SCIENTIFIC ANALYSIS OF AN ARTIFACT FROM A PRESUMED EPISODE OF SPONTANEOUS HUMAN COMBUSTION:

A Possible Case for Biological Nuclear Reactions

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ABSTRACT

Spontaneous Human Combustion (SHC) is defined as a phenomenon that causes a human body to burn without a known, identifiable ignition source external to the body. While science recognizes scores of materials that can spontaneously combust, the human body is not among them. Although numerous theories have been posited to explain SHC, very little, if any, detailed scientific analysis of an actual SHC artifact has occurred. This study was designed to scientifically evaluate a known SHC artifact (Mott book jacket) and compare the findings to those of an identical book jacket (control sample). The results indicated significant visual, microscopic, atomic and molecular differences between the blackened front cover of the Mott book jacket and the unaffected back cover. The authors posit a theory for the idiopathic thermogenic event involving a biologically-induced nuclear explosion. This theory is capable of explaining most, if not all, of the scientific findings.

KEYWORDS: Spontaneous combustion, biological, nuclear, reaction

BACKGROUND

Spontaneous Human Combustion (SHC) is defined as a phenomenon that causes a human body to blister, smoke, or burn without a known, identifiable ignition source external to that body. While science recognizes scores of materials that can spontaneously combust under certain conditions, such as damp hay, linseed oil-soaked fabric, and the water-reactive metal magnesium, the human body is not among them. Nonetheless, episodes said by physicians to be SHC have been discussed in mainstream medical literature for centuries.[1-4]

The earliest textbook example dates to the 1470s of a knight named Polonus who, according to the medical historian Bartholini, "vomited a flame and was thereupon totally consumed."[5] Since then, some 400 cases have been documented which suggest this phenomenon does occur.[6]

SHC-type incidents are undoubtedly more frequent than the statistics would indicate. Under-reporting of the phenomenon may be due to:

1. Ill-defined parameters identifying such occurrences;
2. Failure of local investigators to thoroughly and correctly evaluate anomalous fire deaths when confronted by them;
3. Refusal by authorities to acknowledge overwhelming evidence of no external ignition source in the vicinity of the victim.

Since the body consists of over 70% water by weight, getting a body to burn independently is a very difficult thing to do. Human bodies can be made to burn completely under certain circumstances. Arson-murders and retorts are the two known means by which a body can be cremated. However, even in the optimized conditions inside a crematory's retort, temperatures approaching 2200-2400 degrees Fahrenheit are insufficient to ashen all bones to dust. These temperatures far exceed those produced by everyday house structure fires in which more than 4000 Americans die annually but are not found consumed to powdery ashes.

Crematoria also utilize filters to capture the noxious odors of burned flesh and cremulators to grind bone fragments raked from the retort into fine ash. However, episodes that apparently meet the definition of SHC, which one of the authors (Arnold) has termed SuperHyperthermic Carbonization, have important characteristic features which distinguish these rare events from routine fires:

1. Unlike in routine fire fatalities, SHC events are void of any readily identifiable ignition source and/or accelerant(s);

2. In SHC cases, the body usually is found far more severely burned than is a person who has been trapped in a normal house structure fire. Both photographs and discussions with crematory operators confirm that reduction of the victim's body during SHC is more thorough than is achieved within the normal parameters of modern scientific cremation. Further, some episodes suggestive of SHC demonstrate that, not only is reduction more complete, but the rate of total body burning can be much faster than happens in the hot crematorium retort.

3. SHC burns are not distributed evenly over the body. More often, the extremities are unscathed whereas the torso undergoes incineration. In classic cases, the torso is completely destroyed and its bones reduced to powdery ash.

4. In SHC, combustion is localized to the body. Damage to other readily combustible objects in the vicinity of the body is negligible, excepting thermal effects to hydrogen-rich elements such as water (dehydration); plastics (charring, dehydration); and waxes (melting). Occasionally, even the victim's clothing is unaffected by the SHC energy source.

5. Contrary to the typical noxious odors associated with normal fire fatalities, SHC scenes lack these same pungent smells. Upon encountering an SHC event, first-responders often describe a sweet aroma.

A "fire" fatality in 1986 in New York exhibited most of these traits, and consequently mystified the first-responders at the scene. The victim was George Mott, a 58-year-old retired fire-fighter who lived in Crown Point, a few miles north of Ticonderoga, New York. On the evening of March 26, the ashed remains of his body were discovered in the bedroom at the rear of his

800-square-foot home. The lower half of his right leg lay atop his bed's heat-cooked mattress springs, along with his shrunken skull at the head of the bed; the rest of his body had burned through the mattress, through the floorboards below, ending up as calcified powder on the earthen foundation below.

There was neither flame nor heat damage to the ceiling a mere four feet above the bed. Evidence suggests the energy source had no more than 15 hours to cremate Mr. Mott, yet it left the tinderbox house intact.

Throughout the house, however, caramel-hued carbonization was baked onto objects' surfaces. Many hydrocarbon plastics were found either heat-distorted (e.g., plastic wrap on a roll of paper towels and acrylic lamp shades) or completely melted (a television chassis three feet from the bed, an adding machine in an adjoining room, a fly swatter paddle, a hard plastic bread board and wall ornaments throughout the house).

In the kitchen, Mott's refrigerator, running with its door closed when investigators arrived, presented a puzzle of its own. Inside was found a melted butter dish and an unopened packet of hot dogs which, the medical examiner remarked, appeared to have been microwaved or parboiled, presumably by the same energy which cremated Mr. Mott.

County emergency personnel invested considerable effort to identify the event's origin. No mechanical failures, gas leaks, or electrical malfunctions were found; nor was any accelerant. Suicide and foul play were ruled out for lack of evidence. Mr. Mott was an avowed non-smoker who had a respect for fire and its potential hazards. Even if a fire had begun by careless accident, officials could not explain the intense, yet localized, thermic effect which consumed its victim yet produced no noxious odor.[6(p.393-411),7]

Although numerous theories have been posited to explain SHC, very little, if any, detailed scientific analysis of an actual SHC artifact has occurred. Retrieved from the Mott scene by one of the authors (Arnold) was a book's dust jacket from one of Mr. Mott's books, which was uniquely affected by the energy source. The resultant scientific findings, and interpretations, of this book jacket are reported in this study.

OBJECTIVE

This study was designed to scientifically evaluate a known SHC artifact (Mott book jacket) and compare the findings to those of an identical book jacket (control sample).

METHODS

1. Microscopic analysis was performed using a standard light microscope with both 250x and 500x magnification. This evaluation was completed at the The Ohio State University (OSU) Geology Department, SEM Facility, and included a thorough visual inspection of the Mott book jacket and control sample.

2. Infrared (IR) absorbency analysis was used to assess the surface molecular structure of samples from the Mott book jacket, including both the plastic-coated side and the paper (reverse) side. These tests were performed at the OSU Chemistry Department, Keck Laboratory.

3. X-ray Photoelectron Spectroscopy (XPS) was employed for the chemical analysis of both sides of the Mott book jacket (both plastic-coated and paper sides of the charred front cover and unaffected back cover). Also analyzed was a portion of the control sample after it had been exposed to an open flame from a Bunsen burner (fire-burned control).

   XPS can yield accurate quantitative information on most absorbed species, surface phases, and functional groups, either on or within the outermost few surface layers. Any change in the chemical state of the source atom will influence the energy of the emitted characteristic electron. These tests were performed at the Surface Analysis Laboratory in the OSU Chemistry Department.

4. Carbon-14 (C14) analyses were performed on two samples cut from the Mott book jacket and on one sample obtained from the control book jacket that was not known to have been exposed to any fire or thermal source. These tests were performed at Beta Analytic Laboratories in Florida.

RESULTS

VISUAL INSPECTION/LIGHT MICROSCOPY

The book from which this artifact was taken was, at the time of the Mott SHC event, laying on a bookshelf in Mr. Mott's home. The front cover was exposed to the air while the back cover was not. Most likely, the book was lying face up on the shelf. The actual book itself was not recovered for this study.

The book's jacket is of a durable paper stock coated on the outside with a thin plastic coating. The thin polymer coating only exists on the outside of the book jacket. The front cover has an uniform black charred appearance with consistent variation from the top of the book jacket to the bottom (see photos in Figures 1 and 2).

The discoloration reflects an impact with an energy source coming directly at the book as is noted in the gradual lessening of the blackening effects down

Figure 1. *Outside of the Mott book jacket cover illustrating blackened front cover gradually dissapating down spine of book jacket. Note at the top (left of center) of the blackened portion a slight notch revealing unaffected cellulous.*

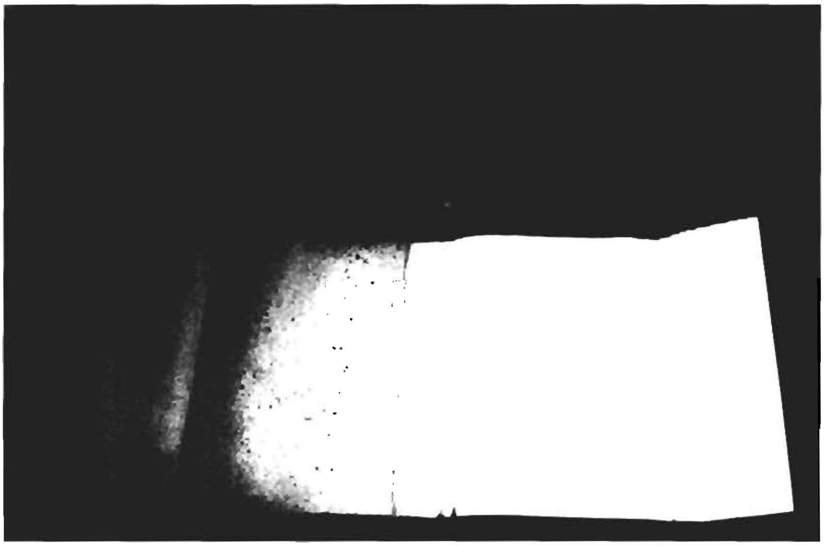


Figure 2. Inside of the Mott book jacket revealing only a slight discoloration to the cellulous directly beneath the blackened front cover.

the spine for about one inch until the effect completely dissipates. Interestingly, the plastic coating seems to be the only thing transmuted into a dull, blackened carbonized material. The texture also demonstrates a dullness when compared to the back cover, which visually appears unscathed.

When an identical book is placed inside the Mott book jacket, the discoloration on the inside back cover lines up exactly with the pages of the book. This observation supports the theory that the energy source uniformly impacted the book at a direct angle. These markings eliminate random heat as the cause of the blackening effect on the Mott book jacket.

In contrast, the fire-burned control sample, exposed to the open flame of a Bunsen burner, appeared disproportionately charred predominantly at the edges that received the most exposure to the open flame. We were unable to create the same blackened effect as found on the Mott front cover using an open flame. A second small sample taken from the identical control, was exposed to

700-degree Fahrenheit temperatures in the OSU Geology Department's furnace. This sample was completely turned to a gray ashen powder. Clearly, high thermal temperatures were not sufficient to replicate the blackening effect noted on the front cover of the Mott book jacket.

Light microscopy analysis of the blackened front cover of the Mott book jacket, revealed that its plastic coating might be totally gone (or transformed), e.g., not covered by an additional layer of soot. This assessment is based on the fact that the Mott back cover reveals a polka dot look under magnification, which is the pigment in the plastic coating; whereas, none of this can be seen, even when scrapping the surface off, on the Mott blackened front cover. Examination of the spine of the book jacket, where the effect appears to diminish proportionally, demonstrates a consistent pattern in which the polka dot effect gradually returns to normal.

INFRARED (IR) ABSORBENCY ANALYSIS

The most important bands observed on the Mott back cover (as described in Figure 3) are:

1. O-H vibrations around 1645 and 3454 cm^{-1} [8]

2. C-H vibrations around 2904 cm^{-1} [8(p.418-425)]

3. C-O vibrations from around 1089 to around 1200 cm^{-1} [8(p.(418-425))]

After the energy-source exposure, the following changes are noted on the blackened Mott front cover:

1. O-H and C-O vibrations have been drastically reduced making it difficult to discriminate them from the background

2. C-H vibration band has split and is of lower intensity

3. A new band at 1754 cm^{-1} has been formed, most likely due to a cyclic C = O vibration mode.[8(p.918)]

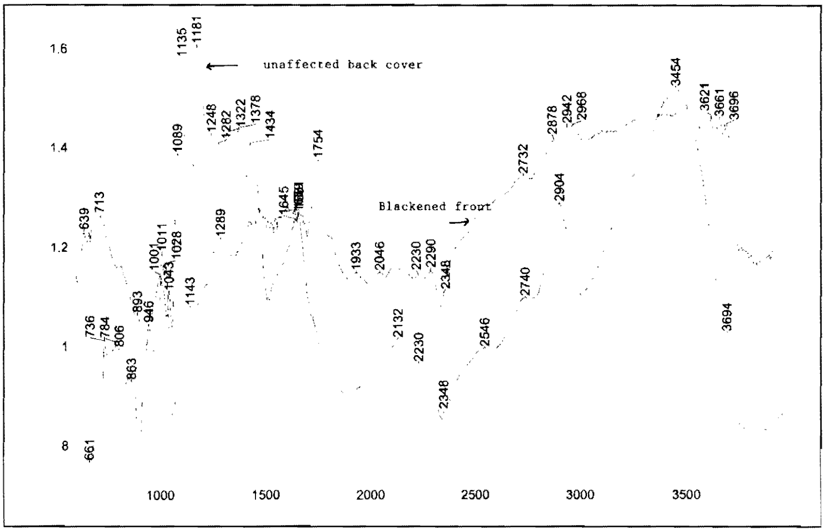


Figure 3. Absorbance/Wavenumber (cm^{-1}) *Plastic book cover spot II.*

IR analysis comparing the cellulose sides of the blackened Mott front cover and unaffected Mott back cover revealed little to no differences (see Figure 4).

XPS ANALYSIS

XPS analysis of the atomic surface content of the blackened Mott front cover, unaffected Mott back cover, and fire-burned control sample. The Full Width Half Mass (FWHM) illustrates the amount of each element found in the sample. The assumption that can be made is that the smaller the number, the less element content observed (See Table I).

CARBON-14 ANALYSIS

The control sample was from an identical book jacket printed in 1976. This book was not known to be exposed to any unusual thermic or radiation sources (See Table II).

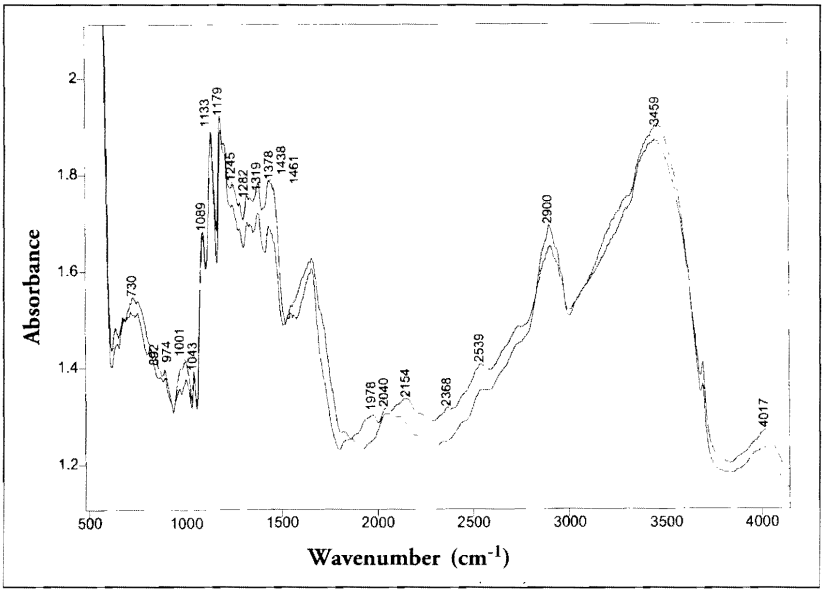


Figure 4. *Blackened "white" back sample and white control, 15x objective, Bruker IR microscope.*

1. Results indicate an age of post-0 Before Present (BP) (BP = 1950 CE) and have been reported as a % (percent) of the modern reference standard.

2. These figures represent an estimated linear extrapolation using the standard reference half-life of Carbon-14 of 5,730 years. Calculations prepared by the "Carbon-14 Dating Calculator" provided by the Radiocarbon Dating Laboratory, University of Waikato, Hamilton, New Zealand, and the Oxford Radiocarbon Accelerator Unit, Research Laboratory for Archaeology and the History of Art, Oxford, United Kingdom Internet website.

DISCUSSION

On the cellulose (paper) side of both the blackened Mott front cover and back of the Mott book jacket, little to no change is observed between the blackened

TABLE I
Full Width Half Mass (FWHM)
Results from XPS Atomic Surface Content Analysis

FWHM	Back of Mott Book Jacket	Front Mott Book Jacket (Blackened)	Fire Burned Control Sample
Carbon	2.00	1.90	2.00
Oxygen	3.70	2.00	3.50
Nitrogen	3.20	3.10	3.20

sample and the back cover in the IR analysis. The discoloration inside the book ranged from extremely light and very superficial to non-existent. This observation, along with the C14 findings, supports the hypothesis that the cellulose was not indiscriminately affected, front versus back cover, by the energy source. Thus, both internal surfaces demonstrated similar IR features.

On the front blackened side of the Mott book jacket, the layer of carbon produced may have been thick enough to block the paper from being observed by the IR detector beam. This can explain why most of the paper peaks are either lower in intensity or not present. Predominately observed in that spectrum is the carbon film and, apparently, some incompletely-combusted paper that is near the surface.

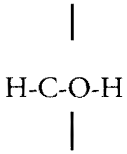
TABLE II
Carbon-14 Percentages of Book Dust Jackets from 1976
(Prepared by Beta Analytic Laboratories, USA)

Sample Tested	Percent Modern (1)	Est. Calendar Age (2)
Front of Mott Cover (Blackened Sample)	106.8 +/-0.6%	-540 yrs. (2490 CE +/- 5%)
Back of Mott Cover	105.8 +/-0.6%	-470 yrs. (2420 CE +/- 5%)
Control Sample	119.7 +/-0.5%	-1490 yrs. (3440 CE +/- 5%)

The significant molecular differences noted in the IR results, and the atomic composition changes measured in the XPS tests, can be explained as follows:

> **Observation:** Disappearance of O-H and C-O vibrations in the blackened sample
>
> **Explanation:** Carbon is blocking the IR beams, hence, not permitting a signal to be obtained from the deeper unburned layers of paper. For example, assume the IR beam can detect about 100 layers of paper. A reasonable assumption, consistent with the statistically identical Mott front and back cover findings of the C14 data, is that only a top few outer layers of the Mott book jacket's front cover were transformed into carbon by the energy source. This carbon layer subsequently blocked the other unaffected layers from being observed by the IR beam. An intense background signal in the areas where the bands disappear demonstrates that the carbon is absorbing IR frequency in that region and, therefore, blocking the light.
>
> **Observation:** The C-O-H groups of the first layers have reacted
>
> **Explanation:** Paper, primarily consisting of cellulose, is a polymer of carbohydrate rings. Each ring contains 6 carbons, five of them attached to OH groups (making C-O-H) and 2 of them to O-C which forms C-O-C. The C-H splitting is due to the alteration of the C-O-H groups.

This assumption is reflected by the fact that the C-H bonds in cellulose are found in the carbons containing OH. The structure of most of the carbons in these molecules is:



$$\begin{array}{c} | \\ \text{H-C-O-H} \\ | \end{array}$$

If the C-0 or 0-H bonds are altered, the C-H bond will find itself in a different carbon and, therefore, its vibration energy will change. If the different carbons change the C-O-H structure, in different ways, then more than one new frequency of C-H will appear. The spectrum shows at least two distinctive regions in the C-H mode, resulting from at least two types of C-H.

The diminished intensity noted in the blackened Mott front cover can be explained by this "splitting of signal" which leads to splitting the intensity. The complete combustion of the polymer plastic coating and superficial cellulose layers into carbon breaks the C-H bonds and blocks additional signals from reaching the IR beam.

The appearance of the new band in the C = O region is due to a diol dehydration mechanism.[8(p.848-849)] Alcohols have an OH group attached to a carbon. When the next carbon also has an OH, the molecule is called "diol" (di [2] ol [Alcohol]). Cellulose contains many diol sections, that is, two OHs in neighboring carbons. Under certain conditions, these two adjacent OHs can react with each other. This is represented as one OH taking one H from the other OH forming an H_2O molecule with an O bonded to the two carbons. The H_2O molecule separates as gas from the carbon because it is more stable by itself. This reflects the dehydration aspect observed. It may also account for the significant reduction in oxygen, observed by XPS testing, in the blackened sample.

The remaining O forms a second bond to the carbon to account for the loss of the OH bond. This carbon then passes one of its CH hydrogens to the C that lost the water molecule. The result is a >C = O and a $>CH_2$ instead of two >COH (whereby ">" represents two bonds to the two neighbor carbons). The actual mechanism may be different and the first H migration may come from a different source; however, this simplistic view is useful for understanding the general process.

Since cellulose is made out of glucose rings, the C = O will be part of the ring after the diol dehydration. Some strain due to the geometry of the bonds involved is created and the signal may shift to higher frequencies from the standard 1715 cm^{-1} for normal >C = O to about 1754 cm^{-1}. This shift was observed in the blackened Mott front cover sample.[8(p.418-425,918)]

The diol dehydration may occur as a result of a thermal radiation exposure or by an acid catalysis.[8(p.848-849)] This diol dehydration can clearly account for each variation observed in the IR spectrum: the OH and C-O disappearance, the modified CH signal and the C = O signal appearance. At the same time, the spectrums show the carbon background, which could be formed if a thermal energy source, was applied beyond the dehydration. A thermal, or heat effect, can account for the carbonized organic material more easily than an acid. However, the two effects, thermal radiation and acid, may not be mutually exclusive in explaining the scientific test results.

INTERPRETATION OF C14 RESULTS

According to Beta Analytic, the expected C14 percentage for a cellulose-based product from 1976, the year the Mott and control book jackets were printed, would range from 116% to 120% of modern.[9] This elevated C14 level, significantly greater than modern, is due to the "atom bomb effect" in the environment at the time of the book jacket's creation.

As Table II indicates, the identical control sample falls within the predicted and expected range (119.7%). Curiously, the book jacket from the Mott SHC scene falls significantly short of the expected range (105.8 to 106.8) This 13 to 14 percent difference represents an aging factor of approximately 744 to 802 years for the Mott samples as compared to the control sample.

According to Beta Analytic, one possible explanation for this discrepancy is that the inner portion of the tree pulp was used to create the Mott book jacket. Thus, the older tree portions would reflect a more aged C14 result.

Another possible explanation can be found when evaluating one of the remnants from the Nagasaki bombing of 1945. In the early 1990s, a cotton sample from a tunic worn by a bomb victim some 1.5 km from the epicenter of the Nagasaki explosion was evaluated for C14 content at the University of Arizona. The AMS test demonstrated that the material had been aged by the explosion by about 300 years.[10] According to Russian scientist, Dr. Dmitri Kouznetsov, aging through nuclear radiation, or by decrease of the C14 content via radiation, is due to the powerful energy source that activates numerous changeable chemical processes including "out-gassing" and "pyrolysis."[10] For this artifact, clearly, older interior tree pulp cannot explain the aging found in the tunic's cotton fabric.

One theory, that may account for all the empirical data found in the Mott case is a biologically-induced nuclear explosion. In such an intracellular nuclear reaction scenario occurring within the body of the victim, both neutron and proton radiation would be released, leaving remnant effects on the artifacts found at the post-SHC scene. This theory is capable of explaining most, if not all, of the scientific findings.

CHARACTERISTICS OF NEUTRON RADIATION

Neutrons are neutral particles with approximately the same mass as a proton. Inasmuch as they are neutral, they react only weakly with material substances and, thus, would be capable of penetrating metal or steel objects like a refrigerator.

Neutrons differ from another high-energy ionizing radiation, gamma radiation, in that they are not attenuated according to the density of the shield. Energy from fast neutrons, 1 MeV to 20 MeV, is normally absorbed by elastic scattering. This is accomplished best by molecules of the same size as a neutron. Hydrogen best meets this criteria; therefore, water, wax, plastic, and concrete are the most effective moderators because of their high content of hydrogen atoms. Once fast neutrons have been slowed to thermal neutron energies, of about 0.039 MeV, they can be captured. Once slowed or captured, thermal effects, such as produced in a flash of heat, will occur in the capturing material.[11]

Neutrons stopped by the hydrogen within the body may be responsible for the "sweet odor" characteristic of many SHC events including the Mott case. Carbon is found in molecules of carbohydrates which is, literally, hydrated carbon, e.g., carbon and water. All have the formula $(CH_2O)n$, where n can be small or quite large. The basic unit of carbohydrates are the sugar molecules.

Neutrons, attracted by the similar hydrogen atoms in the sugars, especially the abundant monosaccharides, disrupt the CH_2O bonds dehydrating the molecule as noted in the Mott book jacket. This, in effect, "caramelizes" the sugar into a carbon residue producing a distinctive sweet or sugary odor.

Other observed effects noted at the Mott post-SHC scene include the predisposition of the plastic items in the house to melt while leaving flammable, yet less hydrogenated items, seemingly unaffected. This would also be characteristic of fast neutrons.

CONCLUSION

The observed effects of an acid reaction on the blackened cover of the book jacket might reflect contact with a proton radiation. Research has demonstrated that cellulose exposed to 1.4 MeV of proton radiation results in surface acid oxidations.[12] This may account for the acid effect noted in the IR analysis and would meet the specified requirement of being both an acid and thermal radiation.

Any successful theory attempting to explain the Mott SHC case, and similar presumed SHC events, must provide for a sufficiently high-energy source capable of producing the reactions documented in the light microscopy, IR, XPS and C14 tests noted for the Mott book jacket. Simultaneously, the theory must account for the other observations noted at the Mott post-SHC scene including:

1) The differential thermal effects to heavily hydrogenated items, e.g., plastics, water, etc.;

2) The sweet odor noted at the scene by fire fighters versus a typical burnt flesh odor;

3) The cremation-level bodily remains without burning of nearby flammable objects;

4) The "cooking" of plastic-wrap covered hot dogs inside of an operational refrigerator; and,

5) The absence of any identifiable conventional ignition source.

Given the scientific evidence from the Mott case study, the authors posit that the energy which interacted with the Mott artifact may have included high-energy neutron and proton radiation originating from the body itself. If this is the case, there are significant public health ramifications including radiation safety issues at SHC scenes and identification of factors that may predispose a person to an SHC event.

Future research is needed to isolate the causative mechanism(s) that might induce a biological nuclear reaction within living organisms. Additionally, further studies should be performed on artifacts from other SHC-presumed events as well as on survivors of these atypical combustions. These efforts should seek to corroborate the above findings and/or to identify other signature characteristics of a phenomenon that has been virtually overlooked by the medical and scientific communities.

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