzinger** and **C. Wiegand**) in the K capture decay of ^{7}Be and the internal conversion decay of the 99m isomeric state of Technetium.

During the decay process, the chemical environment of the nucleus is changed, thus altering the decay constant. R. Daudel pointed out that the isomeric decay constant of the 2-keV isomeric state transition in the Technetium isotope ^{99m}Tc arose from a change in the electron density near the nucleus. **J. C. Slater** suggested that the faster decay rate observed for the $RtCO_4$ compound form is due to a *greater squeezing* of the Tc atoms with the metal Tc-Tc bond distance of 2.7 Å. Note that the symbol Å refers to the distance measure of one Angstrom which equals 10^{-8} cm.

A good example of the effect of a chemical change in the nuclear environment during radioactive decay is for the intensity change of the 122-keV E2 gamma ray observed for the ^{90m}Nb isomeric state of Niobium. This effect on the decay rate for the 21-second transition was an order of magnitude greater and in the opposite direction than observed in ^{99m}Tc and was achieved at **Lawrence Berkeley Laboratory** by **J. O. Rasmussen** and his colleagues, **J. A. Cooper** and

J. M. Hollander in 1965. [24]

In 1975, **Elizabeth A. Rauscher** lengthened *beta* emissions for ^{20}Si simply by surrounding it with specifically designed matrix material, thus lengthening the decay rate by 6% with only 15 minute exposure, demonstrating the impact of environmental conditions on radionuclides.

natural transmutation

Natural, low-energy transmutation phenomena have been observed for centuries. In 1799, the French chemist, **Nicolas Louis Vauquelin** noted that hens could excrete 500% more lime that they take in as food, suggesting a creation -- transmutation of Calcium Carbonate. Scientific literature notes many similar phenomena that occur in vegetation processes of plants as well where new elements and minerals inexplicably emerge. Nobel Nominee Prof. **Louis Kervran** replicated these numerous findings and advanced very far the understanding of natural, non-radioactive transmutations, acquiring in this pursuit a term for such transmutations, ***Kervran reaction***, while engendering solid physics support from the **Institut de Physique Théorique Henri Poincaré** physicist, **Olivier Costa de**

Beauregard. He stated in 1974 that the theory of weak neutral currents accounts for the transmutations observed, with due respect for the physical laws of conservation. [7, 12, 13, 14] The theory of neutral currents gave its authors, **Sheldon Glashow**, **Abdus Salam** and **Steven Weinberg** the ***Nobel Prize for Physics*** in 1979. De Beauregard proposed the following equations for biological transmutation:

$n \rightarrow p + e- + \underline{\nu}$	(1)
$p + \nu \leftrightarrow p + \nu'$	(2)
$p \leftrightarrow p' + \underline{\nu} + \nu'$	(3)

Table 1. **The Olivier Costa de Beauregard equations for biochemical transmutation**

These equations imply the conversion of a neutron (n) to a proton (p) by virtual exchange processes -- the neutral currents of Weinberg. These processes produce protons (p and p') of different energy levels and two neutrinos (ν and ν') of different energy levels. $\underline{\nu}$ represents the antineutrino and e- the electron. In one state the proton will be bound to an atomic nucleus, and in the other state, it will be relatively free in a chemical binding.

***in vitro* transmutation**

Physicist Dr. **Andrija Puharich** was able to observe and photograph Kervran reactions *in vitro* by using a high-power dark-field microscope that was developed by the Canadian scientist, **Gaston Naessens**. Kervran reactions were documented by him to include the oxygen atom entering into a virtual nuclear reaction with p or n to yield $_{14}N$ or $_{19}F$, by using an electrolytic process similar to that of Prof. **Yull Brown**, as disclosed by Puharich in his U.S. Patent 4,394,230, *Method and apparatus for splitting water molecules.* [20, 21]

There exists as well the phenomenon of transmutative "digestion". **L. Magos** and **T. W. Clarkson** of the British **Research Council Carshalton Laboratories** noted disintegration of the radioactive isotope $_{203}Hg$ ingested by rats, a volatilization which they ultimately attributed to such bacteria as *Klebsiella aerogenes*. [16]

cold fusion examples

On June 19, 1995, **Texas A&M University** hosted a low-energy transmutation Conference, sponsored by the "father of electrochemistry", Professor Dr. **John O'M Bockris**. Some of the papers that were presented noted anomalies in the formation of new elements in cathodes -- definitely not sourced from contaminations -- which were involved in cold-fusion experiments. For example: Drs. **T. Ohmori** and **Reiko Notoya**, both of **Hokkaido University**, reported Iron formation in Gold and Palladium cathodes, Potassium changing into Calcium, Cs_{133} producing an element of mass 134, and Na_{23} becoming Na_{24}; Dr. **John Dash** of **Portland State University** reported spots of silver, cadmium and gold protruding in palladium electrodes in both light and heavy water cells; Dr. **Robert Bush** of **California Polytechnic, Pomona**, reported strontium on the surface of nickel cathodes. [18]

Another development is the system that reduces radioactive material by electrolysis using palladium -coated microspheres of a beads as a catalytic agent was patented by James A. Patterson. [17]

low-temperature transmutation

Very pertinent is the long-term research by Dr. **Georgiy S. Rabzi** of the **Ukrainian International Academy of Original Ideas** who reported his analyses of the mechanism of low-temperature transmutation, which he has conducted since 1954. He passed out samples to attendees: a steel nut that acquired the color of copper and was reduced in size; magnetic stainless steel turned non-magnetic, asbestos which became like ceramic. No radioactivity had been observed in any of his experiments and he is convinced that radioactive wastes can be stabilized. [19]

These observations, originating from various domains of scientific research form a solid case of low-level advanced transmutation -- with minuscule power and signal strength and sometimes without any, i.e. in nature alone.

advanced transmutation: **disposing of nuclear waste**

Experimental results obtained by advanced transmutation have direct bearing on the problem of disposal of nuclear wastes.

The first relies on the interaction of nuclear wastes with ionic hydrogen and ionic oxygen gas known as Brown's Gas. Brown's Gas has been developed by a Bulgarian-born Australian national, Prof. **Yull Brown**. In his process, water is separated into its two constituents, hydrogen and oxygen in a way that allows them to be mixed under pressure and then burned simultaneously and safely in a 2:1 proportion. The process results in a gas containing hydrogen and oxygen in the required proportions that can be generated economically and safely and be compressed up to 0.45 MPa. [1, 3, 4]

At this time, Brown's Gas generators are mass-produced in the Bautou, a major research city in the People's Republic of China by the **NORINCO** factory which also manufacturers locomotives and ordinances -- and services the nation's nuclear industry complex. Most of these generators (producing up to 4,000 litres/hour/2.4 litres of water at 0.45 MPa with power requirements ranging from 0.66 kW/hr up to 13.2 kW/hr) are marketed for their superior welding and brazing qualities, costing between $ 2,000 and $ 17,000. Other models, usually near the 1,000 litres/hour range are being manufactured in smaller quantities in several countries. Some units have been used for the decontamination of radioactive materials since 1991. Brown's Gas generators produce between 300 and 340 litres of Brown's Gas per 1 kW/hr energy DC current approximately and one litre of water produces about 1,866.6 litres of gas. A generator that produces 10,000 litres per hour has been built specifically for the reduction of nuclear waste. Prof. Brown first successfully reduced radioactivity radionuclides of Cobalt 60 in his laboratory in Sydney, Australia with initial experimental results of about 50%. [25]

On August 24, 1991, Baotou's **Nuclear Institute # 202** released a report, ***The results of experiments to dispose of radiation materials by Brown's Gas*** which establishes that experimentation on Cobalt 60 radiation source decreased radiation by about 50%. [2] The treatment involved exposures to Brown's Gas flame, *lasting only a few minutes,* as in the samples described in the table below:

	First Experiment	Second Experiment
Original		
Source Intensity	580 *millirads/hour*	115 - 120 *millirads/hour*
After Treatment	220 - 240 *millirads/hour*	42 *millirads/hour*

Table 2. **Reduction of radioactivity of Cobalt 60 by exposure to Brown's Gas flame for less than 10 minutes. 1991 experiments conducted by Baotou Nuclear Institute # 220, People's Republic of China.**

In another test conducted by Yull Brown before a public audience including U.S. Congressman Hon. **Berkeley Bedell** with committee responsibilities in this area of concern, the experiment ran as follows as reported by the press:

> *Using a slice of radioactive Americium ... Brown melted it together on a brick with small chunks of steel and Aluminum ... After a couple of minutes under the flame, the molten metals sent up an instant flash in what Brown says is the reaction that destroys the radioactivity. Before the heating and mixing with the other metals, the Americium, made by the decay of an isotope of Plutonium, registered 16,000 counts per minute of radiation. Measured afterward by the [Geiger Counter], the mass of metals read less than 100 counts per minute, about the same as the background radiation in the laboratory where Brown was working.* [2]

This experiment indicated a reduction of radiation in the order of over 99% (to about 0.00625 of original level) -- in less than 5 minutes, with minimal handling. The improvement in the reduction of radioactivity process from about 50% to nearly 100% has come only with persistent research over the decades by Brown and his colleagues. The Brown's Gas generating units that produced such effects are not expensive -- a far cry from the multi-million processes tabled by atomic energy agencies worldwide. They are powered by low energy requirements and require only small volumes of water, at most a few litres per hour as fuel. Furthermore, the training required for operation is minimal.

The Hon. Bedell has reported, "It has been my good pleasure to witness experiments done by Prof. Yull Brown in which it appeared to me that he significantly reduced the radioactivity in several nuclear materials. Under the circumstances, I believe it is very important for our federal government to completely investigate Dr. Yull Brown's accomplishments in this area." [9]

On August 6, 1992, almost a year after the Chinese nuclear report, Prof. Yull Brown made a special demonstration to a team of 5 San Francisco field office observers from the **United States Department of Energy**, at the request of the Hon. Berkeley Bedell. Cobalt 60 was treated and resulted in a drop of Geiger readings from 1,000 counts to 40 -- resulting in radioactive waste residue of about 0.04 of the original level. Apprehensive that somehow the radioactivity might have been dispersed into the ambient environment, the official requested the **California Department of Health Services** to inspect the premises. The health services crew found no radioactivity in the air resulting neither from this demonstration nor from another repeat demonstration held for their benefit. [9] This sequence of experiments was monitored by the Hon. **Daniel Haley**, the legislator who established the forerunner **New York State Energy Research and Development Agency**.

Other demonstrations, measured with under more sophisticated protocol and instrumentation have been conducted before Japanese nuclear experts, including four scientists from **Toshiba** and **Mitsui**: Cobalt 60 of 24,000 mR/hr reduced with one treatment to 12,000 mR/hr. The Japanese scientists were so excited by what they saw that they immediately purchased a generator and air shipped it to Japan. They sent Prof. Brown a confidential report of some of their results. Subsequently, they tried to obtain additional Brown's Gas generators directly from the People's Republic of China.

In 1999, one of the authors, **Mark Porringa** (responsible for one of the world's largest research reactors) used Brown's Gas to process a 1.0 uCi sample of Am^{241}, a weak alpha emitter with a half-life of 461 years. The radiation levels were reduced from over 70,000 cpm down to less than 6,000 cpm in less than 1 minute without any attempt at optimization. This would normally require thousands of years by natural decay processes. Yull Brown originally developed the proprietary protocol used. The author suspects from his tests and theory that a wide variety of radioactive wastes or undesirable materials such as plutonium would respond in like manner.

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